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All correspondence should be addressed to The South East European Journal of Economics and Business. School of Economics and Business, Trg Oslobodjenja-Alija Izetbegovic 1, 71 000 Sarajevo, Bosnia and Herzegovina, telephone: 00-387-33-275-965, e-mail: seejournal@efsa.unsa.ba .

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Editorial

The current issue of the South East European Journal of Economics and Business publishes thirteen contributions from diverse economic and business empirical studies focusing primarily on South East European region. A short overview of each contribution follows.

Kurecic et al. (2023) research focuses on the causes of migration from Croatia (its one county) by using primary survey data and quantitative regression analysis. The main finding is that monetary causes and believes that individuals could earn more abroad are the primary motivator of migration, but not corruption, which is frequently reported as the driving force of migration. Delalić et al. (2023) in their paper classify local communities in the Federation of Bosnia and Herzegovina, one of the Bosnia and Herzegovina' entity, according to socio-economic characteristics by applying quantitative methodologies. The paper identifies factors that are significant predictors of local communities' development and concludes that these clusters correspond to the NUTS principles. Alfirevic et al. (2023) analyse the scientific productivity and impact of selected public business schools in South East Europe over the 2017-2021 period. The authors find in the observed sample a mixed record regarding research productivity and impact. In the next article, Lee (2023) examines the determinants of firm-level growth in three eastern European countries – the Czech Republic, Hungary, and Poland. The paper reports that these factors play a different role in the firm-level growth of these countries, which are elaborated for each of them. Čučković and Vučković (2023) report recent research on the effects of the COVID-19 pandemic on global trends and the global value chain including their own quantitative analysis of the characteristics of Croatian firms that recorded a decrease in their exports in the pandemic period. Veselinović et al. (2023) analyse the extent to which individuals are willing to undertake energy efficiency measures in Bosnia and Herzegovina. The authors find no statistically significant predictor across measures used in the study, while some individual characteristics of respondents are found to be relatively common across the observed energy-saving behaviors.

Next contribution is by Turulja et al. (2023), who explore the mediating effect of innovation in the relationship between human resource management practices and organizational performance in an emerging economy. The authors find that innovation influences the relationship between selective hiring, training, and participative decision-making and organizational performance, while no mediating effect of innovation was found in a relationship between rewarding and organizational business performances. Kovač and Verbič (2023) report the empirical relationship between financial and non-financial institutions and wealth inequality using a global panel data for the period 2010–2016. The obtained results report a significant effect of financial institutions on global inequality while the effect of non-financial institutions observed in the data is not precisely estimated, which applies to the both, shorth and long-run estimates. Next, Sovilj et al. (2023) evaluate a national economic model using a system dynamics approach with a set of macroeconomic data coming from a transition economy. This quantitative paper provides additional

insights on the macroeconomic effects of the economic policy, making it a valuable tool for economic policy analysis. Aktaş (2023) quantifies the effects of total factor productivity growth on economic prosperity for the 2007-2020 period and 18 Central Eastern Europe countries. The main outputs of several econometric models confirm conventional expectation that total factor productivity growth positively affects economic prosperity.

Pezer et al. (2023) explores the impacts of social spending on households with children in Croatia and its capital city by using a microsimulation model. The obtained results demonstrate the progressive effect of in-kind transfers on income distribution; this reduces income inequality and poverty in this society. Miteski et al. (2023) in their paper calculate the natural interest rate for the Macedonian economy using quarterly data 2001- 2019 and different types of quantitative models. It comes that natural rate in the Macedonian economy has declined over time, and the main driver of this decline was the slowdown of the Macedonian potential GDP growth. The last paper by Havolli (2023) investigates the economic consequences of the government cost of borrowing for European transition economies during the period 2003-2016. The results indicate that consequent upon a positive shock to the cost of sovereign borrowing, the cost of borrowing for loans to both non-financial corporations and households increases, while the price transmission from government borrowing costs to the private sector is at play.

On behalf of Editorial Board

Adnan Efendic, Editor-in-chief
University of Sarajevo
School of Economics and Business

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IS CORRUPTION THE DRIVING FORCE OF MIGRATION FROM CROATIA: EVIDENCE FROM A SURVEY

Petar Kurecic, Filip Kokotovic, Vesna Haluga

Abstract

Migration of higher-educated individuals from Croatia is damaging the long-term perspective of the Croatian economy as lower levels of the participation rate in the Croatian economy may endanger the feasibility of the social, healthcare and pension systems. With Croatia's accession to the EU, a wave of migration was facilitated as a result of easier access to foreign labour markets. The paper focuses on the causes of migration from Croatia given the relatively limited research devoted to this topic. While there is robust evidence of corruption being one of the main causes of migration globally, this paper questions this assertion specifically in the case of Croatia. The paper analyses information from a survey with a random sampling approach of 223 respondents from the Varaždin County. The data is analysed by implementing different logit regression models. The paper conceptualizes economic and political factors that may cause migration as different variables in order to conduct a robustness check. The main finding of the paper is that monetary causes and a belief that individuals could earn more income abroad are the primary motivator of migration from Croatia. This is contrary to much of the existing literature that identifies corruption as the driving force of migration. Knowing individuals who have migrated abroad also makes it more likely for an individual to migrate from Croatia. While the paper found a significant degree of lacking faith in public institutions, this was common to participants regardless of whether or not they considered migrating from Croatia. As such, the paper considers monetary conditions rather than corruption to be the key driving force behind migration from Croatia.

Key words: *migration, Croatia, political factors, corruption, logit regression.*

JEL classification: *E24, F22.*

Petar Kurecic, PhD (corresponding author)
Associate Professor
University North, Trg dr. Zarka Dolinara 1
48000 Koprivnica, Croatia
E-mail: petar.kurecic@unin.hr
ORCID: 0000-0002-7763-6651

Filip Kokotovic, PhD
L & D Specialist
TaskUS Croatia, Croatia
E-mail: filip.kokotovic@hotmail.com

Vesna Haluga, PhD
Senior Expert Advisor
City of Varazdin, Croatia
E-mail: vesna.haluga@gmail.com

1. Introduction

Croatia is one of the countries within the European Union (hereafter: the EU) that is experiencing a significant demographic decline (Botrić 2016). It is for this reason why it is necessary to analyse the reasons why

so many competent individuals, particularly those with higher education degrees in the STEM field, are migrating from Croatia. The current demographic trends in Croatia are not sustainable as the increasingly aging structure of the Croatian population will question the sustainability of the healthcare, pension and social system (Pokos 2017). Keeping the labour participation rate stable and ensuring that there is no exodus of highly-skilled individuals from Croatia is essential to its long-term development.

There have been few studies focused on the general sociodemographic traits of individuals considering migrating from Croatia. Similarly, there are few studies analysing their motivation for doing so compared to the numerous global studies about corruption specifically being a key cause of migration including Dimant et al. (2013), Poprawe (2015), Cooray and Schneider (2015), Auer et al. (2020) and Arif (2022). There is a consensus in several papers that most people migrating from Croatia in the migration wave post entry to the EU are not doing so for economic reasons (Hornstein Tomić and Taylor 2018). The main reason why many decide to migrate from Croatia, based on these papers, is a frustration with the social climate based on nepotism, a climate of corruption and an unwillingness to implement structural reforms that would deal with any of the aforementioned issues (Jurić 2017; Troskot et al. 2019). This paper questions this hypothesis as most of the papers that have developed this hypothesis developed this conclusion either based on the anecdotal evidence and interviews or by applying an inconsistent methodological approach between the development of the hypotheses to the interpretation of the final research results. Demographic decline is an existential issue for Croatia and several authors including Živić (2017) have pointed out the devastating impact the continuation of this trend could have. For this reason, finding policy recommendations based on the underlying evidence is of the utmost importance.

This paper examines the motivation for individuals considering migration from Croatia in the case of the Varaždin county. As emphasized by Horvat et al. (2022), the Varaždin County is among the better developed in Croatia with higher levels of GDP per capita and lower unemployment rates compared to the average development of Croatian counties. Perhaps even more importantly, there is a significant influx of foreign labour in the Varaždin County given that there seems to be a labour shortage (Horvat et al. 2022). Compared to other regions in Croatia, the Varaždin county has less concerns regarding migration according to data from the Croatian Bureau of Statistics (2021). According to this data, around 1 500 people migrated from Varaždin, but 1 350 people migrated to the area. As a result, it did not have as profound of an impact on the adverse economic trends taking place within the country (Croatian Bureau of Statistics 2021). This paper has specifically decided to focus on this county for its booming economic conditions and generally positive outlook. The paper does not question that the adverse impacts of corruption may be hampering the long-term economic growth of Croatia as described in Campos et al. (2010). It should be noted that Croatia is a country marked by high levels of political polarization and increasing dissatisfaction with institutions (Henjak 2017). This paper argues that economic motivators and professional dissatisfaction are the key motivator for many individuals migrating from Croatia. Given the widespread dissatisfaction with political institutions within Croatia that is common to people migrating from Croatia but also to those who have never considered migrating from Croatia, this paper will try to distinguish that while corruption and lacking faith in institutions may be a lingering problem for Croatian society, it is not the key factor driving migration.

2. Literature review

The idea that corruption fuels migration is not endemic to Croatia and has been introduced as a "gravity model of migration" (Poprawe 2015, p. 357-358). The general theory indicates that migration is more likely from countries that have a higher degree of corruption given that corruption is "associated with a lower standard and wasteful spending of government funds that does not prioritize focusing on equity or public welfare" (Poprawe 2015, p. 358). The author examined evidence from 230 countries and determined that corruption is associated with an increase in net migration. There are many reasons for corruption contributing to adverse living conditions that then decrease the overall quality of life for individuals as described in Dimant et al. (2013). The authors have implemented an approach based on regression analysis and have found that corruption drives both net migration as well as the migration of skilled workers (Dimant et al. 2013). Dimant et al. (2013) examined a panel of 165 countries and found that corruption had a much more pronounced impact on the migration of skilled workers, while they noted that their results concerning the possible relationship between corruption and net migration were less statistically robust.

Cooray and Schneider (2015) examined the impact of corruption on a panel of data of 20 OECD economies. The authors utilized different methods

including a general method of movement (GMM) approach as well as instrumental variable estimations and found that there is a link between corruption and the migration of highly-skilled individuals (Cooray and Schneider 2015). The authors point out that one possible explanation is the way many modern migration systems are set up and the ease of migration for highly-qualified individuals compared to those who have less skills or education (Cooray and Schneider 2015).

It should be noted that the impact of corruption on society in general is still an area that is being studied. This is discussed in-depth in Campos et al. (2010) as the authors explain that there is a possibility that corruption could help private sector actors circumvent redundant regulation and could actually help encourage economic activity. While the authors conducted their own research showing that there is a link between corruption and a decrease in economic growth, the authors indicate the bias in the existing academic literature that "fails to critically approach the issue and is biased towards reporting negative findings even when they are not statistically significant" (Campos et al. 2010, p. 15). The authors also indicate that the variables commonly used to measure corruption are not fully adequate and for many countries there are insufficient observations to conduct a valid regression analysis (Campos et al. 2010). Another example pushing the boundaries of the field can be found in Dimant and Schulte (2016). By examining the impact of corruption from a transdisciplinary viewpoint, the authors managed to provide a more meaningful and comprehensive elaboration of how corruption has a strong impact on the fabric of society (Dimant and Schulte 2016).

Further evidence about the impact of corruption is considered in Arif (2022), who has found that highly-skilled migrants are more likely to migrate to a country that is not impacted by a high degree of corruption. The author does not find that there is any link between corruption causing migration in a panel of 122 countries (Arif 2022). Urbanski (2022) has considered the impact of push and pull factors in Romania and Poland and concluded that pull factors tended to be more important that push factors based on the results of the survey conducted. The author particularly notes that economic factors such as wages and better working conditions can be a significant pull factor that drives migration (Urbanski 2022). Auer et al. (2020) conducted regression analysis to understand how corruption impacted the desire of individuals to migrate on representative surveys of 280 000 respondents from a total of 67 countries. The authors found that corruption has an adverse impact and causes net migration (Auer et al. 2020). Auer et al. (2020) argue that corruption can be connected to an increase in net migration as it causes an increase of economic uncertainty amid lagging levels of economic growth.

Begu et al. (2019) conducted a panel regression analysis of the impact of corruption on net migration across the EU member-states. The authors found that corruption had a statistically significant impact in increasing the level of net migration in the observed time period from 2008 until 2016 (Begu et al. 2019). While the authors show that there is some correlation between migration levels and perception of corruption, causality is not clearly. The authors themselves note that "the connection between perception of corruption and migration is "weak" in the data they have examined" (Begu et al. 2019, p. 476).

There are also numerous papers that have analysed the motivation of individuals to migrate on the level of individual countries such as Lapshyna (2014), who conducted a logit regression based on a survey of Ukraine from 2011 and concluded that both economic and political factors caused net migration. The author found that individuals who believed that corruption was a significant problem in Ukraine were 1.5 times more likely to migrate from Ukraine. Lapshyna (2014) argued that implementing measures to curb corruption were policies that were essential to stemming migration flows from Ukraine. Iacob (2018) conducted a survey in Romania and analysed pull and push factors that were driving migration from the country. The author concluded that controlling the levels of corruption in society was essential to reducing the migration of highly-skilled individuals (Iacob 2018), who also found that the salaries of participants were an important factor in determining the decision to migrate, even though the author did not consider it the most impactful in their decision to migrate.

Begović et al. (2020) analysed survey responses in Bosnia and Herzegovina and argued that analysis of the causes of migration from the Western Balkans is an area of research that has not been sufficiently explored. The paper finds that those who perceived corruption to be a significant issue as well as age were the most significant contributors to migration (Begović et al. 2020). The paper itself notes that younger individuals tended to have significantly more negative views concerning corruption so the paper does not fully clarify whether corruption or age were the primary motivators of net migration as this was not its primary purpose (Begović et al. 2020). While the general theory centred around the link between migration and corruption is important, the findings of studies that have analysed migration in Croatia are particularly significant.

There are numerous studies that question the link between migration and corruption, but there are comparatively few studies that analyse the causes of migration from Croatia. Jurić (2017) conducted surveys and semi-structured interviews on 1,200 Croats migrating to Germany and concluded that moral decay in Croatia and a culture that does not understand what honest labour is drive migration. The author further concludes that there is a clear link between the political structures and weak institutions with the decision of Croats to migrate abroad (Jurić 2017, p. 362). Jurić (2017: 365) concludes the paper with a selection of statements from the interviews that highlight that many of the migrants are highly unsatisfied with the political situation in Croatia and Bosnia and Hercegovina. Troskot et al. (2019) similarly indicates that corruption is a significant problem in Croatia and that it has undermined economic growth and further development of society. The authors conducted a detailed analysis of migration trends and have concluded that the collective pessimism among the Croatian youth is contributing to their desire to leave the country (Troskot et al. 2019, p. 898). The authors believe that Croatia needs to implement drastic reforms to increase its competitiveness and to ensure that the brain drain does not persist (Troskot et al. 2019, p. 899).

Draženović et al. (2018) analysed the causes of migration from new EU member-states by implementing a macroeconomic approach based on regression analysis. The authors found that variables that accounted for the stability of the short-term macroeconomic outlook were statistically significant to increasing net migration (Draženović et al. 2018). The authors further found that corruption was not statistically significant in their model and did not have a meaningful impact in increasing corruption (Draženović et al. 2018). Šverko (2005) emphasizes that as early as 2004 that 75.3% of the students surveyed by the author considered migrating from Croatia. The author conducted a survey of 553 students and emphasized that there was a significant gap between the number of participants who considered leaving and those who were sure about this decision given that only a quarter of those surveyed were certain they would migrate from Croatia (Šverko, 2005: 1157). The author found that the reason why most students considered leaving Croatia was better material conditions that could be expected if they migrated abroad (Šverko 2005, p. 1160). The author compares the results to surveys conducted in 1995 and 1997 and emphasizes that the 40% of participants considering leaving Croatia for this reason was actually a decline compared to the 57% of participants stating this belief in 1995.

Golub (2003) conducted an analysis of why young researchers are migrating from Croatia. The author determined that most of these young researchers were considering migration from Croatia as a result of economic factors including not owning real estate, low wages and a perception that they could not achieve professional development in Croatia (Golub 2003). While this was accounted for 90% of the surveyed individuals, only roughly 50% emphasized that they were not satisfied with the general political conditions in Croatia (Golub 2003). Adamović and Mežnarić (2003) analysed a survey conducted on the University of Zagreb using a logit regression approach. The authors found that dissatisfaction with wages and not having a perspective to progress in the institution were leading causes of the brain drain in the Croatian academic scene (Adamović and Mežnarić 2003).

There are numerous papers that deal with the migration problematics of various states of Southeastern Europe, mostly trying to explain the patterns and factors of migration.

For example, Efendic (2015) analysed intentions to emigrate from Bosnia and Herzegovina, focusing not only on typical individual and household determinants, but also on post-conflict specific influences. Findings indicate that higher intentions for emigration are indeed linked to the typical individual and household conditions: the young, educated and low-family income respondents report the highest intentions to emigrate. In addition, the post-conflict environment characterised by economic and political instability, as well as by conflict and post-conflict related migration, increases these intentions further, both independently and in different combinations. Although determinants such as employment status, household income and perception of economic development are relevant, their effect is of second-order importance. This contradicts the conventional thinking that economic factors are the main driving forces of emigration intentions and conforms to the views expressed in Šverko (2005).

In Kosovo, where almost a fifth of the population is estimated to be living abroad, Kotorri (2017) hypothesizes a nonlinear relationship between the probability that migrant returns and the income they earn abroad, since the income effect might off-set the substitution effect if reverse migration is a normal good.

Loxha (2019) estimates that remittances from migrants considerably decreased the chances of poverty in Kosovar households that received them. Williams and Efendic (2019) examine the trust of institutions among internal and external migrant entrepreneurs in the post-conflict economy of Bosnia and Herzegovina. Drawing on survey data and in-depth interviews, they

find that external migrant entrepreneurs with international experience have lower trust in institutions than internal migrants. This is explained by the comparison of institutions in the country of origin with more stable institutional environments they experienced while being abroad. Consistent with this conclusion, a more complex institutional setup within the country is associated with lower trust in institutions.

Parker (2020) used a UN dataset of foreign-born residents in and from 154 different countries, available every fifth year since 1990, to estimate an augmented gravity model for Eastern Europe and the world. Migration responds to higher incomes in the host country, though the effect diminishes with income. Unlike the rest of the world, East European migration increases with the exchange rate in the host and higher incomes in the origin, but not with political autocracy or conflict in the origin country. Controlling for these differences, Eastern Europe has fewer immigrants and emigrants than the model would otherwise predict. Arandarenko (2021) studies how migration, human capital and the labour market interact in Serbia, drawing conclusions on the factors and specificities that influence migration from Serbia.

Overall, there are numerous studies that have considered the link between corruption and migration. There are several studies that have established that corruption is one of the key factors driving migration including Poprawe (2015), Cooray and Schneider (2015), Auer et al. (2020), and Begović et al. (2020). A number of papers noted that the connection between corruption and migration that was established by the paper was either weak or statistically insignificant such as Draženović et al. (2018) and Begu et al. (2019). Dimant et al. (2013) have noted that the link between corruption and net migration is not particularly statistically robust, but have found a connection between corruption and the migration of skilled migrants. Some authors including Arif (2022) believe that there is no empirical proof that corruption drives migration. Other authors such as Lapshyna (2014) have established that a combination of economic and political factors may drive migration. Most of these studies had different samples and different conceptualizations of how they measured corruption, which can partially account for the diversity of findings within the field. In the case of Croatia, Šverko (2005) has emphasized the problem of material conditions as the main cause of migration while other authors including Jurić (2017) and Troskot et al. (2019) have emphasized that corruption and lacking faith in political institutions are the main causes of migration.

3. Methodology and data

The research approach of the paper includes several steps. The first step was conducting an online survey of participants with a random sampling approach in the Varaždin county. The data was collected by the authors utilizing a random sampling approach through an online questionnaire. The second step was implementation of a logit regression model, while the final step includes a regression analysis of the questions based on the Likert scale. A more detailed breakdown of every aspect of the aforementioned approach is provided below.

3.1. Variable selection

The selection of variables is based on the existing theory as well as similarly-adapted models from the relevant literature including Poprawe (2015), as well as Cooray and Schneider (2015). The survey contains 16 initial questions that question broad sociodemographic and other traits about the participants. It also questions whether they have financial, social, or familial obligations within Croatia. Each of these questions provides a different dimension relevant to the decision to consider migration from Croatia. With the aim of doing so, respondents are expected to address whether or not they have real estate in Croatia, whether or not they have children or other dependents within Croatia. The idea of including real estate and other links in Croatia is based on the findings in Golub (2003). The aim of including these variables is to determine whether strong ties within Croatia have an impact on the decision to consider migrating abroad. A variable is also included that accounts for whether or not participants have anyone in their immediate social group who has migrated abroad. The inclusion of this variable is grounded in numerous papers focused on the transition of social and human capital across borders that illustrates that knowing individuals from your immediate social group abroad may make the difficult decision to migrate more tangible and the consequences of migrating easier to understand (Colic-Peisker 2002; Nowicka 2014 and Lulle et al. 2021).

The paper also includes variables that account for the monthly income of participants as well as their satisfaction with their working conditions. While some of the research has focused on the political drivers of migration including that of Jurić (2017), there are some indicators that migration may be caused by economic concerns. Golub (2003) and Šverko (2005) specifically

found monetary causes to be one of the key factors that fuelled the desire to migrate from Croatia. As a result, this can be considered to be one of the key push factors from Croatia based on findings from Golub (2003) and Šverko (2005). Therefore, there is no clear consensus on what push factor is driving migration from Croatia.

Aside from the 16 initial questions, the paper also includes 20 statements based on a five-point Likert scale. The goal of each question is to operationalize the dissatisfaction of participants with specific aspects within Croatia, namely: 1) the capacity of professional development within Croatia; 2) the problem of corruption, lacking faith in institutions and an ineffective use of public finances; 3) perception of how employees would be treated were they to choose to migrate abroad; and 4) satisfaction with different aspects of their current workplace.

This paper implements several logit regression models. Aside from the actual act of migrating from the country, it can be difficult to conceptualize considering migration within individuals who live in Croatia. This paper approaches this through a survey question that asks participants whether or not they are considering migrating from Croatia. The conceptualization of whether or not people are likely to migrate from a certain country is a difficult aspect to consider and these conceptualization issues have been expressed in Auer et al. (2020). From such a viewpoint, it is likely that not every individual who is considering migrating from Croatia will ultimately migrate from it. If not for any other reason, the individuals in question may fail to find suitable professional opportunities abroad or they may not be able to obtain entry permits in the countries they wish to relocate to. As a result, there are some methodological concerns about fully capturing the desire to migrate abroad and whether this actually translates into relocating.

3.2. Logit model specification

The first set of logit regression models will model the data obtained from the 16 initial questions, while the second set of logit models will aim to operationalize the results of the claims based on the Likert scale. One problem that has been mentioned in the existing literature including Arif (2022) and Campos et al. (2010) is the limited conceptualization of corruption in the available literature. Due to the fact that the paper implemented a survey, dissatisfaction with corruption and issues concerning weak institutions can be conceptualized in different ways. The same is also true for variables that account for economic factors related to migration. Such different conceptualizations allow for a robustness check as inconsistencies between different conceptualizations of similar variables would signal that the results may not be statistically consistent. While the statistical validity of the data will be ensured by calculating the Cronbach Alfa, this additional robustness check will strengthen the validity of the results. The dependent variable in both models is the same, the decision to migrate from Croatia. Therefore, the research approach will be based around the following equations:

$$(1)\ \mathrm{MC} = \alpha + \beta_1 X + \beta_2 Y + \beta_3 P + \mu$$

$$(2)\ \mathrm{MC} = \alpha + \gamma_1 D + \gamma_2 REF + \gamma_3 V + \gamma_4 W + \mu$$

where MC is the decision to migrate from Croatia and in both models is being explained through a vector of explanatory variables. In the first models, this is a set of socio-demographic traits labelled as X, societal connections labelled as Y, and dissatisfaction with political institutions labelled as P that are explained in greater depth in Table 1. For the second equation, this is a set of potential push and pull factors explained in-depth in Table 2. They include dissatisfaction with the possibility of their professional development in Croatia labelled as D, the problem of lacking faith in institutions and reforms that are not implemented labelled as REF, possible pull factors and better conditions abroad labelled as V and satisfaction with their current working conditions labelled as W. Both models include a constant *(α)* and an error term (μ*)*. The different coefficients of the logit regression *(*$\beta_{1..3}$ and $\gamma_{1...4}$*)* indicate the interrelation between the selected independent variable and the perceived choice of migrating from Croatia.

The logit regression model will test the relevance of a number of independent variables with the research goal of answering the following questions:

1) Which variables are most important in determining the choice to consider migrating from Croatia within the surveyed sample of individuals?
2) Does dissatisfaction with political conditions make individuals more likely to migrate from Croatia?

This paper conceptualizes the variables for the first set of logit regression models in accordance with the information provided in Table 1.

The questions based on the five-point Likert questionnaire were devised in a manner so as to consider specific components that may lead individuals to consider migrating from Croatia. The conceptualization and relevance of all of the questions is elaborated on in Table 2. All of the variables in the table below are measured on a five-point Likert scale.

Table 1. Key variables

Variable name	Variable abbreviation	Measurement	Relevance
Gender	GEN	Dummy variable	Basic socioeconomic traits
Age	AGE	Stratified groups from the age of 18 to 66	
Monthly income	MI	Stratified 7 groups of income obtained	
Living in rural or urban area	AREA	Dummy variable	
Employment status	EMP	Dummy variable	
Children in Croatia	CHI	Dummy variable	Familial and social obligations in Croatia
Other dependents in Croatia	DPN	Dummy variable	
Belonging to STEM field	STEM	Dummy variable	Workplace traits
Workplace satisfaction	WS	Dummy variable	
Dissatisfaction with corruption	COR	Dummy variable	Satisfaction with the political climate in Croatia
Faith in institutions	INST	Dummy variable	
Owning real estate	RE	Dummy variable	Other social or financial links in Croatia
Political party affiliation	PPA	Dummy variable	
Importance of social network in Croatia	SN_CRO	Dummy variable	Importance of social networks
Association with individuals who have migrated from Croatia	SN_ABR	Dummy variable	

Source: Survey conducted by authors

Table 2. Variables deriving from the Likert scale

Variable definition	Variable abbreviation	Relevance
Competitive environment in Croatia	COM	Dissatisfaction with the general climate in Croatia
Faith in being able to achieve professional outcomes	PRO	
Importance of membership in political parties compared to work-place competences	PP	
General social climate in Croatia	SC	
Dissatisfaction with corruption	DC	
Dissatisfaction with taxes and parafiscal levies	TAX	Lacking faith in institutions and different political concerns
Misuse of government funds	GF	
Public procurement impacted by corruption	CPP	
Lacking rationalization of public administration	RPA	
Slow government intervention in key issues	GS	
Could be paid better for the same work abroad	WA	Perception of condition participants could expect abroad
Workplaces would be more professional abroad	WP	
Easier and more transparent progress abroad	PA	
Quicker and more effective learning on the job	QEL	
More professional opportunities than in Croatia	MPO	
Satisfaction with wage	PAY	Satisfaction with current working conditions
Progress in Croatia under equitable conditions	PEC	
Having all of the necessary equipment to conduct work-related tasks	EQI	
Lacking respect from superiors	LRS	
Having to conduct work outside job description	WOR	

Source: Survey conducted by authors

As can be seen from Table 2, such different conceptualizations enable the paper to broadly understand which specific factors drive migration from Croatia. In terms of workplace satisfaction, two of the variables concerning wages and promotion are based on the research by Golub (2003).

4. Result and discussion

The survey was conducted on a sample of 223 participants who were of working age within the Varaždin County. As a result, given that Varaždin County has 109 452 people of the corresponding age based on the latest census data from the Croatian Bureau for Statistics (2022), this means that the conducted survey has a margin of error of 6.6% assuming a 95% confidence interval. In terms of the characteristics of the sample, there are some problems that are consistent with a survey that was conducted through an online random sampling approach. Notably, the sample has a lower rate of unemployment compared to the Croatian average and the wages are higher compared to the average wage in Croatia that can be found on the Croatian Bureau for Statistics (2022).

The descriptive variables summarizing the results of the Likert scale variables are provided in the appendix. As can be seen from the details provided there, the standard deviation is smallest in the variables that consider satisfaction with political conditions and the impact of corruption. It is clear that almost the entire surveyed sample is highly dissatisfied with the impact of corruption on society and they have little or no faith in public institutions. These findings are mostly consistent with findings in the existing literature including Hornstein Tomić and Taylor (2018) and Jurić (2017). Aside from considering the general results, it is important to analyse how specifically these variables impact the likelihood of migrating abroad. In order to discuss the findings of the survey in greater depth, the first set of logit regression models in estimated and shown in Table 3.

The selection of the variables, as has been previously noted, is based in the underlying theory as well as the authors' own perception of what may impact the desire to consider migrating abroad. While the underlying theory suggested many of these variables may have a statistical significance, few have proven to be significant through this framework. This is likely caused by the fact that the underlying theory has been developed in many different areas around the globe and it is entirely likely that there are country-specific factors that may impact the decision to migrate from a particular country. For example, Lapshyna (2014) found that a combination of political and economic factors was essential for the decision of individuals to migrate from Ukraine and the author found that lower wages or unemployment were significant to making the decision to migrate abroad. Similar variables that account for whether or not someone is employed that were utilized in this model were not statistically significant. This illustrates the relevance of spatial constraints when studying variables that can have an impact on making the decision to migrate abroad.

This paper identifies that two variables, of those considered, have the largest statistical significance on people considering migrating abroad. The first variable is MI and it is clear that individuals who have higher monthly incomes are far less likely to consider migrating abroad. This is consistent with most of the academic literature published abroad including Urbanski (2022) and Arif (2022). It is also consistent with Draženović et al. (2018), Golub (2003) and Šverko (2005), but contradicts several studies that have specifically analysed causes of migration from Croatia including Jurić (2017) and Troskot et al. (2019).

Another variable that has proven to be significant is knowing individuals who have migrated above. Many papers that have studied the development of social capital and networks of migrants have shown that individuals from their own social circles tend to be first points of contact when migrating abroad (Colic-Peisker 2002; Snel et al. 2006; Ryan 2011). This is a particular area of network analysis that authors such as Ryan (2011) have examined. Individuals abroad can provide information about their own migration experience, thus making the entire process more tangible and easier to implement in practice even as Ryan (2011) emphasizes that every migration experience can be entirely different.

After estimating all of the models above, variables were excluded based on whether or not their exclusion helped improve the key information criterions of the model. The only variables the paper considered omitting were those that were clearly not statistically significant. Finally, after excluding a number of variables the final model is shown in Table 4.

Based on the best estimate utilizing the first set of socio-demographic variables, the paper can easily determine that earning less income on a monthly basis can contribute to the decision to migrate from Croatia. The paper has also determined that knowing individuals from your social network who have migrated from Croatia also significantly interrelated with the decision to migrate from Croatia. Among the observed sample, dissatisfaction with political institutions was actually higher among those who did not consider migrating from Croatia. These findings

Table 3. Logit regression models

Variables	(1)	(2)	(3)	(4)	(5)	(6)
const	1.16 (0.298)	0.238 (0.866)	0.252 (0.859)	0.604 (0.6734)	0.24 (0.872)	-0.073 (0.961)
GEN	-0.578* (0.087)	-0.615* (0.0735)	-0.629* (0.069)	-0.607* (0.828)	-0.75** (0.043)	-0.669* (0.074)
AGE	-0.23 (0.128)	-0.19 (0.212)	-0.199 (0.24)	-0.269 (0.136)	-0.191 (0.309)	-0.237 (0.226)
MI	-0.273** (0.0128)	-0.251** (0.029)	-0.253** (0.024)	-0.233** (0.039)	-0.223* (0.054)	-0.239* (0.0513)
AREA	0.209 (0.605)	0.205 (0.622)	0.197 (0.635)	0.188 (0.656)	0.332 (0.44)	0.478 (0.286)
EMP	-0.007 (0.995)	-0.017 (0.987)	-0.08 (0.941)	-0.102 (0.927)	-0.25 (0.836)	-0.112 (0.924)
COR		0.93 (0.275)	0.959 (0.259)	0.969 (0.249)	0.496 (0.553)	0.562 (0.508)
INST		-1.54** (0.045)	-1.53** (0.046)	-1.48* (0.056)	-1.56** (0.048)	-1.62** (0.
CHI			-0.096 (0.849)	-0.11 (0.824)	-0.29 (0.584)	-0.138 (0.800)
DPN			0.196 (0.674)	0.21 (0.658)	0.203 (0.678)	0.13 (0.792)
STEM				-0.264 (0.348)	-0.302 (0.395)	-0.303 (0.402)
WS				-0.438 (0.188)	-0.352 (0.309)	-0.356 (0.316)
SN_CRO					-0.24 (0.497)	-0.282 (0.433)
SN_ABR					1.22*** (0.0022)	1.19** (0.0031)
RE						-0.067 (0.882)
PPA						0.659 (0.103)
Number of observations	223	223	223	223	223	223
Log-likelihood	-130.17	-126.27	-126.17	-124.98	-121.17	-118.25
Pseudo-R^2	0.722	0.722	0.722	0.713	0.731	0.753

Note: *, **, and *** indicate statistical significance at the 0.1, 0.05, and 0.01 levels of statistical significance for each coefficient.

Source: Authors' calculations

concerning the importance of wages conform to the findings of Golub (2003) and Šverko (2005).

Of the remaining variables, most of them are not been statistically significant at the 5 percent significance level. The only remaining variable that was significant was INST. As a result, there is a statistically negative interrelation between the dissatisfaction with political institutions and the decision to migrate from Croatia. This should be interpreted as a primarily statistical distinction and one that may not be true for the entirety of the Croatian population, but among the sample itself 84% of individuals surveyed were not satisfied with the quality of political institutions in Croatia. While Jurić (2017) broadly indicates that an array of factors contributing to the decision to migrate from Croatia derive from political inaction, corruption,

Table 4. Logit regression model

Variables	(7)
const	0.114 (0.911)
GEN	-0.609* (0.085)
AGE	-0.239 (0.154)
MI	-0.217** (0.041)
COR	0.487 (0.555)
INST	-1.66** (0.035)
STEM	-0.306 (0.388)
WS	-0.368 (0.287)
SN_CRO	-0.201 (0.559)
SN_ABR	1.14*** (0.0037)
PPA	0.581 (0.132)
Number of observations	223
Log-likelihood	-118.98
Pseudo-R^2	0.767

Note: *, **, and *** indicate statistical significance at the 0.1, 0.05, and 0.01 levels of statistical significance for each coefficient.

Source: Authors' calculations

and lacking accountability, some of these conclusions may fail to consider other motivators to migrate from Croatia. A similar problem is present in Troskot et al. (2019) who when indicating the presence of "collective pessimism" among the Croatian youth failed to specifically identify why in the presence of collective pessimism only some individuals decide to migrate, while others do not. Indicating that there needs to be changes to the founding blocks of society is an aspirational idea indicated by Jurić (2017), but such changes take a long time to implement and there may be no political incentive to engage in such broad reforms. On the other hand, the findings here suggest that some measures that are comparatively less expensive for the government budget and less difficult to implement could at least help stem the flow of migration from Croatia.

The current policies implemented by the government are focused on ensuring that those younger than 30 have higher disposable income through tax cuts. The essential goal of this policy, which does provide more disposable income to at least this targeted group, could be a viable policy solution based on the findings of this paper. Another viewpoint should be considered here. There is no guarantee that individuals older than 30 will not migrate and, as several studies including Gadžo (2019) have already shown, the government is currently not providing sufficient incentive for these individuals to remain in Croatia. Gadžo (2019, p. 134) correctly points out that those younger than 25 are largely too young to benefit from these tax provisions and it could be argued that those in the age group of 25 to 30 face a significant change in their disposable income when they turn 31 and the policy provisions no longer apply. Given that age has not shown to be a variable in many of the studies of migration from Croatia and this is consistent with the findings of this paper, it may be better to develop policies that would encourage people with higher education to remain in Croatia. Encouraging or subsidizing bonuses for individuals who have obtained higher education, such as MA's or PhD's, could be a viable policy step. In the short-term, the ability of the government to navigate the crisis of the cost of living and inflation will have a significant impact on the immediate macroeconomic outlook.

While most of the respondents are not satisfied with the underlying political factors in Croatia, this is a trait shared between those wishing to migrate to Croatia and those not considering doing so. While combating corruption is a priority for ensuring development for Croatia in the long-run, achieving political satisfaction may be more complex and should not be linked to policies concerning migration. As indicated by Henjak (2017), the political state of Croatia is impacted by partisanship and increasing levels of dissatisfaction with the state of politics. In order to further consider findings from the survey, it is necessary both to examine the following logit regression model both as a robustness check and as a method of providing additional insight to the opinions presented by the surveyed participants.

4.1. Robustness check

The Cronbach's Alpha indicator for the results of the Likert scale is 0.913. Such a value indicates that the results are statistically valid as a value as low as 0.7 is considered to be acceptable. In addition, the general value of the Pseudo-R^2 indicates that the model itself is suitably specified. A lower value of the Pseudo-R^2

Table 5. Logit regression model

Variables	(8)
Const	-7.37*** (0.002)
COM	-0.25 (0.225)
PRO	0.892*** (0.0001)
PP	–0.121 (0.541)
SC	–0.354 (0.183)
DC	0.408 (0.381)
TAX	–0.72** (0.029)
CPP	0.512* (0.092)
GS	–0.345 (0.2203)
WP	0.849** (0.0201)
PA	–0.959** (0.0108)
QEL	0.676** (0.0361)
PAY	1.08*** (0.00001)
PEC	–0.477** (0.049)
LRS	0.411** (0.03)
WOR	–0.334* (0.097)
Number of observations	223
Log-likelihood	-93.57
Pseudo-R^2	0.82

Note: *, **, and *** indicate statistical significance at the 0.1, 0.05, and 0.01 levels of statistical significance for the coefficient.

Source: Authors' calculations

would indicate the possibility of the model having selected variables that have no relevance in determining the dependent variable. As the value of this indicator is never lower than 0.7, it is possible to determine that the models are suitably specified. Aside from calculating the value of the Cronbach's Alpha, the paper also analyses whether conceptualizing corruption and wages into different variables had an impact on their statistical relationship with the desire to migrate from Croatia. The results of the logit regression with the information from the Likert-scale questionnaire are provided in Table 5. Some of the variables listed in Table 2 were omitted from the final model as they were not statistically significant and excluding them provided a better fit for the model.

The initial results appear to be consistent with the finding in Table 5. There is consistent evidence that wages and dissatisfaction with working conditions is the main cause of people migrating from Croatia. This indicates that the findings from Table 3 and 4 are consistent across different types of conceptualization of dissatisfaction with corruption and lacking faith in public institutions. The difference between the participants who considered migrating from Croatia and those not thinking of doing so that was relevant at the 1% level of statistical significance was in the variables PRO and PAY. This is consistent with the findings from the previous logit regression models. Of the previous studies conducted, Golub (2003) clearly established that focusing on workplace conditions was a necessary component of mitigating the brain drain.

This paper similarly finds that focusing on wages and ensuring better conditions for professional development are essential to preventing further migration waves from Croatia. It should be noted that of the variables that accounted for lacking reforms or high taxes and parafiscal levies, none had a positive interrelation with the choice to migrate from Croatia. In fact, dissatisfaction with taxes and parafiscal levies was actually higher among those not considering migrating for Croatia and in the remaining instances the variables used to consider lacking faith in institutions or dissatisfaction with corruption were not statistically relevant.

5. Conclusion

This paper considered factors driving migration from the Varaždin County and considered a wide array of political and economic factors. The main finding of the paper is that a perception of being unable to professionally develop in Croatia, along with dissatisfaction with wages, are the main factors contributing to individuals migrating from Croatia. This finding is consistent across different attempts of conceptualizing both economic factors as well as dissatisfaction with corruption and lacking faith in public institutions. The paper also finds that individuals who know people who have migrated abroad are more likely to also consider doing so. Despite utilizing a significant number of variables that account for dissatisfaction with

political factors including lacking reforms in public administration, mismanagement of public funds, and corruption in public procurement, none of these variables have shown to be statistically significant in determining the decision to migrate from Croatia. As a result, the paper argues that policy-makers should focus on measures that would decrease costs of life and increase the disposable income of consumers.

There is clear evidence that all of the survey participants are highly dissatisfied with institutions and corruption which does reflect the "societal pessimism" mentioned in Jurić (2017). This is not a factor that distinguishes these two groups and this paper does not find that there is a causal link between dissatisfaction with corruption and migrating abroad. The findings of the paper are specific to Croatia and in no way dispute the findings of other country-specific studies such as Lapshyna (2014). For future research, it is clear that considering such country-specific effects is something that researchers should be aware of when devising research frameworks.

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Appendix

The descriptive statistics about information concerning the Likert scale questionnaire are provided in Table A1 below.

Table A1: Descriptive statistics of Likert scale questionnaire

	Mean	Median	Mode	Standard deviation
Statement 1	3.4	3	3	1.02
Statement 2	3.43	3	5	1.25
Statement 3	4.05	5	5	1.24
Statement 4	4.23	5	5	0.95
Statement 5	4.69	5	5	0.68
Statement 6	4.36	5	5	0.82
Statement 7	4.36	5	5	0.99
Statement 8	4.23	5	5	0.96
Statement 9	4.44	5	5	0.87
Statement 10	4.31	5	5	0.91
Statement 11	4.45	5	5	0.86
Statement 12	3.97	4	5	1.12
Statement 13	3.95	4	5	1.06
Statement 14	4.07	4	5	0.97
Statement 15	4.07	4	5	0.98
Statement 16	3.44	3	5	1.26
Statement 17	3.31	3	5	1.31
Statement 18	2.9	3	3	1.37
Statement 19	2.78	3	2	1.34
Statement 20	3.24	3	3	1.31

Source: Authors' calculations

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REGIONALIZATION BASED ON SOCIO-ECONOMIC DEVELOPMENT INDICATORS IN BOSNIA AND HERZEGOVINA – EXAMPLE OF FEDERATION OF BOSNIA AND HERZEGOVINA

Adela Delalić, Mirza Šikalo, Selma Numanović

Abstract

This study classifies local self-government units (local communities) in the Federation of Bosnia and Herzegovina (FBIH) according to socio-economic characteristics by applying the following multivariate methods: principal component analysis (PCA), regression and cluster analysis. The selection of variables was based on literature and adjusted by FBIH specifics, covering the four hypothetical dimensions of regional differentiation: macroeconomic, demographic, infrastructural and socio-cultural indicators. PCA has identified five components: the productivity component, demographic component, component of economic activity potential, spatial component and employment component. Further analysis showed that all identified factors are significant predictors of local communities' development, measured by the development index. The cluster analysis resulted with four clusters in the FBIH with significant differences in development level. Considering that FBIH municipalities are administrative units of local government and that the classification is based on socio-economic dimensions, identified clusters correspond to the NUTS principles.

Keywords: *development index, socio-economic factors, NUTS classification, multivariate analysis.*

JEL classification: *R12, R58, C10*

1. Introduction

The development of Bosnia and Herzegovina (BIH) is limited by major regional differences in the development of local communities. The significance of an even regional development has been pointed out by the European Union (EU) through their financing of regional projects encouraging regionalization with the main idea of an even, sustainable and competitive socio-economic development of the country. When analyzing Bosnia and Herzegovina, it can be concluded that a complex, asymmetric and multiple-tier government structure has led to an inefficient local government structure (Mujakić 2010). Economic, demographic and territorial differences between regions are the main obstacle for a balanced and harmonious development

Adela Delalić, PhD
Associate Professor
School of Economics and Business
University of Sarajevo
Bosnia and Herzegovina
E-mail: adela.delalic@efsa.unsa.ba
ORCID: 0000-0003-2556-0461

Mirza Šikalo, MA (corresponding author)
Senior Teaching Assistant
School of Economics and Business
University of Sarajevo
Humska 438, Sarajevo 71000
Bosnia and Herzegovina
E-mail: mirza.sikalo@efsa.unsa.ba
ORCID: 0000-0001-8709-3745

Selma Numanović, MA
Senior expert associate for business with large clients
Bosna Bank International d.d.
Bosnia and Herzegovina
E-mail: selma_sa94@hotmail.com
ORCID: 0000-0002-1441-4293

at regional and country level. Since major geographical units lack homogeneity, i.e. the geographical proximity does not automatically entail socio-economic proximity, such differences among territorial units of a single country are a factor of significant interest to economists and policy makers. A thorough analysis must consider smaller geographical units with political authority and a wide spectrum of socio-economic indicators (Soares et al. 2003).

1.1. Mechanisms of regionalization

There is not a single system of measuring disparity in the EU. On the contrary, EU countries use different approaches and methods and apply selected relevant indicators and methods. According to Lipshitz and Raveh (2010), research on regional disparities and policies for their reduction do not focus enough on socio-economic differences within peripheral and key regions, highlighting the inequality among regions.

The current regionalization in BIH can be classified into three categories: administrative regionalization regulated by the Constitution of FBIH, economic regionalization founded in the operating area of regional development agencies, and regionalization according to the vision of the European Commission-the NUTS classification (Osmanković et al. 2009). As part of the EU joining process, BIH is obliged to establish a statistical regionalization following the criteria of the Eurostat NUTS classification, which is based on the adoption of spatial units from political and governing systems such as areas of local communities. The aim of NUTS is to provide the framework for the division of the economic territory of EU into territorial units for collecting and publishing standardized statistical data and to develop and harmonize regional statistics suitable for analysis and to direct the political interventions on the regional level (Zarić and Vuković 2010). For example, regions selected to receive special aid from the EU structure funds will not be chosen on an ad hoc basis, but rather match certain regions in the NUTS hierarchy. Most importantly, regionalization provides policy makers with an opportunity for a better supervision of municipality development by using the most relevant predictors.

1.2. The regionalization based on socio-economic factors

Multivariate methods of analysis have been used in multiple studies with an aim of grouping territorial units based on different and socio-economic variables idiosyncratic to a particular area. This study utilized factor analysis to summarize and identify the main socio-economic factors, cluster analysis to classify local communities in FBIH in homogeneous groups and regression analysis to examine the impact of socio-economic factors on local communities' development.

Numerous studies have utilized cluster analysis in research and classification of local communities in relation to their development (Soares et al. 2003 - Portuguese NUTS 2 regions, Rovan and Sambt 2003 – municipalities in Slovenia, Lovrinčević et al. 2005 – Croatian NUTS 2 regions). Similar to this paper, some of the previous studies conducted their research of regional inequalities and classification of local communities based on combination of factor and cluster analysis (Del Campo et al. 2008 - 241 regions in 25 EU countries, Palevičienėa and Dumčiuvienėa 2015 - NUTS 2 regions in EU countries, Rašić-Bakarić 2005 – Croation NUTS 2 regions, Kurnoga-Živadinović 2007 – NUTS 1, 2 and 3 in Croatia).

Considering the selection of variables for the study, justification is also found in the inputs of numerous studies in the region, the EU and the world (Del Campo et al. 2008, Palevičienė and Dumčiuvienė 2015, Bartkowska and Riedl 2012, Cruz-Jesus et al. 2012, Melecky 2012, Kurnoga-Živadinović 2007, Rovan and Sambt 2003, Rašić-Bakarić 2005, Aragon el al. 2003, Gonzalez and Morini 2000, Peschel 1998, Pettersson 2001, Kronthaler 2003, Ru'a Vieytes et al. 2003, Stimson et al. 2001 – socio-economic indicators, Soares et al. 2003 - demographic, economic, health, educational and cultural characteristics, Lovrinčević et al. 2005, Pejanović and Kordej De-Villa 2015 - economic, demographic and social characteristics, Botrić et al. 2006 - development of road structure construction, Botrić et al. 2003 - wages, employment, unemployment, labor mobility, Bloom et al. 2001, Feyrer 2002, Gómez and Hernández de Cos 2006, Hartmann 2010, Balan 2015, Kelley 2001, De Haas 2008 - demographic indicators etc.).

1.3. Objectives and Research Questions

The topicality of the research arising from obligations of BIH, following the Stabilization and Association Agreement is to determine statistical regional units in accordance with the regulated Eurostat standards. The aim is to define an optimal region for statistics, organize regional policy and provide easier access to funds, programs and support projects for regional economic development. It is vital to observe local community development through its multidimensional nature and conduct multivariate analyses based on

available data to identify the relevant factors of economic development.

The main aims of this study are to investigate the efficiency of different multivariate analysis methods conducted to analyze the effect of socio-economic indicators on the development of local communities in the FBIH and utilize the obtained results to identify a way of their efficient classification with a goal of encouraging a harmonized economic development.

Following the aforementioned aims, the following research questions are posed:

1. Is it possible to identify the socio-economic factors in the characteristics of local communities in the FBIH?
2. Is it possible to determine the direction and intensity of the impact of socio-economic factors on the development of local communities in the FBIH?
3. Is it possible to efficiently classify FBIH municipalities into homogenous groups? What are the defining properties of these groups?
4. Does an eventual classification of local communities create a better surrounding for profiling the policies of regional development?

The aforementioned research questions will be tested based on the latest data available during the period of the research.

2. Methodology

2.1. Data and variables of interest

The successful classification of local self-government units largely depends on the adequate selection of manifest variables. The original intention was to conduct the research on the entire territory of Bosnia and Herzegovina. However, the statistical system in BIH is still under the jurisdiction of two entity institutions for statistics: Institute for Statistics of the FBIH and Institute for Statistics of Republika Srpska, whose reports are not harmonized. Therefore, at the time of the research, it was impossible to provide comparable data at the local community level for both entities in BIH. The survey was conducted in all 79 municipalities in the FBIH. The initial set, after the selection of variables in accordance with the relevant literature, consisted of 21 manifest variables. All data used refer to 2020. The literature review revealed that studies used different indicators as variables of interest, without paying too much attention to their selection and ignoring the fact that successful classification depends, to a large extent, on the adequate selection of variables. It should be taken into account that, in the process of variable selection, some common socio-economic variables were not available at the local

Table 1. Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Unemployment rate	79	13.70	77.40	43.89	12.59
Tax revenue per capita	79	25.00	717.00	156.19	113.19
Average net salary	79	591.00	1381.00	864.16	164.26
Average retirement income	79	252.00	640.00	426.38	62.07
Export-to-import ratio	79	0.00	5386.44	235.53	728.38
Ratio of workers to retirees	79	0.60	3.70	1.46	0.64
Number of business entities per 1000 residents	79	27.00	183.70	63.99	26.44
% of uncultivated land	79	0.00	96.90	44.15	31.67
The size of the local community in km^2	79	9.90	1175.00	330.51	268.81
Population density	79	2.70	6451.60	243.96	787.11
Population migrations in 2020/2013	79	0.00	4.10	0.91	0.48
Vitality index	79	0.00	119.64	58.33	25.61
Share of working age population	79	54.40	76.30	69.02	4.00
Share of unemployed with a university degree	79	0.00	2400.00	312.05	467.87
Number of pupils per 1000 residents	79	4.00	106.00	72.54	20.95
Number of citizens per one doctor	79	48.35	2428.00	1067.93	461.86
Number of citizens per one dentist	79	0.00	20071.00	5852.21	3984.89
Length of main roads in km	79	0.00	115.00	25.42	22.92
Number of registered vehicles per capita	79	0.05	0.65	0.29	0.09
Construction work	79	0.00	96338.00	11113.06	17319.24
Number of TV and radio stations	79	0.00	6.00	1.15	1.20

Source: The authors' calculation

level, such as ethnic and religion structure or variables related to tourism. In addition, some variables, such as hospital bed availability or direct foreign investment, were not appropriate considering that they are irrelevant at local level. Bearing in mind the previously stated facts and the variables used in similar researches in the region and the world, the variables in the paper were initially selected from four categories: macroeconomic indicators, demographic indicators, infrastructure indicators and socio-cultural indicators. Selected variables and basic descriptive indicators are shown in Table 1.

2.2. Selected methods of multivariate statistical analysis

Multivariate analysis methods provide a simultaneous analysis and reduction of a larger number of indicators from one or more sets of indicators, leading to a simplification of input and the reduction of the risk of not fulfilling the premises in the succeeding steps of statistical analysis. This paper will use the multivariate analysis methods to research the interdependence within a set of selected indicators, to analyze the structure and the degree of influence of the extracted factors on economic development and to classify municipalities on the basis of their common features. This study, based on multivariate method features and set goals, relies on the results of factor analysis, i.e. the method of principle component with an aim of researching interdependence, structure and identifying the factors of development. Next, it relies on the results of regression analysis with an aim of determining significance of identified factors on the index of municipalities' development and finally, it relies on the results of the cluster analysis which was used to classify municipalities in the FBIH based on socio-economic factors. Following the intention to include factors of local community development as input variables in the regression model, the principle component analysis (PCA) for factor extraction was chosen as appropriate (Johnson and Wichern 2014).

PCA aims at summarizing most of overall variance of the initial variables to a minimal number of factors needed to make estimates when previous knowledge suggests that specific variance and error variance represent a relatively small portion of the overall variance (Hair et al. 2010). The primary aim of the model is to maximize the explained variability of manifest variables through factor extraction. The essence of principal component analysis is to define a set of non correlated component variables $Y_1, Y_2, \ldots Y_n$, with each component presented in the form of linear combination of manifest variables $X_1, X_2, \ldots X_n$. The first step refers to the determination of the component:

$$Y_{1k} = \sum_{i=1}^{n} a_{1i} X_{ik} \quad (1)$$

for $k = 1,2, \ldots, n$, whose variance $\sigma_{Y_1}^2$ covers the largest possible part of the total variance σ^2 of the manifest variables:

$$\sigma_{Y_1}^2 = \frac{1}{n} \sum_{k=1}^{n} (y_{1k} - \bar{Y}_1)^2 \quad (2)$$

The variance of the second extracted component Y_2 covers the largest possible part of the remaining variance $\left(\sigma^2 - \sigma_{Y_1}^2\right)$. The procedure is repeated until a set of component variables $(Y_1, Y_2, \ldots Y_n)$ is generated. Since $\sigma_{Y_i}^2 = \sum_{i=1}^{n} \sum_{i=1}^{n} a_{li}\, C_{ij} a_{jr}$ the problem is narrowed down to calculating the conditional extreme:

$$\max_{l} \sigma_{Y_i}^2 = \sigma_{Y_1}^2 = \sum_{i=1}^{n} \sum_{j=1}^{n} a_{li} C_{ij} a_{jr},$$

$$under\ condition \ \sum_{j=1}^{n} {a_{il}}^2 = 1 \quad (3)$$

Using the method of Lagrange multipliers to determine the conditional extreme in the process of maximizing the variance $\sigma_{y_1}^2$, the following equation is generated:

$$\left|[C_{ij}] - \lambda l_n\right| = 0 \quad (4)$$

with an n of positive solutions, i.e. characteristic roots/eigenvalues $\lambda_l > 0, l = 1,2 \ldots, n$. It needs to be noted that each characteristic root λ_l is assigned with a characteristic vector $\boldsymbol{a_l}$.

In other words, an n of principal components $Y_l, l = 1,2, \ldots, n$ can be determined for the covariance matrix $C = [C_{ij}]_{mxn}$ alongside respective eigenvalues $\lambda_l > 0, l = 1,2 \ldots, n$, characteristic vectors $\boldsymbol{a_l} = [a_{il}]_{nx1}$, $\sum_{i=1}^{n} a_{il}^2 = 1,\ l = 1,2, \ldots, n$ and variances $\sigma_{Y_l}^2 > 0,\ l = 1,2, \ldots, n$.

Accordingly, principal component variances $\sigma_{Y_l}^2$ have equal value as eigenvalues of the covariance matrix C, i.e. the following is stated:

$$\sigma_{Y_l}^2 = \lambda_1,\ \ l = 1,2, \ldots, n. \quad (5)$$

The goal of PCA is to determine the component with the maximal variance in each of n phases. This leads to a formation of a descending sequence $\lambda_1 \geq \lambda_2 \geq \cdots \lambda_n$ of the eigenvalues of the matrix C and a corresponding sequence of principal components: $Y_1, Y_2, \ldots, Y_n$.

If the obtained solution is not clear and interpretable, it is recommended to rotate the factors

with an aim to achieve simple structure in which each variable will be loaded with as few factors as possible, while maximizing the number of high loadings on each variable (Rummel 1970). The paper uses the orthogonal varimax rotation, which is based on minimizing the number of variables that have large loadings on each factor and reducing small loadings from a certain factor to make it even smaller. This rotation technique has proven to be very successful, which is why it is most often used (Kurnoga-Živadinović 2007).

Since the main goal of factor analysis is the condensation of a larger number of initial indicators to a smaller number of latent dimensions, Kaiser criterion is used to reduce the number of principal components. Based on the results of the factor analysis and the obtained factor scores, further analysis is done in multiple linear regression model using the ordinary least squares method (OLS):

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_K X_{iK} + e_i \qquad (6)$$

where the factor scores of socio-economic components are used as independent variables and development index is used as a dependent variable. The development index measures the degree of development of municipalities and it is one of the most important instruments in the regional policy of BIH. It is a composite indicator calculated as a weighted average of multiple basic socio-economic indicators: tax revenue per capita income (X_1), employment rate (X_2), population migration (X_3), share of the elder population (X_4), the educational level of the workforce (X_5). The value of each indicator is normed in a way that the normed value of each indicator is put in ratio with the normed indicator value at the level of the FBIH. Further, the weight for each indicator considered when calculating the development index is determined. The following weights were used in the process of determining the used development index: 25% for X_1, 20% for X_2, 20% for X_3, 15% for X_4 and 20% for X_5 (Regulation on the creation of a development index 2019).

Finally, the non-hierarchical method of cluster analysis based on a previously determined number of clusters was used for the regionalization of municipalities. This method enables moving objects from one cluster to another in different stages of the analysis. The most popular non-hierarchical algorithm is the *K-means,* where, after the selection of the number of *K* clusters, the initialization of *K* clusters and positioning the objects into clusters is conducted randomly. The transfer of objects from one cluster to another is done based on the distance of the centroid of a particular cluster from the objects that are joined to other clusters. If an object is less distant from the centroid of another cluster than its own, it will be transferred to another cluster and the centroids of the clusters will be recalculated. The procedure is repeated until there are no more objects to move, which means that each object is closest to the centroid of the cluster to which it belongs. There are several measures of distance than can be used in cluster analysis. This study uses the most common Euclidean distance.

Formally, a set of objects is given $\{x_1, x_2, ..., x_m\}$, where each one presents an *n* dimensional vector, with coordinates equal to the values of the *n* variables at *m* objects. The K-means method distributes objects in a *K* number of sets (clusters): $C = \{C_1, C_2, ..., C_K\}$ $(K \le m)$ in such a way to minimize the sum:

$$\sum_{k=1}^{K} \sum_{x_i \in C_k} d^2(x_i, \mu_k) \qquad (7)$$

where $\mu_1, \mu_2, ..., \mu_k$ present the cluster centroids $C_1, C_2, ..., C_K$, and *d* is the selected distance measure. The selection of the non-hierarchical method of clusterization was chosen, as the results are less susceptible to the effect of the chosen distance measure and the most distanced data.

3. Results and discussion

The analysis was completed in three main steps: (i) identifying the principal factors of municipality development using PCA, (ii) analyzing the impact of these factors on the municipality development index using the OLS regression model and (iii) classifying the municipalities into clusters.

3.1. Identifying the main factors across the selected data

Factor analysis was repeated several times in the process of identifying factors of economic development. Through the process, the selection of the final set of manifest variables was based on the communalities, anti-image correlations and factor loadings criteria. When analyzing the adequacy of data for the application of factor analysis, the factorability of the input set of variables was examined by using

the Kaiser-Meyer-Olkin measure (KMO = 0.627) and Bartlett's test of sphericity (p = 0.000). After observing the results, it was concluded that the selected data were suitable for factor analysis. The PCA with varimax rotation provided clear factor structure with five main components extracted that explained over 81% of the total variability. Table 2 shows the factor loadings of 14 manifest variables on 5 extracted components.

Table 3 provides an overview of identified components and related variables. The first extracted component is related to: tax revenue per capita, average net salary, average retirement income, population density and share of unemployed with a university degree. Considering that this component is based on total population earnings and corresponding taxes and that it considers the share of the unemployed with a university degree, it is called the *productivity component*. Moreover, population density is fairly expected in this component, bearing in mind that according to Yegorov (2009) and Hummel (2020), population density is related to income, employment rate and total economic growth potential. The second, *demographic*

Table 2. The rotating matrix of factor structure

	Component				
	1	2	3	4	5
Tax revenue per capita	0.715				
Average net salary	0.766				
Average retirement income	0.730				
Population density	0.767				
Share of unemployed with university degree	0.786				
Unemployment rate					-0.837
Ratio of workers to retirees					0.899
Number of business entities per 1000 residents			0.821		
Share of working age population			-0.838		
Number of registered vehicles per capita			0.687		
The size of the local community in km^2				0.888	
Length of main roads in km				0.911	
Vitality index		0.888			
Number of pupils per 1000 residents		0.920			

Source: The authors' calculation

Table 3. Principal components

Number	Component name	Variable
1	Productivity component	Share of unemployed with an university degree Average net salary Average retirement income Tax revenue per capita Population density
2	Demographic component	Vitality index Number of pupils per 1000 residents
3	Economic activity potential component	Number of business entities per 1000 residents Share of working age population Number of registered vehicles per capita
4	Spatial component	Length of main roads in km Size of the local community in km2
5	Employment component	Ratio of workers to retirees Unemployment rate

Source: The authors' creation

component, is related to the vitality index and the number of pupils per 1000 citizens which indicate the population health, fertility and age structure. The variables related to the third component are as follows: the number of business entities per 1000 residents, share of working age population and the number of registered vehicles per capita, which is recognized as *the economic activity potential* of local communities. The fourth, *spatial dimension* of local communities is defined by the size of the local community (km2) and the length of main roads (km). The fifth component is related to the unemployment rate and ratio of workers to retirees, which indicate the state of *employment* in the local community.

Depending on the selected set of manifest variables, different studies that used the PCA method resulted with the identification of different factors. The factors identified in this study are essentially closest to the factors identified by Del Campo et al. (2008): unemployment, economic development, education and two demographic factors. After reviewing other research papers that use factor analysis (Palevičienėa and Dumčiuvienėa 2015; Rašić-Bakarić 2005; Kurnoga-Živadinović 2007), some common characteristics of the identified factors can be observed: the socio-economic status of population, the work status of population, employment, economic activity and education.

3.2. The effect of socio-economic factors on regional development

Factor analysis reduced the number of manifest variables to five socio-economic components. These components represent independent variables in a regression model while the development index is a dependent variable.

The model itself did not meet the assumptions of a regression model on the adequacy of the functional form, homoscedasticity and normality of residuals. An outlier was spotted during the estimation of the linear regression model - the municipality of Centar Sarajevo with a standardized residual of > 4, which could affect the estimate of the regression model. In order to isolate the effect of this outlier on the regression coefficients, we defined a dummy variable and included it in the model.

The estimated model is evaluated by using several tests of linear regression diagnostics. The adequacy of functional form is confirmed by the Ramsey RESET test (p=0.159). The assumption on homoscedasticity was tested using the Breusch-Pagan's test. According to results of Breushch-Pagan's test (p=0.9600), the homoscedasticity assumption cannot be rejected. The assumption on normality of the residuals was tested using the Skewness-Kurtosis test (p=0.603) and the Shapiro-Wilk normality test (p=0,884). Both tests indicate that the normality of residuals assumption cannot be rejected. Considering that the set of exploratory variables contains five uncorrelated factors and one dummy variable, a multicollinearity problem does not exist in the model. Following the Gauss-Markov theorem, the obtained OLS estimator is BLUE (the Best Linear Unbiased Estimator). Table 4 presents the suggested valid model.

Based on the estimated regression model, it can be concluded that 94% of development index variation can be explained by the variations of independent

Table 4. The evaluated regression model

N	F (6.72)	Prob > F	R Squared	Adjusted R Squared
79	217.25	0.0000	0.9477	0.9433

	Coeff.	Stand. Error	t	P > | t |	95% conf. interval	
fac1	0.1831	0.0089	20.40	0.000	0.1652	0.2010
fac2	0.1465	0.0083	17.66	0.000	0.1210	0.1630
fac3	0.1064	0.0087	12.19	0.000	0.0890	0.1238
fac4	-0.0341	0.0083	-4.09	0.000	-0.0508	-0.0175
fac5	0.0874	0.0086	10.16	0.000	0.0703	0.1046
outdummy	0.4309	0.0864	4.99	0.000	0.2586	0.6031
(constant)	0.8471	0.0083	101.97	0.000	0.8305	0.8637

Source: The authors' calculation

variables (adj. R^2=0.9433). All independent variables: productivity component (fac1), demographic component (fac2), economic activity potential component (fac3), spatial component (fac4), employment component (fac5) and the outlier dummy variable are significant on all conventional error levels. All components, except the spatial one, have a positive impact on local communities' development. Following these results, the first two research questions are answered: there are five socio-economic factors among the characteristics of local communities in the FBIH that have significant impact on their development level.

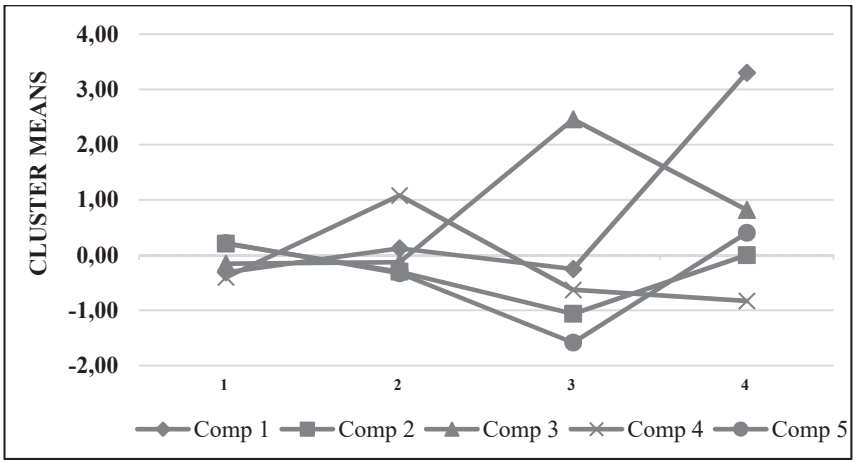
3.3. Regionalization based on socio-economic components

The K-means nonhierarchical cluster method was used for grouping municipalities into clusters. Factor scores obtained by conducting a factor analysis were used as input data. Since factor analysis produced five principal components, five factor scores were calculated for each municipality. The factor scores indicate the relationship between the objects and components, i.e. factor scores would represent the score of each municipality on the underlying latent component. Figure 1 shows the means of factor scores of all five components classified by clusters. The number of clusters (4) was determined based on the results of analysis of variance (ANOVA).

The first cluster contains 49 municipalities. It is characterized with the all five average factor scores close to 0, which indicates that local communities in this cluster have no significant advantages or disadvantages in terms of identified socio-economic factors. The second cluster contains 23 municipalities. This cluster is characterized by the pronounced spatial component, which is expected considering that this cluster contains many spatially large municipalities such as Zenica, Tuzla, Mostar, Bihać, etc. The third factor contains three municipalities: Foča, Pale and Trnovo, characterized by the fact that the pre-war areas of those municipalities were administratively divided between FBIH and entity of Republika Srpska. As expected, the divided i.e. peripheral municipalities, are characterized by a low value of the employment and demographic factor. The economic activity potential component is moderately pronounced in this cluster. In the fourth cluster, the municipalities that make up the administrative area of the city of Sarajevo stood out. As the most developed local communities in FBIH, they are characterized by a very high score of the productivity component and moderately high score of the economic activity potential component. The negative score of the spatial dimension indicates the relatively small area of these municipalities. Grouping of capital cities or regional centers into one cluster is common in most researches based on the regionalization of local communities (Soares et al. 2003, Rovan and Sambt 2003, Lovrinčević et al. 2005).

The cluster analysis, based on factor scores, provided an efficient way to classify FBIH municipalities into homogeneous groups. The values of factor scores inside the clusters enabled the identification of clusters' common characteristics, which served as an answer to the third research question: "Is it possible to efficiently classify FBIH municipalities into homogenous groups? What are the defining properties of these groups?" Geographical distribution of obtained clusters is presented in Figure 2.

Figure 1. The relationship between the clusters and municipality development components



Source: The authors' creation

Figure 2. Municipality classification based on five socio-economic factors

Source: The authors' creation

Testing the differences in the development index among the clusters was conducted by the non-parametric Kruskal–Wallis test since the Kolmogorov-Smirnov test indicated that the development index variable for 79 municipalities does not follow normal distribution. Following the Kruskal–Wallis test, it can be concluded that there are statistically significant differences in the development index per municipality depending on the cluster they belong to. According to the average value of the development index, cluster IV, which consists of municipalities which are a part of the city of Sarajevo, is the most developed one (Table 5).

Identification of common characteristics of the clusters provided a partial answer to the fourth research question: "Does an eventual classification of local communities create a better surrounding for profiling the policies of regional development?" Aiming to provide more useful foundation for planning regional development strategies, clustering is also performed on the basis of each individual socio-economic component.

Table 5. Average development index value per cluster

Cluster		Development index
I	N	49
	Mean	0. 83531
II	N	23
	Mean	0. 75622
III	N	3
	Mean	0.76000
IV	N	4
	Mean	1.68750

Source: The authors' calculation

Clusterization based on the *productivity component* (Figure 3.a.) classified Tuzla, Mostar and four municipalities of the city of Sarajevo into two clusters (cluster II and cluster IV) with the highest values of variables related to the productivity component. The remaining municipalities are classified into two clusters: cluster I with moderate and cluster III with low value of variables corresponding to the productivity component.

According to the *demographic component* (Figure 3.b), the local units are classified into four clusters, with different values of the *vitality index* and the *number of pupils per 1000 residents*. For example, the lowest values of the vitality index (14.03) and the average number of pupils per 1000 residents (15.67) are in the first cluster, while these values are six times higher in the fourth cluster, 82.93 and 90.07 respectively.

According to the component of the *economic activity potential* (Figure 3.c.), no single cluster has a dominantly high value of all variables. The variables *number of business entities per 1000 residents* and *number of registered vehicles per capita* are the highest in cluster III (145.5 and 0.65 respectively), while the *share of working age population* is the highest in cluster IV (71.42).

When the spatial component is taken into account (Figure 3.d), larger geographical municipalities are grouped into clusters 1 and 4, while smaller municipalities are classified into clusters 2 and 3. The average size of the municipality in cluster 4 is 1084.5 km2, so the length of main roads is consequently the longest. On average, these municipalities have over 100 km of main roads. The smallest municipalities are grouped in cluster 3, with an average size of the local community of 145.77 km2 and only 5.57 km of main roads in average.

According to the employment component (Figure 3.e), cluster 1 has the most desirable indicators. It consists of only six municipalities: Tešanj, Centar Sarajevo, Usora, Neum, Kupres, and Ravno. In this cluster, the unemployment rate is the lowest (21.5%) and there are 3 employed persons per one pensioner on average. On the contrary, the second cluster has the highest average unemployment rate of 63.4% and it is the only cluster with a ratio of workers to retirees lower than 1. This cluster includes the following municipalities: Foča, Pale, Sapna, Teočak, Čelić, Kladanj, Trnovo, Zavidovići, Stolac.

Figure 3. Municipality classification based on individual components of development

a. Productivity component

b. Demographic component

c. Component of economic activity potential

d. Spatial component

e. Employment component

Source: The authors' creation

Considering the fourth research question: "Does an eventual classification of local communities create a better surrounding for profiling the policies of regional development?", classification based on individual socio-economic factors enables the identification of local communities that suffer from deficiencies in the context of individual dimensions of regional development. Identified weaknesses at the local level will make it easier for decision-makers to target local communities and create future strategies of harmonized development in the entire FBIH.

4. Conclusions and recommendations

The question of regional inequality, regional development in particular, have taken the spotlight in the literature on economics in the last two decades. Bosnia and Herzegovina, a rather small country in terms of size and population, stands out regarding its big differences at the level of local communities. Since the Stabilization and Association Agreement requires the proposition of a regional division base, this study is aimed to provide a classification of local communities in FBIH, harmonized with the European statistical standards (NUTS). Accordingly, the first task of this research refers to the possibility of identifying socio-economic factors and the evaluation of their impact on the development of local communities. Based on the available data on municipalities in FBIH, five factors were identified: productivity, demographic factor, economic activity potential, spatial factor and employment. It was found that each of them has significant impact on the development of local communities in FBIH. In addition, the task of this study was to find an efficient way of classifying local communities into homogeneous groups and to identify their common characteristics. Based on the identified factors of local communities' development, FBIH municipalities were classified into four homogeneous clusters and their specificities were identified. The resulting classification can serve as the basis for regionalization required by the Stabilization and Association Agreement. Finally, aiming to support the efficient planning of regional development policies, a classification of local communities was carried out on the basis of individual socio-economic factors. Policy makers can utilize these data in the context of planning more efficient strategies and activities, classifications based on productivity, demography, economic activity potential, employment and identifying and evaluating the strengths and weaknesses among FBIH municipalities. The results shown in the paper are a significant support to policy makers in the process of classifying local units and focused enhancement of regional development based on identified features of a given self-government unit and its grouping. The continuation of the research could be focused on expanding the variables considered to be important for research such as indicators of ethnical and religious structure, indicators of housing stock and position, as well as indicators associated with tourism that were not available at municipality level. Further, the limitation of the paper is that the focus is narrowed down to the FBIH alone, hence the analysis should be expanded to encompass the entire area of BIH, i.e. it should be insisted on the harmonization of entity statistical data as data resource.

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A BIBLIOMETRIC ANALYSIS OF PUBLIC BUSINESS SCHOOL SCIENTIFIC PRODUCTIVITY AND IMPACT IN SOUTH-EAST EUROPE (2017-2021)[1]

Nikša Alfirević, Jurica Pavičić, Darko Rendulić

Abstract

In this paper, we analyze the scientific productivity and impact of selected public business schools in South East Europe (SEE) in the 2017-2021 period by using the scientific output indexed in the Elsevier Scopus reference database. The region's most productive and influential authors, institutions, and publication outlets are identified in the field of business research. Empirical results are discussed from the viewpoints of two research questions related to regional business school research patterns and the research cooperation outcomes. Selected public business schools in the SEE region have been found to have a mixed record regarding research productivity and impact. International collaboration is valuable in increasing the research impact, while institutional collaboration seems more effective in raising impact than national one. Recommendations for business school administrators are identified and discussed.

Keywords: *Higher education, Business schools, Bibliometric analysis, Research cooperation, South East Europe*

JEL classification: *I23, O30*

1. Introduction

Since scientific research aims to produce new knowledge, its productivity is usually conceptualized in simple terms of scientific output, with an implicit expectation that it should be referred to in citation databases, such as Elsevier Scopus or Clarivate Web of Science (WoS). Such indexing enables quantitative measurement of publication impact and calculation of relevant indicators for research evaluation (Moed 2009). However, while the expectation of Scopus/WoS indexing could be directly applied to the STEM fields, it might not fully work for the arts, humanities, and social science fields (Abramo and D'Angelo 2014).

While productivity is often equalled to 'quantity' and impact to 'quality' of research, there is a clear distinction between research 'quality' and impact. While quality could be described in terms of *"the relative excellence of academic outputs intended for academic consumption"* (Donovan 2011, p. 176), the impact is

Nikša Alfirević, PhD (corresponding author)
Professor
Faculty of Economics, Business and Tourism
University of Split, Cvite Fiskovića 5
21000 Split, Croatia
E-mail: nalf@efst.hr
ORCID: https://orcid.org/0000-0002-2130-982X

Jurica Pavičić, PhD
Professor
University of Zagreb, Trg Republike Hrvatske 14
10000 Zagreb, Croatia
E-mail: jurica.pavicic@unizg.hr
ORCID: https://orcid.org/0000-0002-6580-1162

Darko Rendulić
Associate professor & Senior lecturer
Karlovac University of Applied Sciences
Trg Josipa Jurja Strossmayera 9
47000 Karlovac, Croatia
E-mail: darkorendulic1@gmail.com
ORCID: https://orcid.org/0000-0002-6529-0630

defined by national research evaluation frameworks by *"the benefits that research outcomes produce for wider society"* (ibid). Its measurement is complex and could be viewed as contributing to solving 'real world' problems. However, this might conflict with the notion of academic autonomy of researchers and their institutions (Bornmann 2017).

In the UK, the impact is recognized by the value for external (non-academic) stakeholders. This opens another conflict in business school research - the tension between theoretical rigor and practical relevance (Philips, Sage, and Sebu 2020). While the 'ivory tower' metaphor can be raised as an argument for the perceived mismatch between the business school research and the business community knowledge requirements, the gap among the business school and the stakeholders' expectations also seems to depend on the adoption of an implied higher education model (Grotkowska, Wincenciak, and Gajderowicz 2015). Some studies (Aistrich, Saghafi, and Sciglimpaglia 2006) even show that such a mismatch might not be very high in countries with developed market economies, such as France, Germany, Netherlands, UK, etc.

On the other hand, the public higher education (HE) in the region of South East Europe (SEE) finds itself in a different context, which is often described in terms of the clientelistic and politicized public sector, serving the interests of the self-propelling political elites (Šimić Banović 2019; Pavlović 2022). This might drive the regional public business schools to continuously legitimize their role and activities toward the stakeholders, as previously empirically shown for the cases of primary and secondary education levels in Croatia (Vican, Alfirević, and Pavičić 2017; Alfirević, Vican, and Pavičić 2018). The described need for HE legitimization can often be found in a different context(s), where economic and social circumstances lead to high levels of youth unemployment (Simmons and Smith 2016), thus hinting at low performance and social contribution from higher education institutions (HEIs).

'Hard data,' such as bibliometric indicators verified by international citation providers, could be viewed as a preferred source of information related to HEI performance. We propose that the bibliometric approach might be especially applicable to social science HEIs and business schools, as their graduates might be less competitive and less inclined to participate in the global labor market. The practice of 'STEM colonization' supports such a proposition, i.e., the transformation of academic practices, especially research and publishing, in social sciences and humanities, toward the patterns from STEM and bio-medical fields (Brajdić Vuković, Vignjević Kotoraj, and Ćulum Ilić 2020).

Science evaluation systems in the SEE region and the broader neighborhood also increasingly focus on internationally indexed publications (Ciurak, Mijač, and Wierczyński 2021). These databases include the Elsevier Scopus and Clarivate Web of Science databases, which will be further discussed in the next section of this paper. The attractiveness of described trends for the SEE policymakers and academic experts wishing to demonstrate that social relevance and commitment to the modernization and reform agenda(s) can be best described by a quote from Živković and Panić (2020, p. 2319), who state that *"…a development model for WB* [Western Balkans] *countries has been proposed* [as related to development and measurement of science and higher education], *whereby they can acquire measurable competencies as a starting point for equal negotiations for their entry into the EU and gain a respectable position in the world".*

From the described perspective, quantitative bibliometric methods could indicate HE modernization and signal to stakeholders that the 'correct' management practices are being used. In the nonprofit sector, those have been recognized as a significant driver of how stakeholders assess organizational effectiveness (Herman and Renz 2004; Herman and Renz 2008), which might also apply to the academic sector. Some other business school practices, such as international accreditation efforts (Butt et al. 2021), could be classified in the same way, driving the stakeholders' perception of school performance.

Citation analysis, serving as a cornerstone for quantitative bibliometric methods, makes it easy to assess how the peer research community evaluates the primary scientific outputs, such as books, chapters, journal articles, etc. Measuring social impact is much less straightforward since there might not even be a consensus on the impact and which social stakeholders should be involved in receiving and evaluating research benefits (Aistrich, Saghafi, and Sciglimpaglia 2006).

Previous research (Siemens et al. 2005) shows that the public opinion and rankings of business schools, at least its undergraduate programs, depend highly on the research productivity scores. Although this study found a much weaker relationship between research productivity and graduate program rankings, Mitra and Golder (2008) later showed that research matters for MBA programs. In their study of 57 business schools, both positive short-term and long-term effects of the research performance have been observed over 18 years. These studies hint at the relationship between research productivity and business school performance. However, the regional HE context and the relationships of regional business schools

to its stakeholders (as explored by Pavičić, Alfirević, and Mihanović 2009) could have a significant impact on the nature of this relationship. This study should establish the baseline for such a research direction by offering the initial evaluation of the SEE region's productivity, impact, and cooperation patterns of business school research.

Due to such a framing of regional business schools' operations, there is a need for an initial study describing their research from the viewpoint of external stakeholders. Therefore, we examine the following research questions, formulated from the external stakeholders' perspective:

- RQ1. What are the patterns of scientific productivity and the impact of business school research in South East Europe?
- RQ2. What are the patterns of business school research cooperation and their outcomes?

While the approach used in this study has its limitations for a comprehensive research evaluation, it still serves the purpose of this paper, which aims to provide a preliminary overview of the regional public business schools' research performance.

Since an external stakeholder (such as a panel evaluating an EU-funded project proposal; management of a foreign HEI, evaluating cooperation opportunities; etc.) is likely to consult one of the popular bibliometric reporting tools, such as Clarivate InCites, or Elsevier SciVal, we opt to use bibliometric indicators without additional adjustments. An informed choice of bibliometric indicators can be used to assess different aspects of research performance (Waltman and van Eck 2015), and further (re)interpretation of results involves the development of a somewhat arbitrary procedure, considering different contextual factors.

However, in future analyses, in line with the recommendations of the Leiden manifesto (Hicks et al. 2015), additional qualitative evidence on regional business school research impact should be collected and assessed, along with the analysis of alignment between research results and organizational missions.

2. Literature review

Researchers in the field of business are often guided by performance measures, including bibliometric indicators, such as journal impact factors or journal lists, pointing out their relative excellence. In addition, survey-based ranking studies, national expert panels, and hybrid approaches are used to measure and evaluate the business school's scientific research (Hall and Page 2015).

With commercialization and competition increasingly becoming essential determinants of academic life, neoliberal solutions become the general panacea to be applied whenever an opportunity arises (Kleinman, Feinstein, and Downey 2013). This applies to academic research and publishing, as there is an increasing number of publishing outlets and the need to validate the research results by using the simplified and widely available metrics, easily comprehensible to a variety of potentially relevant stakeholders.

Description of challenges to evaluating regional public business schools' research fits a more comprehensive analysis of challenges faced by these HEIs (Rosi et al. 2018). They include pressure from the global education market, including non-traditional providers, such as schools, offering distance learning and e-learning degrees (Thomas and Cornuel 2012). In addition, regional business schools need to adjust to the complex administrative HE landscape(s) and address the social responsibility issues.

The most popular bibliometric indicators are journal citation counts, usually perceived as an acknowledgment of research relevance and interest raised by an article, or a journal, in the academic community (Garfield 1979). However, many researchers believe there is an inherent value of the research, as opposed to the number of citations received, which might vary due to a variety of reasons, including mere luck, the disproportional influence of the publication outlet's reputation, 'incorporation' of the research results into the field's common knowledge, citation of follow-up studies, the existence of 'citation cliques,' etc. (Aksnes and Rip 2009).

At the scientific journal level, it makes sense to calculate an indicator, demonstrating the citation performance of an average journal article over a predefined window of time. The journal impact factor (JIF), as defined by the influential Clarivate indexing service (producing the Web of Science reference database and the annual Journal Citation Reports), refers to the number of citations received by articles in a scientific journal during the previous two years, averaged by the number of 'citable' items, appearing in the journal (Garfield 1972; Garfield 2006). The 'citable' items are usually limited to original research articles and reviews, which Garfield considered drivers of scientific development and efficient communication. The main advantages of JIF were considered as correcting the potential influence of journal size (i.e., the number of citable items published) on the total number of citations received, as well as limiting the influence of 'classic' articles, receiving a considerable number of citations, which can be corrected by capturing those during a limited window of time (Bensman 2011).

Law and Leung (2019) indicated that the traditional JIF calculation methods have a range of weaknesses, including that 'uncitable' items are not included in the number of published articles, while citations are still counted. In addition, Clarivate does not publicly disclose the detailed procedures for WoS journal selection or defining a published journal item as 'uncitable,' which makes it impossible to reproduce the JIF calculation scores. These practices make the JIFs unreliable as journal quality or impact proxies, primarily because the two-year citation windows favor the STEM fields, where technological development is much more rapid than in social sciences and humanities.

Due to the differences in the number and dynamics of citations across scientific fields, there is a need to normalize citations (Podlubny 2005), according to the expected number of citations, depending on the field average. In the Elsevier Scopus ecosystem, such a bibliometric indicator is called Field-Weighted Citation Impact (FWCI). Its value is calculated by comparing the number of citations received with the average expected by the scientific field and the type of study (i.e., journal paper, review, book/book chapter, etc.). FWCI value of 1.0 is set as the global benchmark for the research impact, equal to the global value of the comparable research outputs, with values lower than 1.0 denoting a lower, and values higher than 1.0 – a higher level of research impact (Purkayastha et al. 2019).

However, the JIF metric is valuable only if accompanied by an opportunity to analyze the journal networks and the relationships among the participating journals. Such an initiative had existed since 1964 when the Institute of Scientific Information started covering the articles and references to the content of six hundred journals from the STEM fields and referring to the product as the Science Citation Index (SCI). The first systematic analysis of citation patterns for ISI-covered journals was performed in 1969, setting the grounds for the regular JIF calculation and creating the corresponding Journal Citation Reports (JCR) product. At the time of publication of the influential Garfield's (1972) article, its author contemplated a similar ranking scheme to be applied to the social science field, later leading to the establishment of the Social Science Citation Index (SSCI).

Web of Science (WoS) was born out of Eugene Garfield's idea of capturing only the most influential journals (Moed 2009). Even in the first JIF calculation exercise by ISI in 1969, Garfield (1972) has shown that a small group of 250 highly cited journals accounts for approximately half of all the processed references. His conviction that the core of scientific literature can represent the entire scientific production regardless of the scientific field (Garfield 1971/1977) led to the creation of a multi-disciplinary WoS reference database. Its philosophy still adheres to capturing the core literature and references. At the same time, another major citation database, Scopus, owned and developed by Elsevier BV since 2004, tries to achieve a more comprehensive selection of sources (journals, books, book chapters, etc.), especially in fields, underrepresented in WoS (e.g., social science and humanities) (Norris and Oppenheim 2017).

One of the most popular academic journals lists in the field of business research is the 'ABS Journal Guide,' produced by the UK Chartered Association of Business Schools (CABS), currently classifying 1,703 academic journals in the field by assigning grades of 1* (for journals of modest standard) to 5* (for journals of global distinction)[2]. Although CABS comments that its 'Journal Guide' should not be used as a universal guideline for deciding whether to publish (or not) in a particular outlet, as well as that researchers should consider a wide range of other factors in their publishing decisions[2], in practice, business school researchers tend to choose only journals from the higher ABS Journal Guide brackets. This might lead toward a 'research monoculture' and dominate the development of business scholarship (Mingers and Willmott 2013).

Still, the quantitative approach, based on the dominance of journal impact factors and journal excellence lists, could be preferred by the business school management since there might be a strong relationship between research productivity and international accreditation rankings (Hedrick et al. 2010; Ke, Lin and Sai 2016). Simultaneously, business school management feels pressure to comply with the international accreditation rankings, which are significant drivers of school reputation and produce additional income (Peters 2007).

3. Methods and data

To address the research questions RQ1 and RQ2, we use the Elsevier SciVal scientometric software to report and benchmark scientific productivity and impact. Based on a vast amount of Elsevier Scopus-referred research data, SciVal enables academic administrators and research managers to obtain institutional research profiles using various metrics[3]. Its additional modules can be used to benchmark with other academic entities, review the research trends at the level of individual researchers, research groups, academic institutions, and countries, and evaluate the existing and potential collaboration opportunities (Dresbeck 2015).

The conceptual arguments for the choice of the Elsevier SciVal bibliometric reporting tool have already been presented in the introduction section. Such a choice is aligned with the research intention to understand the regional public business school research output from the viewpoint of external stakeholders. It is also based on Elsevier Scopus data, which better covers the social science research outputs than WoS (Norris and Oppenheim 2017). From the methodological viewpoint, SciVal has recently been identified as a valuable tool for structuring broad literature reviews of entire scientific fields (Cucari et al. 2022).

In addition, SciVal is the reporting tool of choice when it comes to mapping the research output to the United Nations' SDGs, i.e., Sustainable Development Goals (Roberge, Kashnitsky and James 2022) according to the bibliometric queries and the machine learning algorithms (Bordignon 2021), developed by Elsevier and an academic consortium, headed by University of Southern Denmark, Vrije Universiteit Amsterdam and the University of Auckland.

The choice of bibliometric indicators used for benchmarking the scientific output of the public business schools in the SEE region is aligned with the previous studies in the field (Cucari et al. 2022). In analogy with the cited study of global CSR scholarly output and impact, and recommendations developed by Župič and Čater (2015), we follow the four steps of traditional bibliometric analysis:

1. Research design: determining the study aims and scope, including research questions.
2. Compilation of bibliometric data: selecting a referencing database and the supporting bibliometric analysis software solution, developing search criteria and filtering strategy.
3. Bibliometric analysis: data collection and export, data cleaning and import into the software tool of choice.
4. Interpretation of results (including optional visualization).

We captured the values of the selected metrics, following Cucari et al. (2022), automatically calculated by SciVal, based on the underlying Scopus data, available on 14. December 2022.

To adjust the selection of bibliometric indicators and entities (i.e., public business schools) involved in benchmarking, we consulted four anonymous experts from the Croatian academic community. Two were experts in the field of information science, actively engaged in the application of bibliometric methods and tools. Two were experts in academic research management, actively involved in research project development and implementation, and other applicative work at the level of individual schools or universities. An unstructured interview was conducted with each of the experts.

Information science experts were asked to evaluate the choice of bibliometric methods and tools to conduct a preliminary study of the field. They were also asked to recommend relevant bibliometric indicators for the benchmarking analysis. While the two experts confirmed the usefulness of the Elsevier Scopus and SciVal sources/tools, our initial choice of indicators proved somewhat biased. The final choice of indicators represents a balance between the initial views of the authors and the experts' recommendations.

Research management experts, who are knowledgeable in the reputation of the SEE region's public business schools, were asked to identify the broadest possible choice of institutions. The preliminary criteria for inclusion in this benchmarking effort included the following:

- International accreditation (a program or an institutional one): for that matter, lists of institutions accredited by AACSB and EFMD were consulted and discussed with experts;
- Preliminary insight into the research projects awarded to the institution: on this matter, we relied on the experts' information;
- Equal representation of all SEE countries: within each SEE country (Slovenia, Croatia, Bosnia and Herzegovina, Serbia, Montenegro, North Macedonia, Kosovo), we aimed to include at least one public business school in the empirical evaluation. In Bosnia and Herzegovina, we aimed to include business schools from both entities.

Based on the experts' advice and the previously described loose criteria, we chose the following academic entities – public business schools for comparison and benchmarking across the entire SEE region:

1. School of Economics and Business Ljubljana (University of Ljubljana, Slovenia),
2. Faculty of Economics and Business (University of Maribor, Slovenia),
3. Faculty of Management (University of Primorska, Slovenia),
4. Faculty of Economics and Business (University of Zagreb, Croatia),
5. Faculty of Economics and Business (University of Rijeka, Croatia),
6. Faculty of Economics, Business, and Tourism (University of Split, Croatia),
7. Faculty of Economics (Josip Juraj Strossmayer University of Osijek, Croatia),
8. Faculty of Economics (University of Banja Luka, RS – Bosnia and Herzegovina),

9. School of Economics and Business Sarajevo (University of Sarajevo, FB&H – Bosnia and Herzegovina),
10. Faculty of Economics Mostar (University of Mostar, FB&H - Bosnia and Herzegovina),
11. Faculty of Economics Mostar (University Džemal Bijedić Mostar, FB&H - Bosnia and Herzegovina),
12. Faculty of Economics Tuzla (University of Tuzla, FB&H - Bosnia and Herzegovina),
13. School of Economics and Business Belgrade (University of Belgrade, Serbia),
14. Faculty of Economics Subotica (University of Novi Sad, Serbia),
15. Faculty of Economics Podgorica (University of Montenegro, Montenegro),
16. Faculty of Economics Skopje (SS. Cyril and Methodius University Skopje, North Macedonia),
17. Faculty of Economics Prishtina (University of Prishtina "Hasan Prishtina" Kosovo).

Since this paper represents a preliminary analysis, a more comprehensive choice of business schools should be made in future research.

Another limitation of the bibliometric analysis is the correct identification of researcher affiliations in terms of parent (university) entities (Dimzov, Matosic and Urem 2021), as well as internal (school/faculty) affiliations. Only some of the business schools, which were analyzed by the Elsevier SciVal benchmarking module, have been included in the recommended Scopus internal affiliation hierarchies[4]. Identification of researchers is based on the broad SciVal thematic filter, identifying papers from the Economics and Business scientific field, as defined by the OECD FORD classification. This is a significant research limitation since the methodological approach entails that some publications might be missing or misclassified due to the broad classification of scientific fields and publications (Chudlarský and Dvořák 2020). Simultaneously, researchers from different schools, faculties, or departments within the same parent (university) affiliation might be included, or excluded from the analysis. However, until all internal classification hierarchies are correctly defined in Scopus, serving as the major source of bibliometric data for SciVal, there is no alternative solution for scientific output benchmarking.

Any additional adjustments, based on the relative size of the institution, available funding, or other factors, have not been performed for multiple reasons. Firstly, relative bibliometric indicators (in %) make it easy to perform comparison and benchmarking. Even th size-independent metrics have their limitations, which will be further discussed in the following section of the paper. Secondly, we have aimed to present the external viewpoint of the regional public business schools' scientific output, as potentially perceived by external funders and other significant stakeholders. This argument has been introduced and developed in the introduction section of the paper.

The entire period of five preceding years has already been used in similar bibliometric studies based on the argument of the average scientific project length (Körfgen et al. 2018). We adopt the previous recommendation and analyze the bibliometric output of regional business schools for the 2017-2021 period.

4. Results

The scientific output of the analyzed regional business schools is presented in Table 1, confirming the dominant role of schools located in regional capitals (Zagreb, Ljubljana, Belgrade). This is expected due to the number of affiliated researchers and resources available to the larger schools.

The number of citations, even in the early stage of a manuscript's life cycle, is a good proxy of the publication's ultimate impact (Wang, Song and Barabási 2013). Various approaches are related to including vs. excluding self-citations at different levels of science evaluation (Waltman 2016). We opted to exclude self-citations to avoid the potential researchers' self-promotion influence on the benchmarking results. In addition, we include the average number of citations per publication in the analysis to provide a size-independent indicator of scientific impact. This relative metric might be skewed by a small number or a single highly cited publication (Waltman 2016). Normalization of citations, due to the varying citing practices and patterns in different scientific fields (Waltman and Eck 2013), has not been performed since benchmarking is performed within a single social science field.

Table 2 presents the citation analysis results for the selected SEE business schools, which once again favors the larger business schools located in regional capitals, such as Ljubljana, Zagreb, and Belgrade. The trends seem to be compatible with those related to research output, except for an exceptionally high number of average citations, achieved by the business school at the SS Cyril and Methodius University in Skopje, North Macedonia (11.9), due to a single, highly cited article, published in the *Journal of Cleaner Production*[5].

Another interesting metric includes the number of the research entity's highly cited publications (related to a certain threshold[6]) to determine its impact among the peer institutions. We use the output in the top 1% and 5% citation percentiles for all

Table 1. The annual scholarly output of selected SEE business schools (2017-2021)

Entity	Scholarly Output					
	Overall	2017	2018	2019	2020	2021
University of Zagreb	**991**	183	189	193	185	241
University of Ljubljana	**871**	194	170	187	138	182
University of Belgrade	**571**	107	102	113	131	118
University of Novi Sad	**428**	93	82	88	96	69
University of Maribor	**422**	100	72	99	67	84
University of Split	**283**	38	54	51	52	88
University of Rijeka	**234**	40	47	46	42	59
University of Primorska	**209**	39	39	44	42	45
University of Montenegro	**202**	49	42	34	34	43
University of Sarajevo	**186**	43	19	33	50	41
SS Cyril and Methodius University in Skopje	**158**	63	23	24	23	25
University of Prishtina "Hasan Prishtina"	**130**	20	24	30	33	23
Josip Juraj Strossmayer University of Osijek	**93**	21	20	22	14	16
University of Banja Luka	63	14	15	12	11	11
University of Mostar	**28**	2	10	6	7	3
University of Tuzla	**27**	5	6	3	7	6
Dzemal Bijedic University of Mostar	**7**	2	1	0	1	3

Source: Elsevier SciVal, December 2022

Table 2. Citation analysis for the selected SEE business schools (2017-2021)

Entity	Citation Count (excl. self-citations)	Citations per Publication (excl. self-citations)
University of Ljubljana	8091	9.3
University of Zagreb	6457	6.5
University of Belgrade	4473	7.8
University of Novi Sad	2934	6.9
University of Split	2395	8.5
University of Maribor	2279	5.4
SS Cyril and Methodius University in Skopje	1878	11.9
University of Rijeka	1298	5.5
University of Primorska	1265	6.1
University of Sarajevo	1014	5.5
University of Montenegro	940	4.7
University of Prishtina "Hasan Prishtina"	561	4.3
Josip Juraj Strossmayer University of Osijek	493	5.3
University of Banja Luka	206	3.3
University of Mostar	104	3.7
University of Tuzla	98	3.6
Dzemal Bijedic University of Mostar	8	1.1

Source: Elsevier SciVal, December 2022

sources (publication outlets) and academic journals. Various other definitions for scientific excellence can be used in terms of citations. Bormann (2014) advises that most bibliometric studies use quantitative definitions, with one-quarter relying on percentile rank classes and the top 1% frequently used as an indicator of scientific excellence. When the total number of highly cited publications is considered (Table 3), the largest institutions stand out, although some smaller institutions are included, such as business schools at the University of Primorska (Slovenia), University of Novi Sad (Serbia), J. J. Strossmayer University of Osijek (Croatia), and University of Split (Croatia). Once again, a small number of highly cited papers can significantly influence the benchmarking results compared to a relatively smaller scholarly output.

At the individual level, some of the most influential papers[7] might be authored by researchers affiliated with the university to which a business school belongs, not the school itself. However, this is the limitation of the study, which is difficult to account for, unless the internal Scopus affiliation hierarchies are developed properly for all entities involved in benchmarking. Manual corrections might be possible, although such a procedure would make it impossible to use the SciVal tool and require direct access to raw Scopus data.

The number of highly cited publications should be compared to their proportion in the total scholarly output (as a size-independent metric), presented in Table 4. If the size-independent metric is adopted, business schools at the University of Primorska and JJ Strossmayer University of Osijek could be singled out as producing the highest quality scientific output in academic journals. However, they have three (Primorska)[8], i.e., only one paper (Osijek)[9] in the top 1% journal percentiles, as compared to eight (Ljubljana) and five (Zagreb). When considering the top 5% journal percentiles, it is difficult to benchmark with the largest regional public business schools in Ljubljana (85 publications) and Zagreb (78 publications). However, these results show that the three smaller public business schools in Koper, Osijek, and Novi Sad[10] have had solid scientific production in the previous five years and seem to represent strong contenders to the established and centrally located regional schools.

According to quartiles (Q1 to Q4), the classification of journals provides a simplified view of the journal and scholarly output research evaluation. The first

Table 3. Highly cited publications for selected SEE business schools (2017-2021)

Entity	Output in Top 1% Citation Percentiles (excl. self-citations)	Output in Top 5% Citation Percentiles (excl. self-citations)	Publications in Top 1% Journal Percentiles by CiteScore Percentile	Publications in Top 5% Journal Percentiles by CiteScore Percentile
University of Ljubljana	12	57	8	85
University of Zagreb	14	47	5	78
University of Primorska	1	7	3	13
University of Novi Sad	1	15	2	37
University of Belgrade	4	23	1	48
Josip Juraj Strossmayer University of Osijek	1	3	1	8
University of Split	6	19	0	28
SS Cyril and Methodius University in Skopje	3	6	0	4
University of Montenegro	1	5	0	5
University of Rijeka	1	8	0	10
University of Sarajevo	1	7	0	9
University of Maribor	0	16	0	28
Dzemal Bijedic University of Mostar	0	0	0	0
University of Banja Luka	0	0	0	1
University of Mostar	0	0	0	0
University of Prishtina "Hasan Prishtina"	0	1	0	3
University of Tuzla	0	0	0	0

Source: Elsevier SciVal, December 2022

Table 4. The proportion of highly cited publications (relative to scholarly output) for selected SEE business schools (2017-2021)

Entity	Output in Top 1% Citation Percentiles (excl. self-citations. %)	Output in Top 5% Citation Percentiles (excl. self-citations. %)	Publications in Top 1% Journal Percentiles by CiteScore Percentile (%)	Publications in Top 5% Journal Percentiles by CiteScore Percentile (%)
University of Primorska	0.5	3.3	1.6	7.1
Josip Juraj Strossmayer University of Osijek	1.1	3.2	1.5	11.9
University of Ljubljana	1.4	6.5	1.2	12.7
University of Zagreb	1.4	4.7	0.7	10.1
University of Novi Sad	0.2	3.5	0.5	9.7
University of Belgrade	0.7	4	0.2	10.4
Dzemal Bijedic University of Mostar	0	0	0	0
SS Cyril and Methodius University in Skopje	1.9	3.8	0	3.8
University of Banja Luka	0	0	0	2.8
University of Maribor	0	3.8	0	9.3
University of Montenegro	0.5	2.5	0	2.7
University of Mostar	0	0	0	0
University of Prishtina "Hasan Prishtina"	0	0.8	0	2.6
University of Rijeka	0.4	3.4	0	4.6
University of Sarajevo	0.5	3.8	0	6
University of Split	2.1	6.7	0	12.8
University of Tuzla	0	0	0	0

Source: Elsevier SciVal, December 2022

quartile (Q1) consists of the top 25% journals for a research field (area), as evaluated by a provider of bibliometric information, such as Clarivate (with its WoS and JCR products) or Elsevier (with its Scopus product)[11]. Subsequent quartiles (Q2 to Q4) consist of the journal classes, classified according to their impact, each comprising 25% of the remaining body of indexed scientific publications in the field. Therefore, the journal quartiles can be used as an alternative to the impact factor (JIF)-based metric. According to Miranda and Garcia-Carpintero (2019), the total share of Q1 publications is increasingly used for research evaluation and funding, while the amount of such publications varies according to the scientific field. In this paper, we aim to present the empirical results for the regional public business schools regarding the share of their publications in Q1-Q4 quartiles, regardless of the national science evaluation and academic promotion policies. Namely, these bibliometric indicators make it easy to perform an objective comparison of scientific excellence and compare it to the global benchmarks of scientific publication practice.

As expected, the distribution of papers, according to journal quartiles, is not proportional. Contrary to what might be considered 'logical,' top (Q1) journals publish more than 25% of documents, while Q3-Q4 journals publish less than that (Liu, Guo and Zuo 2018). Although higher-quartile journals are much more selective than lower-quartile ones, they attract the highest number of submissions since researchers tend to submit to the journals with the highest JIFs (Ibáñez, Bielza, and Larrañaga 2013).

For the sake of comparison to our results, based on Scopus data and the CiteScore metric (see Table 5), Miranda and Garcia-Carpintero (op. cit.) find the variability of as much as 25.4% to 85.6% of the scholarly output published in Q1 journals, as defined by the WoS Science Citation-Expanded index. Although the WoS SCI index tracks the STEM fields, it is interesting to note that the average share of Q1 documents is as high as 45.7% (i.e., 38.4% for journal articles and indexes only). Liu, Guo and Zuo (2018) obtained similar results for Q1 papers from the STEM field but also analyzed the social science papers indexed by the JCR-Social Sciences Edition (for 2016). The Q1 to Q4 publication shares in the WoS-indexed journals for the social sciences were 36%, 29%, 20%, and 15% (respectively).

Table 5. Publications in journal quartiles for selected SEE business schools (2017-2021)

Entity	Publications in Q1 Journals Quartile by CiteScore (%)	Publications in Q2 Journals Quartile by CiteScore (%)	Publications in Q3 Journals Quartile by CiteScore (%)	Publications in Q4 Journals Quartile by CiteScore (%)
University of Ljubljana	43	24.9	20.4	11.8
University of Belgrade	40.6	17.9	28.7	12.7
University of Novi Sad	33.5	25.1	29.3	12
University of Split	33	19.3	32.1	15.6
University of Zagreb	31.5	22.4	26.1	20
University of Maribor	30.7	27.7	25.3	16.3
University of Rijeka	29.4	22.9	33	14.7
University of Sarajevo	29.1	21.9	35.8	13.2
University of Montenegro	27.3	25.7	25.1	21.9
University of Primorska	25.1	23.5	27.9	23.5
Josip Juraj Strossmayer University of Osijek	22.4	17.9	32.8	26.9
SS Cyril and Methodius University in Skopje	20.2	28.8	28.8	22.1
University of Banja Luka	19.4	25	38.9	16.7
University of Tuzla	17.4	8.7	52.2	21.7
University of Prishtina "Hasan Prishtina"	12.2	33.9	34.8	19.1
University of Mostar	9.5	19	38.1	33.3
Dzemal Bijedic University of Mostar	0	33.3	16.7	50

Source: Elsevier SciVal, December 2022

Although we could not identify any Scopus-based bibliometric analyses of journal quartile publications in social sciences or economics, the presented findings could be used for an approximate comparison with our empirical results (Table 5). In this context, the top six analyzed schools, along with the business school at the University of Montenegro, seem to be doing well. We suggest that the research impact needs improvement once the share of Q1 publications is surpassed by either the share of Q3 or Q4 journal papers, which is the case for the ten entities in Table 5.

Collaboration proves to be a significant factor in research impact in many cases. It is generally expected that more intensive international collaboration should increase the number of citations (Katz and Hicks 1997). This has been empirically confirmed in different studies, especially for small developing countries, including Malaysia (Lowe et al. 2014), Vietnam (Nguyen, Ho-Le, and Le 2017), Brazil (McManus et al. 2020), etc. However, such a finding is not entirely generalizable, as its effect strongly depends on the scientific field (Glänzel and De Lange 2002). Pečlin et al. (2012) have confirmed this variability in the sample of Slovenian research groups' publications and suggested that researchers from small peripheral countries are motivated to collaborate to gain access to new resources. This could be the case with the research fields, which have not been developed enough, while international collaboration might not prove valuable for the already well-established fields.

Our results for the selected SEE business schools (see Table 6) are based on Elsevier SciVal data, identifying international, national, and institutional collaborations, as well as their impact, based on the citation normalization, to account for the multi-disciplinary research. The previously discussed Field-Weighted Citation Impact (FWCI) metric is used for this purpose, with values above 1.0, denoting the impact above the global average for Scopus-indexed publications.

International collaboration, in general, improves the research impact of the selected SEE business schools. However, a very high level of collaboration does not automatically translate into research performance, as demonstrated by several business school cases from Bosnia and Herzegovina. The best results are achieved by the public business school at the University of Split, followed by the two major public business schools in the region (Ljubljana and Zagreb).

Table 6. Collaboration patterns and impact for selected SEE business schools (2017-2021)

Entity	Int'l. Collab. (%)	Int'l. Collab. Impact	National Collab. (%)	National Collab. Impact	Institut. Collab. (%)	Institut. Collab. Impact
University of Split	32.5	18.5	18.4	4.3	36.8	5.3
University of Ljubljana	41.5	14.8	13.6	4.5	29.9	9.1
University of Zagreb	35.4	13.5	17.2	3.2	32.8	4.6
University of Novi Sad	34.6	12	25.5	5.2	36	7.1
University of Belgrade	37	11.9	19.8	7.2	30.7	7.7
University of Sarajevo	35	10.5	17.7	1.6	38.7	4.6
University of Maribor	37.9	9.9	20.1	4.4	33.2	3.8
University of Primorska	50.2	9.8	21.5	4.4	18.7	4.4
SS Cyril and Methodius University in Skopje	35.4	9.5	21.5	3.3	36.1	21.6
Josip Juraj Strossmayer University of Osijek	29	8.9	23.7	3.2	33.3	6.1
University of Montenegro	55.9	8.4	5	2.7	25.7	3.1
University of Rijeka	26.1	7.4	53	5.5	2.1	6.2
University of Prishtina "Hasan Prishtina"	46.9	6.8	18.5	2.4	23.1	4.4
University of Mostar	67.9	5.4	10.7	1	17.9	0.6
University of Banja Luka	49.2	3.7	25.4	1.6	17.5	5.4
University of Tuzla	29.6	3	48.2	5.6	18.5	1.2
Dzemal Bijedic University of Mostar	71.4	1.4	14.3	1	0	0

Source: Elsevier SciVal, December 2022

Table 7. Corporate collaboration patterns and impact for selected SEE business schools (2017-2021)

Entity	Academic-Corporate Collaboration (%)	Academic-Corporate Collaboration Impact
University of Ljubljana	1.6	18.7
University of Belgrade	1.2	12.3
University of Zagreb	1.9	5.9
University of Maribor	2.4	4.8
University of Rijeka	0.9	3.5
University of Sarajevo	2.2	2.5

Source: Elsevier SciVal, December 2022

Collaboration with the corporate entities (i.e., co-authors with corporate affiliations) is relatively modest (see Table 7 – only entities with existing corporate collaborations are listed; all others have no corporate collaboration, which could be identified in Scopus). Once again, FWCI assesses impact across the (potentially) multi-disciplinary collaboration. While the business schools achieve the most intensive corporate collaboration at the University of Sarajevo and Maribor, Ljubljana business school seems to have the most effective one.

5. Discussion

In this study, we aimed to provide an overview of the SEE public business schools' research landscape to inform further discussion and research on the potential influence of research productivity and impact on business school performance. Previous research has shown the linkages between the research productivity and impact and different metrics, describing business school performance in other higher education contexts. Some of those metrics were linked

to stakeholder perceptions (Mitra and Golder 2008), while successful stakeholder management proved to be one of the challenges to the Croatian institutions of higher education (Pavičić, Alfirević and Mihanović 2009). In addition, previous research (Sedlan König and Maškarin Ribarić 2019) on knowledge, skills, and attributes of university graduates relevant to employability hints at differing perspectives developed by the academic community and employers in Croatia. This finding also supports the notion of varying stakeholders' perceptions related to regional business school performance. The presented arguments provide a rationale for the theoretical and practical value of the research questions examined in this study.

In addition, bibliometric methods provide a helpful first step in informing the academic and professional communities, policymakers, researchers, and other business school stakeholders (Ellegaard and Wallin 2015). This justifies the choice of bibliometric analysis for an initial overview of the research arena and the consideration of further research directions.

Regarding RQ1, selected public business schools in the SEE region have a mixed record regarding research productivity and impact. The constant growth of the output seems to be a feature of some of the regional business schools, including the major business schools in Zagreb and Belgrade.

SEE business school research impact is assessed based on the analyses of citations and highly cited publications. Leading business schools in the regional capitals, including Ljubljana, Zagreb, and Belgrade, produced the most cited research output. There are several smaller, more peripherally located schools, contending strongly in this context, including schools located at the public universities in Novi Sad (Serbia), Split (Croatia), and Maribor (Slovenia), as related to the total number of citations (more than 2,000). When considering the highly cited publications, contenders to the major regional public business schools can be identified as business schools located at the public universities in Koper (Primorska – Slovenia), Osijek (Croatia), and Novi Sad (Serbia). When considering the publications in journal quartiles, the business school at the University of Montenegro also seems to meet the suggested criterion of the amount of Q1 publications surpassing the number of individual Q2-Q4 publications.

Regarding RQ2, international collaboration is valuable in increasing the research impact, while institutional collaboration seems more effective in raising impact than national one. It is unclear why this proves to be the case in almost all analyzed institutions and should be resolved by future research. The impact of different collaboration types could be singled out as this paper's most crucial empirical contribution, which still needs to be theoretically explained, with an additional analysis of the business school practices and their characteristics.

Some of the analyzed public business schools in the SEE region, such as the ones at the universities of Split (Croatia), Ljubljana (Slovenia), and Zagreb (Croatia), are especially effective in translating international collaboration into impact. However, this is not the case with business schools in Prishtina, Mostar, Banja Luka, and Tuzla, engaging in a significant international collaboration, but with lower effects, in terms of impact. Since the business schools in Split, Ljubljana, and Zagreb have invested heavily in international accreditation, the accreditation-related practices could serve as a variable, moderating or mediating the relationship between the research productivity (i.e., impact) and the overall assessment of business school performance.

Corporate collaboration patterns are relatively modest, with the business schools at the University of Ljubljana (Slovenia) and the University of Belgrade (Serbia) being the most effective. This hints that the corporate relationships, entrepreneurial aspirations of faculty, and the notion of the entrepreneurial university are much less significant as potential moderators or mediators of the observed relationship in the SEE region, as compared to the 'Western' higher education context (Gulbrandsen and Smeby 2005; Lowe and Gonzalez Brambila 2007; Abramo et al. 2012).

Different aspects of understanding the HEIs' research productivity and impact in the broader region, and recognizing the role of different factors, are to be further explored by future empirical research. The course of such research should not emphasize national scientific criteria and policies but instead rely on the criteria of global scientific excellence and the comprehensive impact metrics, as recommended by the Leiden manifesto (Hicks et al. 2015).

Based on the previous arguments, we believe that the practical value of this paper will be especially significant to the deans and management teams of the public regional business schools, who might be looking into strategies to strengthen the organizational research capacity, develop the relevant and valuable policies to support their researchers and enhance the stakeholder relationships.

Since this is one of the first published analyses of research productivity and impact of the SEE public business schools, its results should be treated as preliminary and informative for all actors involved in the region's economics and business higher education. There are significant limitations to the research results, including a more reliable identification of business

school researchers and papers (depending on the development of Scopus affiliation hierarchies), the inclusion of other regional business schools to benchmarking, as well as using the Clarivate Web of Science and InCites products as additional data sources.

6. Concluding remarks

In this paper, we analyzed the research productivity and impact of the SEE public business schools by using Elsevier Scopus and SciVal bibliometric tools. The empirical results open new theoretical questions, which the existing regional literature has not covered yet. At the same time, the practical implications could be significant to those schools' deans and management teams wishing to improve their research productivity and impact. Although the study has been a preliminary analysis based on using a standardized bibliometric reporting tool, it might also emphasize the external stakeholders' viewpoint on the legitimacy of regional public business schools.

Endnotes

1 This manuscript is based on an earlier version, which has been presented and discussed at the ICES 2022 conference at the School of Economics and Business at the University of Sarajevo.

2 See https://charteredabs.org/academic-journal-guide-2021/ (requiring free registration).

3 Authors are expressing gratitude to Elsevier BV and its Research Intelligence division for granting access to SciVal for research and non-commercial purposes.

4 See the tab 'Affiliation hierarchy,' available, e.g., for the University of Split (https://www.scopus.com/affil/profile.uri?afid=60006948) or the University of Zagreb (https://www.scopus.com/affil/profile.uri?afid=60008408). Affiliation details require licensed Scopus access, provided by the Ministry of Science and Education of the Republic of Croatia to the entire Croatian academic community.

5 Stojkoska, B. L. R., and Trivodaliev, K. V. 2017. A review of Internet of Things for smart home: Challenges and solutions. Journal of Cleaner Production 140: 1454-1464.

6 See Appendix I for Tables 2 and 3. The threshold is determined automatically by Elsevier SciVal from the latest available Scopus data.

7 See Appendix II for the list of papers and authors belonging to 1% of the top citation percentiles.

8 Pejic-Bach, M., Bertoncel, T., Meško, M., and Krstić, Ž. 2020. Text mining of industry 4.0 job advertisements. International Journal of Information Management 50: 416-431; Testa, F., Di Iorio, V., Cerri, J., and Pretner, G. 2021. Five shades of plastic in food: Which potentially circular packaging solutions are Italian consumers more sensitive to. Resources, Conservation and Recycling 173: 105726; Juvan, E., and Dolnicar, S. 2021. The excuses tourists use to justify environmentally unfriendly behaviours, Tourism Management, 83: 104253.

9 Zekić-Sušac, M., Mitrović, S., and Has, A. 2021. Machine learning based system for managing energy efficiency of public sector as an approach towards smart cities. International Journal of Information Management, 58: 102074.

10 This entity had two papers in the top 1% journal percentiles in the observed citation window: Pavluković, V., Armenski, T., and Alcántara-Pilar, J. M. 2017. Social impacts of music festivals: Does culture impact locals' attitude toward events in Serbia and Hungary?. Tourism Management 63: 42-53; Vujovic, S., Stanisavljevic, N., Fellner, J., Tosic, N., and Lederer, J. 2020. Biodegradable waste management in Serbia and its implication on P flows. Resources, Conservation and Recycling 161: 104978.

11 Elsevier does not provide a journal evaluation service, such as the Clarivate Journal Citation Rank (JCR) product. Based on Scopus data, journal and national ranks are provided by a Spanish research group, consisting of Consejo Superior de Investigaciones Científicas (CSIC), University of Granada, Extremadura, Carlos III (Madrid) and Alcalá de Henares. It is usually referred to as the SCImago (see: https://www.scimagojr.com/aboutus.php).

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APPENDIX I.

Percentile thresholds for top cited papers (Tables 2 and 3)

	2017	2018	2019	2020	2021
Top 1%	129	111	87	69	35
Top 5%	51	44	36	27	14
Top 10%	32	28	23	17	9
Top 25%	14	13	10	8	4

Source: Elsevier SciVal, December 2022

APPENDIX II.

Papers and authors belonging to the 1% of the top citation percentiles (Economics and business field, 2017-2021)

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DETERMINANTS OF FIRM-LEVEL GROWTH: LESSONS FROM THE CZECH REPUBLIC, HUNGARY, AND POLAND

Mihye Lee

Abstract

This paper examines the determinants of firm-level growth based on three eastern European countries – the Czech Republic, Hungary, and Poland. We investigate whether there exist common firm-level characteristics that play a significant role in determining firm-level performance across the three countries, and whether development in financial markets can facilitate the growth of individual firms, particularly for firms that require external financing (borrowing). Our empirical analysis shows that in the case of Poland, firm-level characteristics, such as firm age and firm size, turn out to be significant, and that the role of these factors on the sales growth of firms is quite consistent with the findings in the existing literature. The same firm-level characteristics do not appear to be significant in the cases of Czechia and Hungary, which suggests that these factors play a different role in the firm-level growth of these countries. However, a firm's access to external financing matters for the determining the firm's growth and its development of financial markets, which enables the firm to have easier access to external sources of financing, thereby especially facilitating the growth of the individual firm that might need external funds. Our findings provide additional empirical evidence on the existing literature that emphasizes the positive impact of financial development on the individual firms' growth based on a cross-country analysis.

Keywords: *Firm-level growth, Dependence on external finance, Financial development*

JEL Classification: *D22, G30, G1*

1. Introduction

Understanding the factors that can explain the growth of individual firms has been considered an important topic in economics, at it is closely related to a country's economic growth and fluctuations (Gabaix 2011; Giovanni et al. 2014; Stella 2015; Anthonisen 2016; Carvalho and Grassi 2019). Given its importance, there have been studies that examine the determinants of firm-level growth or performance regarding Central Eastern European countries. For example, Burger et al. (2017) shows that there exist

Mihye Lee, PhD
Associate Professor
Division of Economics and Information Statistics
Kangwon National University
1 Gangwondaehakgil, Chuncheon-si,
Gangwon-do, 24341
Republic of Korea
mihyelee@kangwon.ac.kr
ORCID: 0000-0002-9023-2360

country-specific factors to explain the performance of firms in central European countries, while Baumöhl et al. (2019) also investigates the performance of firms measured as the firm survival, and examines the role of institutional quality. There are also studies that examine the issue for Central Eastern European countries, such as Peric et al. (2020), which studies the law of proportionate effect for Slovenia, and Srhoj et al. (2018), which documents the characteristics of high-growth firms in Slovenia. Though this literature provides important implications for a country or Central Eastern European countries, it still lacks empirical research on the determinants of firm-level growth for cross-country comparisons in the region. To fill this gap, we seek in this paper to investigate the determinants of firm-level growth based on three countries in Europe – the Czech Republic, Hungary, and Poland – and examine whether there are common factors that can explain the performance of firms in these countries, since cross-country comparisons help identify the common and country-specific factors that play important roles in determining the growth of firms for each country, and help policymakers design proper policies.

To investigate the factors for firm-level growth for countries in Central Eastern Europe, we consider factors that are found to be significant in the existing studies. The existing literature attempted to unveil factors that are closely related to the performance of firms; however, there is no consensus about which factors are responsible for the growth of firms. For example, Variyam and Kraybill (1992) and Distante et al. (2018) find that firm size and age are negatively correlated with firm growth, while Samuels (1965) documents that in contrast, large firms tend to grow faster. This implies that firm size and age might not play the same role across countries or economies, and suggests that the roles of these factors should be reexamined. Along with firm-level characteristics, such as size and age, existing research also finds that financial constraints could play a significant role in determining the performance of firms. Specifically, it suggests that a firm's need to borrow, or how easily a firm can borrow (finance) from financial institutions when necessary, may be important in deciding a firm's performance. For example, Kim and Robert (2010) emphasize the financial factors that matter when predicting firm growth, and show that the relationship between firm growth and firm leverage is positive. Beck et al. (2005) also documents that financial problems are a significant factor affecting the growth rate of firms, and that the effect of financial problems on a firm's growth rates varies, depending on the firm size. Quader (2017) investigates whether access to external financing has a significant effect on the growth of firms, and finds that if financial constraints are alleviated, firms can expand. Based on the literature, we investigate whether a firm's size, age, and financial constraints play significant roles in determining the firm's performance.

For our empirical analysis, we use data from the World Bank, and attempt to examine the determinants of firm-level performance based on three countries in Central and Eastern European countries –The Czech Republic, Hungary, and Poland – for 2009 and 2013.

The empirical analysis based on these three countries suggests that firm-level characteristics turn out to be significant only in Poland, and that the impact of these factors on the performance of firms is consistent with the findings of the existing literature; for example, young and small firms are more likely to grow faster than old and large firms. However, for the other two countries, firm age and size do not appear to significantly affect the firm's sales growth, which implies that firm-level factors may play different roles, depending on the country. The empirical results also show that firms' access to external financing, which is measured as the amount of loans and the history of loans, may be significant factors in the determination of the growth of firms in these three countries.

Our contribution to the existing literature is that we provide additional empirical evidence on the determinant of firm-level growth for Central Eastern European countries. There have been studies on Central Eastern European countries that examine the determinants of firm growth, such as Srhoj et al. (2018) and Zajc and Ponikvar (2011); however, there have not been many studies that compare the determinants of the factors that are responsible for the growth of firms for Central Eastern European countries based on firm-level analysis. In addition, our empirical analysis based on three Central Eastern European countries helps distinguish factors that are common in these countries. Our results suggest that the countries in our sample have common factors that can explain the performance of firms, which are financial constraints, and access to external financing. The findings in this paper imply that a country can promote the growth of firms by ensuring that the firms that need external sources of funding are able to readily borrow from financial markets. Policies that supply credit to banks or financial institutions, which would ultimately result in increased lending to firms, may also have the same impact. Our paper also adds additional empirical evidence to the existing literature that stresses the positive impact of credit supply to firms that are in need of

external financing based on the cross-country analysis, though it lacks some balance sheet information and time periods to analyze.

The rest of this paper is organized as follows: Section 2 reviews the enterprise data used for empirical analysis, while Section 3 presents the empirical methods and estimation results. Section 4 then concludes the paper.

2. Data

We start with a description of the data that we used for the empirical analysis. The firm-level data is from the World Bank's Enterprise Surveys. The survey collects a broad range of information on each firm, such as the characteristics of the top managers and the business environment (crime, corruption, infrastructure, etc.), though it lacks information on the balance sheet data. The survey compares years 2009 and 2013, which years postdate the global financial crisis, and we use the data from both of those survey years.

The question we are interested in is whether firm-specific factors, such as size, investment, or access to external credit, play significant roles in the performance of firms across countries. However, the data does not contain information on the number of creditors, or other information on balance sheet. To overcome the lack of information on the balance sheet, we construct the variables with the availability of the given data. We also define the firm size based on four categories, though firm size is generally measured by asset size or the number of employees, as the Enterprise Surveys do not contain information on either of these. Thereafter, as an alternative, we use information based on sampling size, which classifies firms into four categories based on their numbers of employees. Table 1 shows the number of firms for each firm size category: micro size includes firms with less than 5 employees, small firms have more than 5 employees but less than 19 employees, medium firms are firms that have more than 20 employees but less than 99 employees, and large size firms are firms that have more than 100 employees. This shows that the Czech Republic and Poland generally lacked micro-sized firms compared to Hungary, while Hungary seems to have an even distribution of micro to large firms.

Table 2 summarizes how the firm was originally established based on the question, how was the firm established. Most firms in the sample started as private firms, and we can observe this pattern among countries in the sample. The list of firms regarding their

Table 1. The Number of Firms by Size.

Sampling size	Whole Sample	Czech Republic	Hungary	Poland	Total
Micro (1 to 5)	232	5	194	33	232
Small (5 to 19)	832	230	167	435	832
Medium (20 to 99)	632	156	148	328	632
Large (100+)	406	113	92	201	406
Total	2,102	504	601	997	2,102

Table 2. Classification by Establishment.

Establishment	Whole	Czechia	Hungary	Poland
No answer	2	1	1	0
Refused	2	0	0	2
Privatization of a state-owned firms	233	46	71	116
Originally private from time of start	1,748	434	486	828
Private subsidiary of a formerly state-owned firm	39	7	8	24
Joint venture with foreign partner(s)	41	10	24	7
State-owned firm	17	1	7	9
Other Spontaneous	20	5	4	11

establishment suggests that we can classify firms into government/state-owned firms, based on their establishment. It seems to be obvious to consider firms that are established as state-owned firms as government/state-owned firms. In addition, government/state-owned firms can also be defined that are established through the privatization of a state-owned firm, and the private subsidiary of a formerly state-owned firm.

While we can identify firms as government/state-owned firms, it helps researchers to distinguish foreign firms/subsidiaries that might be crucial in determining the performance of firms. We use the information that shows the share of private foreign individuals, and define firms as foreign owned if their shares exceed 50%. Given the definition, out of the 2,102 firms, 209 firms turn out to be foreign-owned.

Next, we examine firms' access to external financing using their answers on the value of credit, mainly the internal funds. We use the answers on the value of the most recent lines of credit/loan at the time of approval as a measure of the amount of loans that have been borrowed by a firm. Additionally, we use the information on the shares of internal funds/retained earnings out of fixed assets, and define the variable that then reflects a firm's need for external borrowing. Our conjecture is that firms are less likely to borrow money from financial institutions, as the share of internal funds within the share of fixed assets rises, rather than firms for which the share of internal funds relative to fixed assets is low. As an alternative measure, we also use the answers from the question: a line of credit, or a loan from a financial institution. A firm might answer this question based on their credit history with financial institutions, or it might reject answering this question overall. We define a firm has (had) access to external financing if the answer to the question is "Yes," otherwise we consider that the firm has (had) no access to external borrowing. This approach helps overcome the lack of information on the general balance sheet, and enables the role of credit supplied to a firm to be examined in the determination of its performance across different measures of access to external financing.

Table 4 shows the summary statistics for firm age, the sales growth of a firm, external fund share, history of loan, and the number of loans for each country. We limit our attention to firms where sales growth is less than 300%, to exclude outliers in the data.[1]

The basic statistics on firm size, age, sales growth, and the ownership structure of firms suggest that these three countries do not exhibit significant heterogeneity (or differences). Given the data described in this section, the next section present how we analyze the performance of firms in these countries, and shows some findings based on empirical analysis.

Table 3. Definition of Variables.

Category	Variable	Definition
Dependent variable	Sales growth	$Sales\ growth_{i,t-1} = \frac{Sales_{i,t-1} - Sales_{i,t-3}}{Sales_{i,t-3}}/2$
Independent variable	Government owned firm	A dummy variable for firms that are government or state-owned firms.
	Foreign firm	A dummy variable for firms where the share of private foreign individuals is more than 50%.
	Firm age	The difference between the current year and the year of operation.
	Development in financial market	i) The difference of domestic credit to the private sector between 2007 and 2004. ii) The difference of domestic credit to the private sector between 2011 and 2008.

3. Empirical Results

In this section, we explore the determinants of firm performance given the data described in the previous section. As far as is possible, over the course of the analysis we analyze the firm performance in consistent manner to the existing literature, including variables, such as firm age and size. The purpose of the empirical analysis is to unveil factors that are closely related to the performance of firms. We consider the firms' access to credit as one of the factors that can explain the outcome of firms, as well as firm-level characteristics once controlling other firm-level variables, such as age and firm size, given the availability of the data.

Our main hypothesis is that firms in these countries would grow faster when they have enough cash flows or internal funds to finance investment, than when they finance investment through external sources, such as through private banks, non-banks. We first need to define the variable that can measure the performance of firms in the data to accurately evaluate a firm's performance. We use the average sales growth rate between years t−1 and t−3 based on the survey question, which documents the total annual sales from the last fiscal year, and the total annual sales from 3 years ago, and we calculate the annual sales growth through the following equation:

$$Sales\ growth_{i,t-1} = \frac{Sales_{i,t-1} - Sales_{i,t-3}}{Sales_{i,t-3}}/2 \quad (1)$$

where $Sales\ growth_{i,t-1}$ is the annual sales growth of a firm's measures of performance. We exclude firms with more than 300 percent annual sales growth to control for outliers. As a base-line empirical analysis, we investigate factors that might play significant roles in determining a firm's sales growth. We consider firm-specific factors, such as ownership structure, firm size, and age (Mertzanis, 2017), along with its access to external financing. For ownership, we use the shares of private domestic individuals, a private dummy for foreign individuals, and the shares owned by the government or state. The firm age is calculated based on the information on the establishment date of the firm. The database provides information on firm size based on their sorting into four categories, which consist of micro, small, medium. and large firms, based on the number of employees a firm has. Lastly, we need to define a firm's access to external financing. We use the information on the value of the most recent line of credit or existing loan at the time of approval. This

Table 4. Summary Statistics

Czechia					
Variable	Obs	Mean	Std. Dev.	Min	Max
Firm Age	441	16.1179	8.6621	0	86
Sales Growth	458	21.2905	90.4164	−125	850
External Fund Shares	285	36.7684	38.6162	0	100
History of Loans	458	0.5044	0.5005	0	1
Number of Loans	458	5.3766	7.3898	0	22.8923
Hungary					
Variable	Obs	Mean	Std. Dev.	Min	Max
Firm Age	518	15.5309	7.9914	1	68
Sales Growth	525	14.582	62.2908	−50	642.494
External Fund Shares	207	31.3478	39.3157	0	100
History of Loans	525	0.4248	0.4948	0	1
Number of Loans	525	5.4061	8.0629	0	24.2786
Poland					
Variable	Obs	Mean	Std. Dev.	Min	Max
Firm Age	855	19.8947	14.7116	1	162
Sales Growth	875	16.084	81.5318	−50.045	825
External Fund Shares	347	34.5965	37.3717	0	100
History of Loans	875	0.3749	0.4844	0	1
Number of Loans	875	2.3255	4.9318	0	19.1138

provides essential information on the level of loans or credit a firm has recently obtained. Based on the constructed data, we estimate the following regression equation:

$$Sales\ growth_{i,t-1} = Constant + \alpha Age_{i,t-1} + \sum_{i=1}^{3} \beta_i\ Size_{i,t-1} + \sum_{i=1}^{2} \gamma_i\ Share_{i,t} + \sigma Loan_{i,t-1} + \epsilon \quad (2)$$

where, $Sales\ growth_{i,t-1}$ is the sales growth of a firm from the last year, which is calculated based on Eq. (1). $Age_{i,t-1}$ is the firm age, $Size_{i,t-1}$ is the dummy variable for each firm size category, and $Share_{i,t-1}$ is the dummy variable for foreign-owned and government-owned firms, respectively. Lastly, $Loan_{i,t-1}$ denotes the financial condition of a firm as measured by the number of loans it has obtained from financial institutions, whether it has (had) borrowed from bank and other financial institutions, and the share of external funds, which is defined based on the share of internal funds within the fixed assets of a firm.

We begin the empirical analysis by investigating the relationship between the growth rate of a firm as measured by sales growth, and its access to external financing as shown by Eq. (2) for each country, and compare the results to see whether the firm-level characteristics play different roles across countries, and whether there are country-specific factors that are crucial in determining the growth of individual firms. We discuss empirical results based on firm-level characteristics, such as the firm's age, size, and ownership structure, and compare the results across countries.

Table 5 shows the baseline results. Particularly noteworthy is the fact that a firm's age and size have different implication on sales growth for the three countries in the analysis. For example, young firms in Poland are likely to grow faster similar to the existing literature (Navaretti et al. 2014), as the coefficient on firm age appears to be negative and statistically significant (see columns (5) and (6)), implying that as firms age, the sales growth of firms would decline. However, for the other two countries, it is hard to find significant relationship between a firm's growth and its age, as the coefficients on firm age turn out to be statistically insignificant from columns (1) to (4); this fact suggests that firm age could have asymmetric effects on growth. For firm size, we can also observe different patterns across countries. It is well documented in the literature that small and young firms grow faster than other firms (Lee 2009; Bentzen et al. 2012); however, our empirical analysis presents a different relationship between firm size and its performance during the sample period. It is hard to find a significant relationship between firm size and its sales growth in Czechia, as shown in the values from columns (1) and (2), as the coefficients of the size dummy variables are statistically insignificant, and do not exhibit consistent patterns. If large firms tended to grow slower, the coefficients on the firm size dummy variables would decrease; but the coefficients on firm size dummy variables do not present this pattern, nor are they statistically significant. In contrast to these two countries, in Poland, firm size is a significant determinant of sales growth. We now examine whether ownership matters in the determination of the performance of firms. In Czechia and Poland, the ownership structure that is the share of domestic, foreign individuals, and government appears to be insignificant to determine the growth of a firm. Different from these countries, in Hungary, government-owned firms show lower growth performance, compared to private firms. Similar to firm size and age, the data does not exhibit a consistent relationship between the sales growth of firms and the ownership structure. The role of firm-level characteristics on the sales growth of firms in the baseline results holds even with different empirical specifications, as shown in Tables 6 and 7. The baseline empirical results suggest that firm-level characteristics, such as a firm's age, size, and ownership structure, may have different implications on the growth of the firm, though the results should be further investigated with more detailed firm-level data.

We now examine the role of access to external financing on the growth of firms. We first use the number of loans as a measure of access to external financing, meaning that the larger number of loans that a firm can obtain represents greater access to banks and other financial institutions. What seems to be interesting when comparing other firm-level characteristics is that across all three countries, the access to external financing appears to be significant. The coefficients on $Loan_{i,t-1}$ are positive, and they are also significant in the first, third, and fifth column; this means that firms with large numbers of loans are more likely to grow faster than firms without such a large number. We reaffirm this finding using a different measure of firm's access to external financing, as the number of loans a firm has obtained might not be a perfect measure for a firm's access to external financing, as for example, a firm can borrow/obtain funds that are not in the form of a loan. To reflect the issue, we use the information on the history of loans (k8) to construct an alternative measure. The survey asks a question on whether a firm has obtained a line of credit or a loan from a financial institution, and we classify firms who answered, "Yes," into a group that has a history of loans; otherwise,

Table 5. Determinants of Firm Growth: Baseline Empirical Results

	Czechia Republic		Hungary		Poland	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Age	−0.0029 (0.0049)	−0.0043 (0.0049)	−0.0023 (0.0060)	−0.0039 (0.0060)	−0.0120*** (0.0044)	−0.0117*** (0.0044)
Dummy for Small	−25.4402 (20.2103)	−26.2697 (20.3042)	4.9902 (3.7482)	5.3725 (3.7665)	−18.2066** (7.6818)	−19.3850** (7.6737)
Dummy for Medium	−23.7737 (20.3083)	−24.9447 (20.4186)	10.1507*** (3.9000)	10.5889*** (3.9099)	−20.9802*** (7.7819)	−22.2667*** (7.7797)
Dummy for Large	−30.6298 (20.4571)	−31.4685 (20.5784)	9.4269* (4.8679)	10.9311** (4.8189)	−22.3806*** (8.1608)	−24.3870*** (8.1680)
Dummy for Foreign	6.046 (6.0784)	5.6001 (6.1019)	−2.1171 (4.6617)	−2.4726 (4.6771)	3.6287 (5.7457)	3.7763 (5.7444)
Dummy for Government	−0.1654 (6.3953)	0.9245 (6.4071)	−8.6021** (4.1198)	−7.8207* (4.1154)	3.6157 (4.0981)	3.2757 (4.0965)
log(Amount of Loan)	0.7368*** (0.2699)		0.4476** (0.1789)		1.1387*** (0.2719)	
History of Loan		7.6751* (3.9622)		4.7381* (2.8720)		11.8918*** (2.8019)
R^2	0.0517	0.0432	0.0688	0.062	0.0819	0.0824
N	446	446	518	518	860	860

Note: The numbers in the parentheses are standard errors.
***, **, and * indicate significance at the (1, 5, and 10) % levels, respectively.

firms are classified into the group of firms without a history of loans. The history of loans is defined as a dummy variable, which has the value 1 if a firm has a credit history, but is otherwise assigned value 0. Based on the results in columns (1), (3), and (5), the coefficients on the history of loans would be positive if the access to external credit contributes to the growth of firms; otherwise, it would turn out to be a negative value. The access to external financing might contribute to an increase in the sales growth of a firm, as the coefficients on the amount of loans and the history of loans appear to be significant and positive across all sample countries, as shown in columns (2), (4) and (6). The results imply that firms would experience rapid growth, as firms are better able to borrow money from banks and other financial institutions. The results suggest that firms can benefit from an increase in the number of loans they can borrow from banks and other financial institutions. Based on the findings in Table 5, we now investigate the effect of development in financial resources devoted to private sector firms' growth.

We now consider the development in financial markets as measured by the ratio of domestic credit to the private sector relative to GDP, which is taken from World Bank development indicators. This attempts to consider whether the development of the domestic credit market or changes in the credit supply within a country might contribute to firms' growth. Specifically, we investigate whether any increase in private credit might exert a positive effect on firms that borrow money from banks. As the performance of a firm is measured by the average sales growth of the past 3 years, we define the development in financial markets as the difference between the ratio private credit to GDP at times $t-1$ and $t-3$. The survey is based on data from 2009 and 2013, thus the development in financial markets for each country for each survey year can be defined as follow:

$$FD_{i,2009} = Private\ Credit\ to\ GDP_{i,2008} - Private\ Credit\ to\ GDP_{i,2005}$$

$$FD_{i,2013} = Private\ Credit\ to\ GDP_{i,2012} - Private\ Credit\ to\ GDP_{i,2009}$$

where, $FD_{i,t}$ is the development in financial markets for a country i in year t, and $Private\ Credit\ to\ GDP_{i,t}$ is the ratio of private credit to GDP. Given the definition of the financial development indicator, we now define new variables, which are (i) the interaction term between the amount of loans and the financial development indicator, and (ii) the interaction term between the history of loans and the financial development indicator. The estimation equation now becomes the following:

$$Sales\ growth_{i,t-1} = Constant + \alpha Age_{i,t-1} + \sum_{i=1}^{3} \beta_i\, Size_{i,t-1} + \sum_{i=1}^{2} \gamma_i\, Share_{i,t} + \sigma Loan_{i,t-1} + \eta Loan_{i,t-1} \times FD_{i,t-1} + \epsilon_{i,t-1} \quad (3)$$

The coefficient on the interaction term $Loan_{i,t-1}$ x $FD_{i,t-1}$ would be positive if the increase in credit supply helps firms perform better than the firms that do not obtain loans from financial institutions.

Table 6 shows the results based on Eq. (3). The number of loans that a firm obtained from banks has different impact on the sales growth of firms in Czechia; however, this negative effect is mitigated by the overall credit supply of a country. Similar to the number of loans, the coefficient on the history of loans becomes negative, though insignificant compared to the previous results. Nevertheless, the interaction term between the history of loans and financial development turns out to be significantly positive, as shown in the second column. The results can also be interpreted as any development in the private credit supply benefits firms that reply on external borrowing, as the coefficients on $Loan_{i,t-1}$ x $FD_{i,t-1}$ and $History\ of\ Loan_{i,t-1}$ x $FD_{i,t-1}$ are positive. For Hungary and Poland, the results are consistent with the previous empirical results in Table 5. The amount of loans and the history of loans seem to have a positive impact on the sales growth of firms in both countries, regardless of empirical specification, as the coefficients on both variables appear to be positive and statistically significant. Similar to Czechia, financial development also helps firms that are dependent on external sources of financing. The results suggest that the increase in credit supply would have a positive impact on the sales growth of firms, regardless of countries where firms operate, given the sample country and period at least.

The empirical results presented in Tables 5 and 6 support our hypothesis that financial development may promote the growth of firms, as it enables firms to easily access external funds to finance investment for its operation. The firm-level characteristics, including the firm's age, size, and ownership structure, exhibit heterogeneous patterns across countries; for example, small firms do not necessarily grow faster, except for Poland. Yet, the findings show that increases in the credit supply help firms grow faster, especially firms that are dependent on external sources of financing. Up until now, the empirical analysis uses the number of loans and the history of loans as a measure of a firm's access to external financing. This approach enables firms to be differentiated by whether they borrow funds from banks, or from financial institutions. However, it does not exactly reveal how much firms are dependent on external sources of financing. For example, the history of loans is denoted as 1, regardless of how much money firms borrow from banks or financial institutions. We construct the measure of how much they are dependent on external financing based on the question that asks firms how they financed their fixed assets to resolve issues. The data provides information on the share of internal funds or retained earnings to purchase fixed assets, and we define the external fund shares, which represent how much firms borrow to purchase fixed assets, as 100 percent, minus the percent of internal funds or retained earnings to buy fixed assets. As the share is higher, this indicates that firms are more likely to rely on external funds, rather than internal funds, and that an increase in credit supply in the market might benefit those firms.

We now use new measures of access to external financing, rather than the number of loans or the history of loans as a final robustness check. We estimate Eq. (3) based on the external fund share instead of the number of loans, and Table 7 presents the results. The coefficients on external fund shares should be positive if it helps firms grow faster, and the interaction term between external fund shares and the financial development indicator, which is $External\ Fund\ Share_{i,t-1}$ x $FD_{i,t-1}$, would be positive once firms that reply on external funds to finance their fixed assets benefit from any increase in credit supply or development in financial markets in the country.

When it comes to interpreting the results in Table 7, it is somehow puzzling that the coefficients on the external fund shares are neither significant, nor do they have a consistent sign that is different from previous results. One way to reconcile the results in Table 7 with the results in Tables 5 and 6 is to recall the definitions that are used for the estimation. Different from the previous estimation, Table 7 uses the external fund share as a dependent variable that leads to different results. Previously, the results suggest that a firm can have higher growth as it has (had) access to

external financing, or as it could borrow more money from financial institutions. In contrast, the results in Table 7 denote that a firm with higher borrowing or fewer internal sources of funding might grow more slowly, though this might not hold across all specifications. It is worth noting that the negative effect of higher external fund shares on a firm's growth can be mitigated, as a firm can access loans as shown in columns (1), (3) and (5), though the coefficients on *External Fund Share* x *History of Loan* are not statistically significant in Hungary. The results also suggest that firms in need of external sources of financing can also grow more quickly with the development of financial markets in a country. Firms that lack internal funds can benefit from an increase in credit supply in the private sector, as the coefficients on the interaction term appear to be significantly positive in columns (2), (4), and (6). This bolsters our earlier empirical evidence that shows that a credit supply helps firms that depend on external financing to grow faster.

Similar to the previous empirical results, Table 7 shows that firm-level characteristics somehow play a different role, depending on where the firm is located. For example, in Poland, young and small firms would grow more quickly than old and large firms, which is consistent with the findings in the existing literature. However, in both Czechia and Hungary, it is quite hard to find empirical evidence that shows that firm age and size play significant roles. The empirical results in Tables 6 and 7 might imply that medium-sized or medium-sized and large firms might grow faster in Hungary, which differs from Poland. Of course, these results should also be investigated using more detailed firm-level data.

The empirical analysis in this section shows the significant factors that are related to the performance of firms based on three Eastern European countries. First, for Czechia and Hungary, firm-level factors, such as age and size, do not appear to be significant factors in determining the performance of firms in both

Table 6. Determinants of Firm Growth: The Effect of Increases in Credit Supply

	Czech Republic		Hungary		Poland	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Age	−0.0029 (0.0049)	−0.0042 (0.0049)	−0.0022 (0.0060)	−0.003 (0.0060)	−0.0119*** (0.0044)	−0.0115*** (0.0044)
Dummy for Small	−22.158 (19.9725)	−24.253 (20.1283)	4.0909 (3.7537)	4.0428 (3.8139)	−16.1208** (7.6824)	−17.9894** (7.6972)
Dummy for Medium	−21.9049 (20.0537)	−24.477 (20.2306)	8.5286** (3.9497)	8.8916** (3.9901)	−19.3760** (7.7678)	−21.2304*** (7.7868)
Dummy for Large	−30.1828 (20.1936)	−31.8228 (20.3887)	5.6739 (5.1254)	7.0927 (5.1766)	−20.9079** (8.1412)	−23.3654*** (8.1731)
Dummy for Foreign	5.4898 (6.0021)	4.7038 (6.0532)	−1.2613 (4.6576)	−1.5188 (4.6874)	3.6748 (5.7205)	3.981 (5.7365)
Dummy for Government	0.2199 (6.3138)	1.8294 (6.3553)	−8.4265** (4.1033)	−7.9458* (4.1033)	3.5321 (4.0802)	3.1883 (4.0904)
log(Amount of Loan)	−0.9448* (0.5580)		0.0401 (0.2539)		0.2511 (0.4104)	
log(Amount of Loan) X FD	0.1906*** (0.0556)		0.0488** (0.0217)		0.3517*** (0.1223)	
History of Loan		−11.4127 (7.5808)		0.4249 (3.5905)		7.0938* (3.7761)
History of Loan X FD		2.1552*** (0.7323)		0.6282** (0.3155)		2.0697* (1.0940)
R^2	0.0783	0.0631	0.0785	0.0697	0.091	0.0864
N	446	446	518	518	860	860

Note: The numbers in the parentheses are standard errors.
***, **, and * indicate significance at the (1, 5, and 10) % levels, respectively.

Table 7. Robustness Check: Determinants of Firm Growth

	Czech Republic		Hungary		Poland	
	(1)	(2)	(3)	(4)	(5)	(6)
Firm Age	−0.0042 (0.0049)	−0.0024 (0.0049)	−0.0039 (0.0060)	−0.0039 (0.0060)	−0.0130*** (0.0045)	−0.0130*** (0.0045)
Dummy for Small	−23.851 (20.3186)	−22.8729 (20.0979)	6.7418* (3.7525)	6.6796* (3.7481)	−19.2261** (7.7426)	−17.8250** (7.7701)
Dummy for Medium	−22.3545 (20.4099)	−22.6231 (20.1848)	11.6730*** (3.9185)	11.2586*** (3.9303)	−21.5097*** (7.8500)	−20.6183*** (7.8621)
Dummy for Large	−29.0369 (20.5401)	−28.324 (20.3255)	12.5549*** (4.8446)	11.1546** (4.9915)	−23.4661*** (8.2590)	−22.1030*** (8.2799)
Dummy for Foreign	5.5619 (6.0969)	4.39 (6.0299)	−3.0245 (4.6787)	−2.4908 (4.6956)	3.7664 (5.8048)	2.8792 (5.7947)
Dummy for Government	0.2046 (6.4371)	−0.2135 (6.3709)	−6.9877* (4.1808)	−7.0550* (4.1234)	3.1111 (4.1368)	3.6654 (4.1313)
External Fund Share	−0.049 (0.0825)	−0.2719** (0.1102)	−0.0724 (0.0917)	−0.0910* (0.0540)	−0.0183 (0.0555)	−0.0145 (0.0498)
External Fund Share X History of Loan	0.1657* (0.0923)		0.0237 (0.0994)		0.1165* (0.0683)	
External Fund Share X FD		0.0384*** (0.0111)		0.006 (0.0053)		0.0353** (0.0170)
R^2	0.0459	0.0659	0.0598	0.0623	0.0672	0.0688
N	446	446	518	518	860	860

Note: The numbers in the parentheses are standard errors.
***, **, and * indicate significance at the (1, 5, and 10) % levels, respectively.

countries, which differs from Poland. In addition to these firm-level characteristics, the analysis also shows that firms' access to external financing matters in determining these firms' growth. Granting loans to firms or access to external funds through financial institutions helps firms grow faster, and increases the development in domestic financial markets, which increases the accessibility of funds for firms, thereby contributing to the sales growth of firms. Access to external financing and previous experience on access to external financing through financial institutions play significant roles, which suggests that the availability of borrowing funds from financial institutions might help firms grow more quickly in these three countries, though other firm-level factors do not have the same impact on the growth of firms. In addition, it also shows that the high share of external financing might prevent firms from performing better than firms that have enough retained earnings. The negative impact on high external fund shares on the performance of firms can be mitigated through the development of domestic financial markets. This re-affirms the previous findings, which show that firms borrowing from banks or financial institutions benefit from an overall increase in the credit supply; it also implies that any development in financial markets that allows firms to easily access credit would promote firms that are dependent on external financing. In contrast, the contraction of credit might not have an equal impact on all firms, and result in a disproportionately negative impact on firms that are highly dependent on external financing.

4. Conclusion

Understanding the factors that lead to the growth of individual firms is important for the economic growth and stabilization of the economy, or in other words, the fluctuations of the economy. The existing literature examined the issue based on firm-level data for each country, rather than investigating it for various countries. Given the findings in the existing literature, we tried to analyze the determinants of the

performance of firms across three different Central Eastern European countries, of the Czech Republic, Hungary and Poland, and provide empirical evidence that can provide a cross-country comparison. For this, we use the World Bank's Enterprise Surveys for 2009 and 2013, given the availability of the data.

Our empirical analysis suggests that factors that can account for the performance of firms differ across countries, and the access to external sources of financing may be a crucial determinant of firm growth for Czechia, Hungary, and Poland during the sample period. However, the study does not have enough time periods and detailed information on balance sheets, compared to the data used within the existing literature.

The empirical analysis can be summarized as follows: first, there are cross-country differences that account for the performance of firms. For example, young and small firms grow faster than old and large firms, and only in Poland do the same firm-level characteristics (firm age and size) fail to play a significant role in determining the performance of firms, as they do in Czechia and Hungary. Second, the access to external financing, as measured by the number of loans that firms borrow from banks or the history of loans, matters across all three countries during the given sample period. This also shows that any development in financial markets or an increase in overall accessible credit for firms can contribute to the growth of firms. These results imply that firms that are dependent on external financing can benefit from an increase in credit supply, at least for these three countries.

The empirical results hold important implications for policymakers and their future planned efforts to promote growth and stabilize the economy. The empirical analysis suggests that an increase in credit supply might promote growth by allowing firms that are dependent on external financing to have greater access to necessary funds. In addition, it encourages the setting up of a series of emergency facilities that will help firms with a lack of internal funds borrow from banks or financial institutions.

Our study results provide additional empirical evidence to the existing literature that confirms the effect of finance on firms' growth; however, these empirical results should be re-examined, as the empirical analysis lacks detailed information on balance sheet data, and only examines data over a short time period. In addition, future research should also examine whether injection of credit to firms promotes growth during both periods of tranquility and crisis.

Endnotes

1 Less than approximately 10 % of firms are not included in the empirical analysis

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COVID-19 AND GLOBAL VALUE CHAINS PARTICIPATION: EXPORT PERFORMANCE OF CROATIAN FIRMS

Nevenka Čučković, Valentina Vučković

Abstract

For the last two-three years, the disruptions of the GVC caused by the COVID-19 pandemic have forced the business sector to restructure and adjust, sometimes very costly and painful. Moreover, with the recent war in Ukraine foreseeable negative implications, it is very certain that large-scale disruptions in the global economic trade and investment flows, and ultimately in the GVC, will dictate the survival and sustainability of business in many economic sectors in the years to come. The main goal of this paper is twofold. First, to review the existing research on the effects of the COVID-19 pandemic on global trends affecting the current reconfiguring and reshaping of the GVC. Second, to analyse the characteristics of Croatian firms that recorded a decrease in their (indirect and direct) exports in the COVID-19 period by performing a logit model and utilising the World Bank's Enterprise Survey 2019, backed up by the Enterprise Surveys Follow-Up on COVID-19 (3 rounds up to now).

Keywords: *COVID-19, global value chains, New EU Member States, Croatia, exports*

JEL Classification: *F14, F23, F60, F61*

1. Introduction

Although participation in Global Value Chains (GVC) has been slowing since the global financial crisis, especially after 2011, the most notable decrease in GVC participation happened since the start of the COVID-19 global pandemic in 2020. The recent devastating war in Ukraine only heavily underlined this trend of de-globalisation, which the *Economist* fitfully coined as general "slowbalisation", i.e. reduction in the scale of the overall globalisation process.

The significant global negative implications of the conflict in Ukraine are already causing large-scale disruptions in global economic trade and investment flows. As the GVC, by its nature, is strongly transmitting these exogenous disruptions, the immediate natural reactions of both businesses and governments are reducing exposure to such kinds of international shocks and reconfiguring their participation in GVC

Nevenka Čučković, PhD
Senior Research Adviser
Institute for Development and International Relations (IRMO)
Zagreb, Croatia
E-mail: nena@irmo.hr
ORCID: 0000-0002-0028-2015

Valentina Vučković, PhD (corresponding author)
Associate Professor
Faculty of Economics and Business
University of Zagreb
Trg J. F. Kennedy 6
10000 Zagreb, Croatia
E-mail: vvuckovic@net.efzg.hr
ORCID: 0000-0002-5438-0665

more towards regional and local levels (known as nearshoring or re-shoring). In his recent paper, Zhan (2021) argues that one of the essential driving forces behind recent GVC reconfiguring is "resilience-oriented restructuring" to ensure development sustainability, which has been especially underlined in the context of the new geopolitical situation.

The analyses in this paper are concerned with two main research questions:

RQ1: What are the main effects of the COVID-19 pandemic on GVC and global trends affecting the current reconfiguring and reshaping of the GVC?

RQ2: What are the effects of COVID-19 on firm-level export performance and their participation in GVC?

The paper aims to contribute to the current discussions by exploring the case of Croatia as a late-comer member state of the EU. Although the entire EU was hit hard by the COVID-19 pandemic regarding trade and production (Kolev and Obst 2022), there are noticeable differences between the individual Member States. Also, while most GVC analyses and published work focus on aggregate macroeconomic impacts, our attention in this paper is directed towards the level of the enterprise sector where the GVC disruptions have had immediate results and required adequate realigning to the new situation. The novelty of our analysis is that when examining the effects of Covid-19 on the Croatian business sector, we rely on three rounds of the World Bank Enterprise Surveys Follow-Up on COVID-19, combined with the baseline World Bank's Enterprise Survey 2019. These data have assisted us in surmounting the lack of systemic data on the impact of COVID -19 and provided an excellent analytical window into the immediate changes triggered by the pandemic at the firm level. In addition, the novelty of this research is reflected in the grouping of the firms by various definitions of GVC participation that are available in the literature. Precisely, as a GVC firm, we consider the firm that is a two-way trader (joint importer-exporter), in addition to the broader definition of being only exporters.

The paper is structured as follows. In Section 2, following the Introduction, we explore the existing literature, which covers especially GVC during COVID-19 but also touches briefly upon the trends formed since the financial crisis in which notable shifts in GVC have appeared. In Section 3, we analyse the effect of COVID-19 on Croatian firms export performance, primarily focusing on the GVC participation, utilising the three rounds of Enterprise Surveys Follow-Up on COVID-19 and Enterprise Survey 2019 as our baseline. We conducted the logistic regression model that estimates for which firms the probability of a decrease in exports (both direct and indirect) is larger, using the data from all three rounds of ES Follow-Up Surveys and information from the baseline ES2019 survey. We put particular focus on two GVC groups of firms which are, according to the available research, primarily defined as two-way traders (both importers and exporters), backed up by the broader definition of being exporters. In the final, Section 4, we draw some concluding remarks and implications for policy and identify further research avenues worth exploring, especially related to Croatian enterprise sector participation in GVC.

2. GVC during the COVID-19: Some insights from related literature

The COVID-19 pandemic is an unprecedented challenge for countries globally, affecting all aspects of life. One of these aspects includes the disruptions within the globally fragmented production processes and global value chains (GVCs). It is estimated that most international trade today encompasses flows associated with GVCs, which are characterised by the shifts of intermediate goods, services and technology (Zavarská 2022). For example, OECD (2020) estimates that about 70% of world trade is happening via participation in the GVC. However, the downside of rising vertical integration of production processes via GVC is an intensive dependency and interconnectedness on intermediate products and, consequently, the international transmission of global shocks. This became particularly evident in the aftermath of the global financial crisis, especially after 2011. Yet, the most significant blow to the GVC flows came in 2020 with the outbreak of the worldwide COVID-19 pandemic. Furthermore, the February 2022 Russian invasion of Ukraine only aggravated the problem of exogenous shocks on disruptions in international trade and investments and exposed it to its full scale. All these developments have significantly changed global trade flows and resulted in a contraction of its volume and value. WEF (2021: 5) states that GVCs are currently "in a perfect storm at the nexus of emerging technologies, the environmental sustainability imperative and geopolitical tensions". Hence, the new term often used in recent academic and expert analyses is "poly-crises" when exploring an impact on trade flows and GVC (Evenett 2022).

The existing literature dealing with the effects of the pandemic on GVC can in general be split into two

streams - the one dealing with the aggregate data sources and country-level data (such as OECD TiVA) and the one utilising survey data at firm-level (such as World Bank Enterprise Survey Data).

Kersan-Škabić (2022a), in her thorough and systematic literature review of the effects of COVID-19 on GVC disruptions, considers that the pandemic only accelerated and amplified the processes and trends that already existed. Its main contribution was raising global awareness of their presence to a new level. According to the author, the COVID-19 pandemic heightened threats and vulnerability to intensively internationalised segments of production of medical equipment and medication because of shortages caused by high global demand, but also due to breaking of supply changes. In such conditions, global value chains began to be very vulnerable and countries started to re-introduce local production of crucial products (such as masks, hand disinfection gels etc.) and re-impose export restrictions. In examining the rationale for imposing the export restrictions, Kersan-Škabić (2022a) refers to the work of Pauwelyn (2020), who singled out that at the beginning of the COVID-19 pandemic; as many as 75 countries have banned or restricted exports of medical supplies and medicines. As a result, the pandemic was perceived as an extraordinarily health-threatening situation and many nations restricted or suspended some GATT rules of liberalised trade. In the EU, for those specific reasons, individual member countries were also allowed to introduce export limitations despite the EU rules of common trade policy (Kersan-Škabić 2022a).

According to Brenton et al. (2022), who analysed the World Bank data, during the COVID-19 crisis, the volume of global trade in goods and services decreased by 8.3%, primarily due to the extensive COVID-19 lockdowns and border closures. Precisely, the value of goods trade dropped by 8 % while the value of services trade dropped by 21% in 2020, within which travel services were affected the most. In addition, transport services declined even faster due to the severe impact on passenger transport. However, the category of other services proved to be more resilient than transport and travel services which is consistent with the belief that some of these additional services (such as information technology services and e-commerce) were able to function in an online environment (Brenton et al. 2022).

Since a trade statistic based on gross trade flows does not say much about the international input-output linkages, input-output tables were developed to more accurately measure GVCs (Koopman et al. 2010; Ayadi et al. 2022). The sufficient condition for considering trade as GVC is that it crosses at least two borders. This can be seen as the sum of two measures of cross-border linkages, i.e. backward GVC participation and forward GVC participation (Borin, Mancini, and Taglioni 2021). It is often pointed out that in this way an overvaluation problem in gross exports are addressed (Waldkirch 2021). The most widely used measure, as stated by Fernandes et al. (2021), is backward GVC participation which captures the import content of exports, i.e. how much imported materials are used in countries. On the other side, a country's forward GVC participation measures the domestic value added in exports used by the country's bilateral partner countries for export production as per cent of the country's total gross exports. In other words, it captures a share of domestic value added that is not directly consumed by the bilateral partner (Koopman 2014; Fernandes et al. 2021).

By employing backward and forward linkages, Wuri, Widodo, and Hardi (2022) analysed the COVID-19 pandemic effect on GVC participation in different institutional quality countries and estimated the system GMM model using the Asian Development Bank Multi-Regional Input-Output data for the period from 2010 to 2020. Their results showed that the COVID-19 pandemic significantly decreased GVC participation, with forward participation being larger than backward GVC in most countries. Regarding the difference between regions, the results showed that North American countries had the highest average GVC participation from the forward linkage perspective. In contrast, EU countries have the highest backward linkage values.

Ayadi et al. (2021) analysed the COVID-19 pandemic effects on countries through their regional integration and exposure to GVCs using input–output tables from the EORA dataset. Their results showed, contrary to the previously described paper, that most countries have relatively more extensive backward GVC linkages than forward ones. Also, at the level of specific countries, the authors highlight that Italy and France produce more value-added that is absorbed abroad than the foreign value-added they consume.

Further, Espitia et al. (2022) estimated difference-in-difference models that interact with COVID-19 shocks with sector characteristics in a sample of 28 exporting countries from February to June 2020. Their results show that the adverse trade effects induced by COVID-19 shock greatly varied between different sectors. More precisely, in the trade sector, the results showed that participation in GVCs increased the vulnerability of traders to shocks suffered by trading partners. Still, it also reduced their exposure to domestic shocks.

However, as shown within the latest Global Economic Prospect report of the World Bank (2022),

the post-COVID recovery was faster for the trade of goods, while services trade is still lagging, and the recovery in global trade brought an increase in demand for highly trade-intensive manufactured goods, particularly durable goods. According to the report, GVCs pressures in 2021 were driven mainly by temporary factors, such as factory and port lockdowns, weather-induced logistics bottlenecks, and a deficiency of semiconductors and shipping containers. At the same time, industries have exhausted inventories as a response to increased demand. However, at the end of 2021, the supply chain started slightly recovering (World Bank 2022).

When it comes to microdata analysis, in their paper on the resilience of GVCs during Covid-19, Giglioli et al. (2021) analysed to what extent the participation in GVCs has exposed countries and firms to economic shocks, with a particular focus on Italy, which was hit the hardest by the COVID-19 first wave. The authors find that in the initial phases of the pandemic (i.e. first wave), the GVC participation might have contributed to the transmission of shock in terms of GDP variation. However, they obtained a positive correlation between the variables during the later stages and the second wave. Another paper dealing with the firm-level analysis is the one of Waldkirch (2021), who, on a sample of 21 countries, analysed the effect of COVID-19 on firm performance and obtained that effects were predominantly adverse in terms of business closures, fall in sales and significant exports decrease.

Finally, although the literature dealing with the adverse effects of the pandemic on GVCs is prevailing, there are also authors, such as Espitia et al. (2022), who highlight that participation in GVCs can both lessen or increase the adverse trade effects of COVID-19 shocks, as well as those (e.g. Panwar et al. 2022; Coveri et al. 2020, Shepard 2021) who stress the role of the crisis as a mean for strengthening and reconfiguration of the global economy. Several other authors (such as Gupta 2020; Roscoe et al. 2020) have a similar argumentation stressing that predictions of somewhat chaotic de-globalisation as a side effect of sudden disruptions of GVC, which were present in the early stages of the pandemic, did not materialise. Evenett (2022) and Freeland (2022) consider that enterprise sector executives should be beware of misleading narratives of the broad globalisation retreat. Koopman (2022), the former Chief Economist of the World Trade Organisation (WTO), when examining the lessons learned in the COVID-19 pandemic, also considers that despite wide-scale disruptions, trade and GVCs remain relatively robust. When it comes to the practical EU policy response for mitigating the effects of the GVC disruptions and building resilience, the European Commission adopted policies of "Open Strategic Autonomy" which Christine Lagarde (2022), is calling a "managed globalisation".

As for the foreseeable future global trends, Zahn (2021) argues that GVC will undergo a significant transformation and reconfiguration in this decade, outlining the five fundamental driving forces: "a) economic governance re-alignment, b) technology and the new industrial revolution, c) the sustainability endeavour, d) corporate accountability, and e) resilience-oriented restructuring" (Zahn 2021: 206). Some of the transformations are already underway and supported by current policies in many parts of the world, including the EU, such as those directed at enhancing resilience to exogenous shocks through digitalisation and introducing more energy and climate-sustainable production practices. It is certain that COVID-19 did not cause but only triggered faster transformation and impact of identified drivers.

3. Empirical assessment of COVID-19 effects on GVC in Croatia - firm level analysis

Regarding most of the available international data and participation indices, Croatia stands very low on GVC ladder. However, the situation has somewhat improved since it acceded to the EU, along with the significant increase in Croatian exports, according to the work of Orsini and Perić (2021). Kersan-Škabić (2017), in her paper about participation in GVC, also demonstrated that Croatia is, positioned at the very bottom of the EU and elaborated two main reasons for the such position: (1) the economic structure and (2) late accession to the EU. In the new geopolitical situation, however, the low participation in GVC could be an advantage rather than a disadvantage, at least in the short-term. Namely, the international exogenous shocks caused by COVID-19 and recent conflict in Ukraine so far did not hit Croatia as hard as, for instance, Germany or Italy, which are highly positioned in GVC flows. More precisely, in 2020, the first pandemic year, relative to 2019, Croatia increased its forward component while decreasing its backward component. Generally, Croatia and other NMS have a larger share of backward than forward participation, which could mean that they have a better position in the GVC due to the higher foreign content of exports and thus improving their place in the downstream part of the value chain (Vidaković Peruško, Kovač, and Jošić 2018). The work of Vidaković Peruško, Kovač, and Jošić (2018) also showed that Croatia's integration

in GVCs was relatively unchanged in the pre-COVID period.

As for the participation of Croatia in service sector exports and in-service support to manufacturing exports, Kersan-Škabić (2022b) analyses of OECD TiVA data for 2005-2016 demonstrate a high share of domestic value added in export of services in total gross exports (51%) because of tourism as a dominant services sector. On the other side, the services total value-added participation into manufacturing exports is, together with Greece, among lowest in the EU, i.e. below 30% in 2016 (Kersan-Škabić 2022b). That is pointing towards lesser developed "servisication" of manufacturing sector, i.e various types of services which directly support and ease exports of manufacturing production such as ICT, finance and insurance, transportation and storage services, and public administration services. Building on the existing knowledge for aggregate data, we proceed with more detailed analysis of GVC participation with available data at the firm-level.

3.1. Data

In order to offer additional firm-level analysis of the pandemic effects, in this paper we focus solely on Croatia, the newest EU member state. Croatia is included in the latest Covid-19 specific surveys conducted by the World Bank (3 rounds up to now for Croatia). The main advantage of these surveys is reflected in the fact that they follow up on recently conducted regular Enterprise Surveys (ES) allowing a comparison to pre-COVID period (Waldkirch 2021), as they can be merged by using the firm's id number.

Firstly, the table below provides the main average findings about the effects of Covid-19 on the Croatian firms included in the survey. Business owners and top managers of total of 404 firms were interviewed between November 2018 and November 2019 as part of the standard ES. The same firms were again contacted in September 2020 (Round 1), December 2020 and January 2021 (Round 2) and in May and June 2021 (Round 3).

The data show that Croatian firms faced many challenges related to COVID-19's effects on their performance: average monthly sales dropped, the firms had to decrease the number of full-time workers, and the national sales component of total sales increased relative to the export (direct and indirect). In addition, however, an increase in the share of firms that started or increased online business is observed. Finally, there is a large share of firms that received national or local support/subsidies in surpassing the adverse effects of the pandemic.

Stojčić (2020), using the same database (Round 1), but focusing on the manufacturing sector, showed that the Covid-19 pandemic negatively affected companies' operations, with adverse effects being more noticeable amongst export-oriented firms. Vujanovic et al. (2021) argue that COVID-19 brought also disruptions of investment flows halting the process of positive FDI spillovers on knowledge transfer and technology absorption processes in domestic firms as well as increased difficulties in accessing external funding, especially for SMEs.

Table 1. The effects of Covid-19 on the Croatian firms in various domains

	Round 1	Round 2	Round 3
% of firms that have ever temporarily closed during COVID-19 outbreak	29.7	34.5	33.1
% of firms started or increased online business (%)	12.6	14.9	18.6
Average change in monthly sales compared to one year ago (%)	-16.5	-18.7	5.4
% change of permanent full-time workers since ES	-3.9	-3.2	-2.8
% of firms that received national or local government assistance	60.6	63.3	65.7
Proportion of monthly sales that are domestic sales (%)	89.6	92	91.8
Proportion of monthly sales exported directly (%)	9.4	7.3	7.3
Proportion of monthly sales exported indirectly (%)	1.0	0.7	0.9

Source: Authors compilation based on the Enterprise Surveys Follow-Up on COVID-19 (https://www.enterprisesurveys.org/en/enterprisesurveys)

This paper focuses on the GVC firms, for which, when it comes to the firm-level data, there is no unique measure in the literature and various approaches can be found. Previous research offers many possibilities for classifying GVC and non-GVC firms using survey data. Precisely, some analysts identify GVC firms as traders who have a quality certification (Del Prete, Giovannetti, and Marvasi 2017; Reddy et al. 2021); some stress the condition of participation in GVCs of firms exporting and importing at the same time being the two-way traders (e.g. Winkler and Rigo 2021; Baldwin and Yan 2014; Orlic 2016). Others take into consideration importing foreign intermediate goods or exporting products where import and export take both direct and indirect forms (see, e.g. Ehab and Zaki 2021; Urata 2021; Reddy, Chundakkadan and Sasidharan 2021; Orlic 2016). While in indirect export, a firm may produce items that are used in the goods exported by other firms, direct export is more difficult due to the high fixed costs of finding importers and building networks in foreign countries. Some authors even classify GVC firms as firms with a share of direct exports larger than 40% (Wignaraja 2013) or larger than 10% (Gopalan, Reddy, and Sasidharan2022).

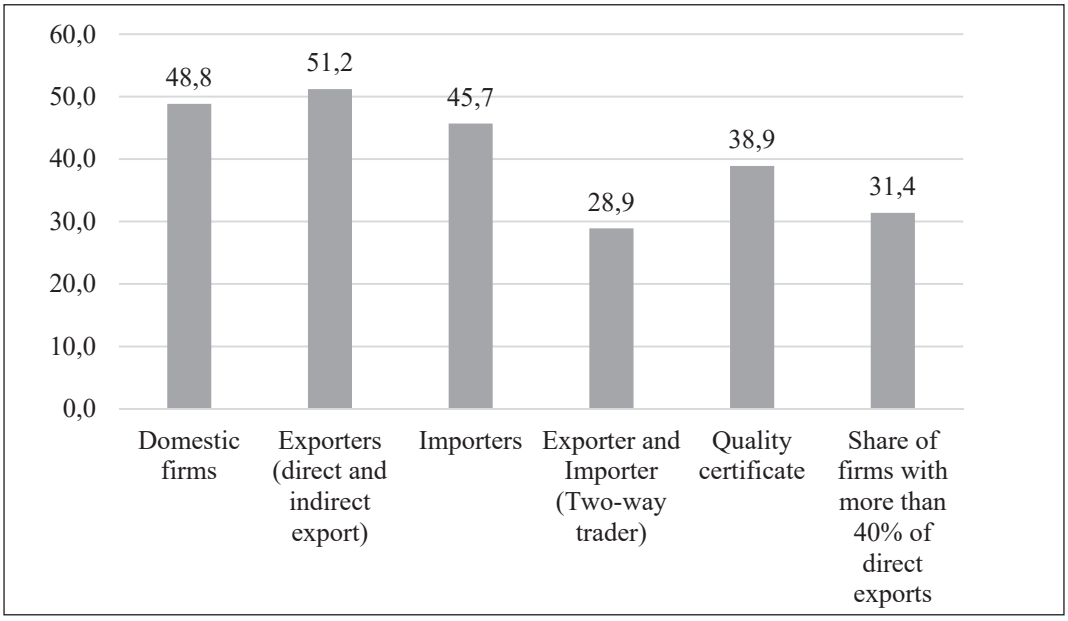
Figure 1 shows the shares of GVC firms in Croatia if classified according to the above-mentioned approaches. In doing so, we combine the regular Enterprise Survey 2019 as a baseline and Enterprise Survey Follow-Up on COVID-19 (Round 1, Round 2 and Round 3). We build our GVC groups of firms based on the survey information on both direct and indirect exports, through the following question [*In the last completed month, …, what percentage of this establishment's sales were: -National sales; -Indirect exports (sold domestically to a third party that exports products); -Direct exports].* Also, for building a group of two-way traders, we added a question [*Were any of the material inputs or supplies purchased in the fiscal year* **…** *imported directly?].* Finally, to include the international quality certification dimension, we utilise the following question: *[Does this establishment have an internationally-recognized quality certification?].*

Further, figure 2 and figure 3 shows the general shares of firms that experienced a decrease in direct and indirect exports since the regular ES2019 (our baseline). The data point out that a fall in direct exports was more dramatic in manufacturing than in services, while the opposite holds for indirect exports.

Also, regarding ownership, firms with foreign ownership experienced a larger drop in exports that domestic ones.

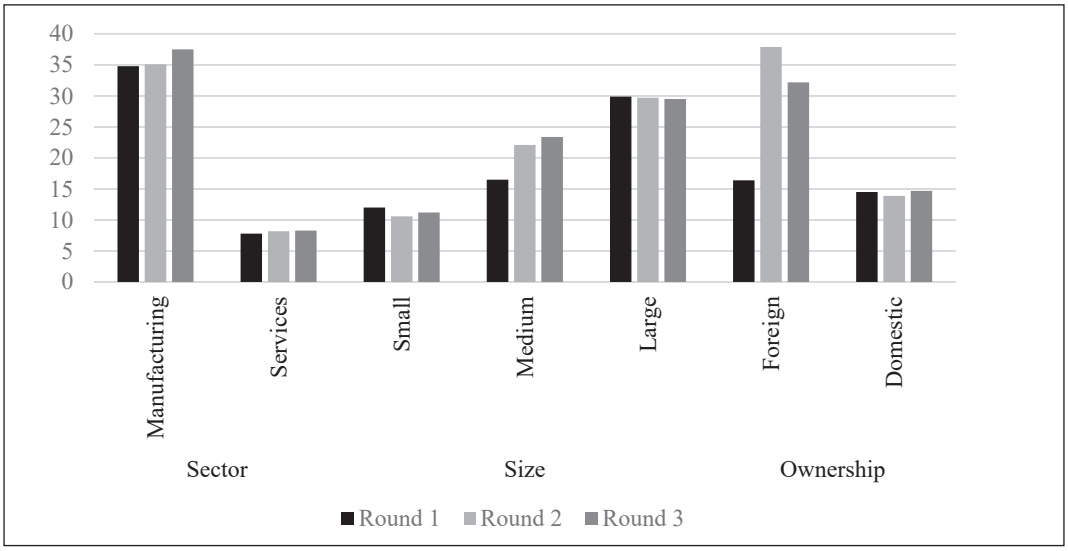
In following section, we analyse in more detail for which firms the probability of a decrease in exports (both direct and indirect) is larger, using the data from all three rounds of ES Follow-Up Surveys, as well as information from the baseline, ES2019 survey. We put special focus on two GVC groups of firms as defined above, i.e. the two-way traders and exporters only.

Figure 1. Firms (%) in a GVC according to different definitions



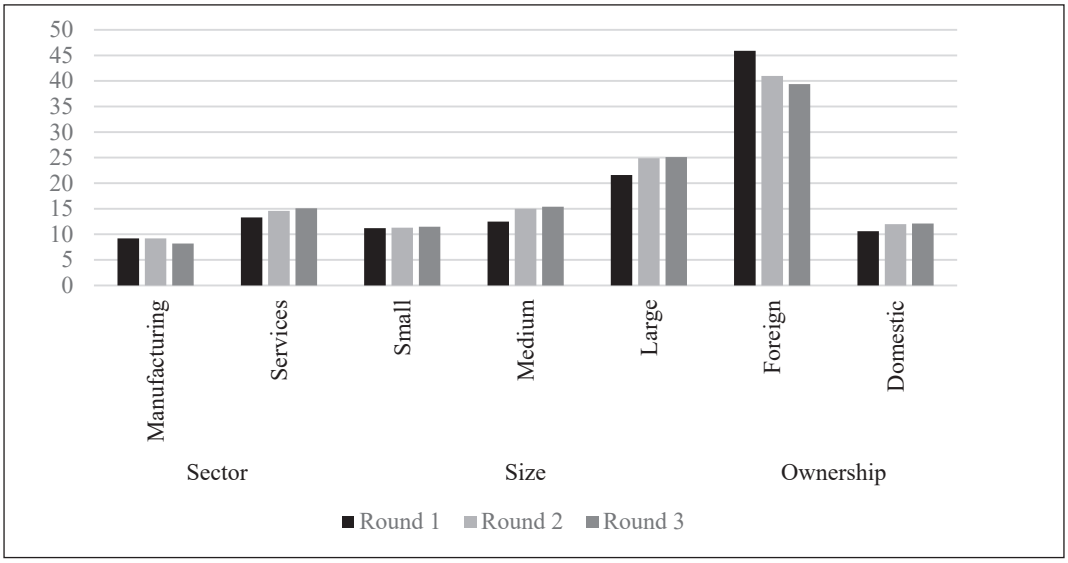
Source: Authors compilation based on the ES 2019.
(https://www.enterprisesurveys.org/en/enterprisesurveys)

Figure 2. The proportion of firms that decreased direct exports since ES (in %, by firm characteristics and sector)



Source: Authors compilation based on the Enterprise Surveys Follow-Up on COVID-19 (https://www.enterprisesurveys.org/en/enterprisesurveys)

Figure 3. The proportion of firms that decreased indirect exports since ES (in %, by firm characteristics and sector)



Source: Authors compilation based on the Enterprise Surveys Follow-Up on COVID-19 (https://www.enterprisesurveys.org/en/enterprisesurveys)

3.2. Methodology

Previous studies have found numerous characteristics of the firms that participate in GVCs by undertaking various econometric approaches, regressing a firm's GVC participation on a number of independent variables (i.e. firm characteristics). We adopt the same approach but with a difference of analysing the characteristics of firms that decreased indirect and direct exports in the COVID-19 period.

Our final sample consists of 175 companies classified as exporters (both direct and indirect export) and 104 firms classified as two-way traders. We dropped the firms that are permanently closed and those with blank spaces in the answers on the question [*Currently is this establishment open, temporarily closed (suspended services or production), or permanently closed*]).

Regarding the methodology, the paper uses a logistic regression model, the goal of which is to describe the relationship between the dependent

variable (response or outcome variable) and a set of independent (predictor or explanatory) variables. Logistic regression allows us to predict the values of a binary variable that takes only two values, 0 or 1, depending on a set of explanatory variables that can be both continuous or categorical. More specifically, the model estimates probabilities of GVC firm's decrease in exports (direct and indirect) relative to the sector, size, demand for the firm's product or service, use of foreign technology, innovation, the primary market in which the firm is selling its main product and firms age.

The model can be written as follows:

$$change\_EX=\beta_1+\beta_2\,(sector)+\beta_3\,(size)+\beta_4\,(tech)+\beta_5\,(inno)+\beta_6\,(demand)+\beta_7\,(market)+\beta_8\,(age)+\varepsilon$$

where *change_EX* is a binary dependent variable indicating whether a firm decreased the exports (value 1) or not (value 0) in relation to the pre-Covid period. The variables *sector, size, tech, inno, demand, market and age* are predictor variables, and they are in more detail described in table 2.

Variables *tech, inno, demand, market* and *age* are constructed using the baseline ES2019 survey, and the information for variables *change_EX*, *sector* and *size* are obtained from Enterprise Survey Follow-Up on COVID-19 (Round 1, Round 2 and Round 3).

3.3. Results and discussion

The table below presents results from the logistic regression model on the main determinants of probabilities of a decrease in indirect and direct export relative to the pre-COVID period. Since logistic regression coefficients are difficult to interpret, the results are translated into the predicted probabilities calculating the marginal effects. Two models were estimated depending on the definition of GVC participation. Model diagnostic is provided in Appendix 1.

The results show that, for the GVC firms defined as two-way traders, the following variables are statistically significant: *sector, tech* and *demand*. Regarding the first model, the obtained results show that the probability of firms recording a fall in exports in relation to the pre-COVID period increases for the manufacturing sector and for firms that recorded a decrease in demand for its products and services. Conversely, the probability of a decline in exports falls for firms using a technology licensed from a foreign-owned company. For the GVC firms defined as exporters, the following variables are statistically significant: *sector, size, inno* and *demand*. For model 2, the results show that the probability of firms decreasing the indirect and direct exports in relation to the pre-COVID period increases for the manufacturing sector and for firms that recorded a decrease in demand for its products and services. Also, the probability of decreasing exports is larger for firms that introduced new or improved products or services. Conversely, the probability of a decrease in exports falls for small firms relative to large ones. Thus, a GVC firm's performance depends on a set of the firm's characteristics, which is line for example with Orlic (2016) research on firms in South Eastern Europe.

The results are also in line with Waldkirch (2021), who also showed that manufacturing sectors globally saw an immediate decline in share of exports, while in services this holds only for transport services (see also Ayadi et al. 2021). Also, from the aspect of variable capturing size, the results can be interpreted in

Table 2. Description of Predictor Variables

Variable	Description
sector	Dummy variable, takes the value 1 for manufacturing sector, and 0 otherwise
size	Dummy variable, takes the value 1 for small firms, and 0 otherwise
tech	Dummy variable, takes the value 1 if firm is using a technology licensed from a foreign-owned company, excluding office software, and 0 otherwise.
inno	Dummy variable, takes value 1 if, during the last three years, the firm introduced new or improved products or services, and 0 otherwise
demand	Dummy variable, takes the value 1 if the demand for its products and services decreased, and 0 otherwise
market	Dummy variable, takes value 1 if, the main market in which this firm sold its main product is international market and 0 otherwise
age	Firms age, continuous variable

Table 3. Results of the logistic regression, average marginal effects.

VARIABLES	(1) Average Marginal Effects (two-way traders)	(2) Average Marginal Effects (all exporters)
sector	0.178** (0.076)	0.188*** (0.048)
size	-0.122 (0.089)	-0.123* (0.066)
tech	-0.164* (0.092)	-0.066 (0.080)
inno	0.105 (0.070)	0.137*** (0.052)
demand	0.559*** (0.103)	0.622*** (0.111)
market	0.024 (0.071)	0.034 (0.056)
age	0.001 (0.002)	0.001 (0.002)
Hosmer-Lemeshow chi2(8) Prob > chi2	2.62 0.96	2.88 0.94
Observations	104	175

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Source: Own calculation (in Stata).

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

line with research of Gopalan, Reddy and Sasidharan (2022) who highlight that larger firms are those that participate more in GVCs relative to small ones, and in our analysis the size was statistically significant only in stricter definition of GVC firms as two-way traders.

We see two potential future research avenues for Croatia. The first one is to check whether and when the manufacturing sector started to recover in Croatia, as the literature review presented in Section 2 pointed that the recovery in GVC already took place globally in 2021. The second one, related to the innovation variable is worth exploring in more details, as by some authors it has been shown that firm GVC participation would increase with firms moving from incremental (a product new only to the firm and not to the market) to radical (a product that is new to the firm and the market) innovation (see Reddy, Chundakkadan, and Sasidharan 2021). According to these authors, climbing up the innovation ladder could be crucial for GVC participation and consequently for the resilience during the crises as such caused by the Covid-19. Just for the illustration, in a case of Croatian firms and data from ES2019, the majority of firms introduced an improved products or services new to the firm, but not to the market.

4. Conclusions and policy implications

The presented analyses have revealed several determining trends and factors that affect the post-COVID-19 GVC participation of the EU NMS, with a focus on the Croatian enterprise sector. In the first part of the paper, the text summarises existing literature that developed in two streams depending on the data used (i.e. macro and micro) dealing with the COVID-19 effects but also with major megatrends, which are shaping and transforming the current GVC landscape. Most of the literature explored expects further reconfiguring and "resilience-oriented restructuring" of the

current GVCs to ensure development sustainability at micro and macro levels.

About replying to the RQ1 and RQ2, the main contribution of our analysis is that we focused on the position of Croatia and the participation of its export enterprise sector in the GVC ladder after the outbreak of COVID-19. Such analyses are still rather rare given the availability of systemic data.

Econometric analysis is performed for the two groups of GVC firms, derived according to the existing definitions from the literature dealing with firm data – two-way traders (Model1) and all exporters (Model 2). Regarding the first model, the obtained results show that the probability of firms recording a fall in exports in relation to the pre-COVID period, increases for the manufacturing sector, and for firms that recorded a decrease of demand for its products and services. On the other side, the probability of a decrease in exports falls for firms using a technology licensed from a foreign-owned company.

For the model 2, the results show that the probability of firms decreasing the indirect and direct exports in relation to the pre-COVID period, increases for the manufacturing sector, and for firms that recorded a decrease of demand for its products and services. Also, the probability of decreasing exports is larger for firms that introduced new or improved products or services. On the other side, the probability of a decrease in exports falls for small firms, relative to large ones.

As for the policy implications, some of the current GVC transformation trends may work in favour of upgrading GVC's position and international trade of Croatian exporting firms' production networks. More intense GVC regionalisation towards the EU would undoubtedly be one of them. In 2021, according to data from the Croatian Bureau of Statistics, the level of trade with the EU countries intensified, especially for manufacturing exports, as well as for imports of intermediate products on which Croatian export is highly dependent. However, one area that requires the immediate attention of policymakers is better positioning of producer services (such as business and professional services, financial services, and insurance services) in GVC trade flows in the future.

Further research avenues worth exploring would involve more detailed sectorial analyses and how the specific Croatian business sectors manage the dichotomy of emerging policy directions, i.e. "the trend of de-globalisation and mainstreaming of sustainability", as Zahn (2021: 219) formulated it. For instance, it would be exciting to explore how leading technological sectors such as ICT or the energy industry, which have significant spill-over effects on other business sectors, participate in GVC on the European Union level and what would be the future position of the Croatian enterprise sector regarding the driving transformation policies that dominantly affect the GVC in the EU such as digitalisation and greening of the economy. Another exciting area of research would be exploring innovation's effect on GVC participation in Croatia, before and after Covid-19.

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Appendix 1.

Model diagnostic

	Model 1	Model 2
Sensitivity	85%	76.7%
Specificity	81.3%	81.7%
Positive predictive value	73.9%	68.7%
Negative predictive value	89.7%	87%
Correctly classified	82.7%	80%
Area under ROC curve	88.6%	88.3%

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THE EXTENT INDIVIDUALS ARE WILLING TO UNDERTAKE ENERGY EFFICIENCY MEASURES: EVIDENCE FROM BOSNIA AND HERZEGOVINA

Ljiljan Veselinović, Jasmina Mangafić, Danijela Martinović

Abstract

This paper studies the extent individuals are willing to undertake energy efficiency measures, with evidence coming from a developing country (Bosnia and Herzegovina). The goal of this paper is to analyze energy-savings behaviors, aiming to understand what is typically meant under the term energy efficiency, who is more likely to know the meaning, and the extent individuals are willing to undertake some energy efficiency measures. The sample size used in this paper is a random stratified sample of 1,415 individuals coming from various backgrounds. Our logistic regression models found no statistically significant predictor across all ten measures used in the study. However, past experience, age, and being married are relatively common across these ten energy-saving behaviors. These results might be beneficial in defining policies in order to promote energy-saving behaviors.

Keywords: *energy-savings behavior, energy efficiency measures, energy crisis, micro data, Bosnia and Herzegovina*

JEL classification: *D90; O13; Q41*

1. Introduction

The more efficient use of energy can be achieved by changing the behavior of many actors, including employers, employees, governments, and individuals. At the micro level of analysis, individuals can take meaningful actions at home and in their working environment, which should not be ignored. For example, some estimations in Bangkok identified opportunities to save energy between 7 and 15%, i.e. 484.2 - 1037.6 kWh/year/household (Jareemit and Limmeechokchai 2019). Energy-saving behaviors are widely promoted as a solution to growing energy-related problems (Suntornsan, Chudech, and Janmaimool 2022). However, as concluded by Sony and Mekoth (2018), electricity-saving behavior "represents a significant untapped potential". Within the organizational context, Glavas (2012) pointed out that the majority of studies

Ljiljan Veselinović, PhD (corresponding author)
Associate Professor
School of Economics and Business
University of Sarajevo
Trg oslobođenja – Alije Izetbegovića 1
71000 Sarajevo, Bosnia and Herzegovina
E-mail: ljiljan.veselinovic@efsa.unsa.ba
ORCID: https://orcid.org/0000-0003-2585-5016

Jasmina Mangafić, PhD
Associate Professor
School of Economics and Business
University of Sarajevo
E-mail: jasmina.mangafic@efsa.unsa.ba

Danijela Martinović, PhD
Associate Professor
School of Economics and Business
University of Sarajevo
E-mail: danijela.martinovic@efsa.unsa.ba

in the field of employee engagement and sustainability have been focusing on macro issues; the knowledge about organization-wide implementation is scarce; and we are just at the beginning of understating how to engage employees in sustainability. Glavas (2012) summarized the conclusions of several studies to identify variables that sustainability has a positive impact on, including performance, engagement, retention, creative involvement, commitment, attractiveness to prospective employees, identification with the organization, organization citizenship behaviors, and employee relationships.

This paper studies the extent individuals are willing to undertake energy efficiency measures, with evidence coming from a developing country (Bosnia and Herzegovina). The goal of this paper is to analyze energy-saving behaviors, starting with the meaning of the term energy efficiency, i.e., how individuals from Bosnia and Herzegovina typically understand the term. As not all respondents are willing to engage in energy-saving behaviors, the following question emerged: Who is more likely to know the meaning of energy efficiency? Finally, the paper identifies the extent individuals are willing to undertake some energy efficiency measures and what factors are important predictors of energy-saving behavior. However, existing literature typically examines one type of energy-saving behavior. Our data contain questions related to the willingness to accept energy-saving behavior in 10 specific domains, with the aim of discovering common predictors across domains.

The contribution of this paper lies in the application of logistic regression on ten observed energy-saving practices and testing which socio-demographic characteristics could predict this behavior, in order to test whether it is possible to find consistent predictors across ten different energy-saving measures. Such results can be used in shaping better policy-decision measures to increase individual's energy efficiency.

2. Literature Review

In this section, we start with the theory of planned behavior as a theoretical background of the paper. Then, a discussion about psychological and socio-demographic predictors is presented.

2.1. Theory of planned behavior as a theoretical background of the paper

An energy-saving behavior can be defined as "an individual action that aims to reduce energy consumption and the negative environmental impacts of energy consumption and production" (Sony and Mekoth 2018 as cited in Suntornsan, Chudech, and Janmaimool 2022). The theory of Planned Behavior (TPB) might be used as a good theoretical background to understand what factors can explain an individual's decision to engage in a certain behavior, including energy-saving behaviors in a very particular category - students with physical impairments (Suntornsan, Chudech, and Janmaimool 2022). TPB is widely used to explain the association between intention and behavior in the general domain, as well as in the environmental and specific energy-related domain (Carrus et al. 2022). The theory postulates that the intention of an individual is an important predictor of actual behavior, while attitude towards the behavior, subjective norms, and perceived behavioral control are important predictors of an individual's intention to engage in that behavior. Attitude towards the behavior represents the belief of an individual about the observed behavior, which could be positive/favorable or negative. Subjective norms explain how social pressure influences intention to engage in certain behavior, while perceived behavioral control (PBC) is best explained by an individual's perception that sufficient resources, opportunities, and capabilities are available to perform a certain action, i.e., it explains how easy or difficult to participate in behavior that is the subject of research. The theoretical background of this paper is drawn from TBP.

2.2. Psychological predictors of energy-saving behavior

Carrus et al. (2022) concluded that "understanding how psychological processes drive human energy choices is urgent, and yet relatively under-investigated, need for contemporary society." By applying a meta-analytical procedure, the moderate association between attitudes, intentions, values, awareness, and emotions, on one side, and energy-saving behavioral intentions (self-reported) and behaviors (actual), on the other side, are found to be positive and moderate in size. While five psychological factors are considered to be statistically and positively related to energy-saving intentions and behaviors, emotions have been identified to have more explanatory power than others, like values or beliefs, by meta-analysis of Carrus et al. (2022). An explanation provided by the authors is that emotions associated with a particular course of action are probably more directly associated with real-life choices.

Using a nationally representative probability sample of US adults, Gustafson et al. (2020) also showed that psychological factors are important considerations in supporting energy-saving behaviors. Particularly, Republicans and Democrats differ in their stated motivation for supporting a transition to renewable energy, i.e. the main motivator of Republicans is economic benefits consideration and Democrats are more concerned about global warming.

As noted by Gustafson et al. (2020), the perception of benefits and the reduction in environmental harms were perceived to motivate individuals to increase their support for renewable energy trends. However, in the qualitative study in Western India, Sony and Mekoth (2018) identified seven master themes related to the question of why consumers do not care about electricity energy-saving behavior, including the lack of reward and motivation, lack of environmental concern, lack of information, lack of communication, lack of policy and legislation, lack of social norms and lack of user-friendly technology.

2.3. Socio-demographic predictors of energy-saving behavior

On a sample from Bosnia and Herzegovina, Radoš et al. (2020) showed that socio-demographic variables are important predictors of an individual's support for projects related to renewable energy sources, including age, gender, income, satisfaction with the standard of living, religiousness, living in a male-dominated household, and ethnicity. For example, socio-demographic predictors, such as education level and household income, are found to play an important role in adopting biogas technologies in Ethiopia (Shallo, Ayele, and Sime 2020). However, regarding age, the results are not found to be consistently significant. The studies conducted on the data from multiple European countries[1] (Mills and Schleich 2012), Portugal (Paço and Varejao 2010), Austria (Getzner and Grabner-Kräuter 2004), and Canada (Kinnera et al. 1974) found that younger individuals are more likely to use renewable energy sources, while other studies (such as Radoš et al. 2020, the study from Bosnia and Herzegovina; and Roberts 1996, the study from the US) showed the opposite, i.e. older people show a higher level of support for renewable energy, compared to younger individuals. Similar contradictory results are found for gender. The studies from the UK (Devine-Wright 2010), a large North-American city (Laroche et al. 2001), and the US (Mainieri and Barnett 1997; Black et al. 1985) found women are more likely to support renewable energy and adopt environmentally friendly behavior, while other studies from Bosnia and Herzegovina (Radoš et al. 2020) and the US (MacDonald and Hara 1994) show men are more likely to support these projects, and two US studies found no statistically significant differences (Groth and Vogt 2004; Samdahl and Robertson 1989). Age and gender are also used as moderator variables. By applying a meta-analytic approach, Carrus et al. (2022) also found that age and gender are significant moderators in explaining pro-environmental values and emotions with energy-saving intentions.

Marital status is also found to increase or decrease the odds of engaging in energy-saving behaviors. Radoš et al. (2020) found that "that married individuals or individuals in a cohabiting partnership will support projects related to renewable energy sources are 24% lower than for single, divorced, or widowed ones". On the other side, using a sample of more than 12 000 respondents from various countries (Australia, Canada, Chile, France, Israel, Japan, Korea, the Netherlands, Spain, Sweden, and Switzerland), Ameli and Brandt (2015) found that individuals in multi-member households demonstrate energy-friendly behavior with a higher probability than single individuals. Existing literature also identifies income as an important predictor, as income can increase the likelihood of energy-friendly behavior (Rados et al. 2020; Ameli and Brandt 2015; Paço and Varejao 2010; Getzner and Grabner-Kräuter 2004). Similar results are found regarding education. More educated individuals are more likely to engage in energy-saving behaviors, as found by two studies from the US (Roberts 1996; Zimmer, Stafford, and Stafford 1994).

Based on the previous discussion, this paper aims to analyze these predictors' consistency concerning specific energy-saving behavior. The main research question is related to discovering common predictors across ten different energy-saving practices.

3. Data and Methods

Data used in this project are collected for the purpose of the Social Monitoring and Evaluation project, which was implemented in Bosnia and Herzegovina in order to monitor and evaluate energy efficiency improvements of selected buildings. In addition to the data collected for the employees and users of the building involved in the energy efficiency project, the survey for social monitoring was designed in a way to

collect data about the level of awareness of energy efficiency and related issues raised, and the level of subjective attitudes toward positive changes in behavioral pattern change. Population data for Bosnia and Herzegovina was used to make initial strata.

Table 1 presents sample characteristics. A total of 1,415 responses were collected. Male respondents represent 44.81% of the sample. The majority of surveyed respondents are from rural areas (54.98%). Regarding age, the most represented age group is 55-75, accounting for 36.89% of the total sample, followed by the 36-55 age group (33.43%). The largest proportion of respondents graduated at least from high school (56.04%). In terms of personal income, the data collected are distributed equally across observed categories up to BAM 900, i.e. 23.32% of individuals with no income, 25.23% of individuals with income up to BAM 500, and 23.39% of individuals with income between BAM 501 and BAM 900. Respondents with income higher than BAM 2000 are the least represented, accounting for 2.61%. Most respondents are married (61.63%).

The data in the study are analyzed using descriptive statistics and logistic regression. Logistic regression is commonly used to generate models from which predictions can be made about the likelihood of an individual supporting energy efficiency measures. Due to its more intuitive interpretation, the study reports the odds ratio Exp(B) to show the change in odds that results from a unit change in the variable of interest. The first logistic regression model was constructed to test which personal characteristics could increase the odds of belonging to the group that self-reported the lack of knowledge regarding the meaning of energy efficiency. The independent variables include gender, type of settlement, age, education level, marital status, and personal income. Afterward, we constructed ten logistic regression models. Dependent variables of these models measure respondents' willingness to undertake specific energy measures, while independent variables include proxies for attitude towards the behavior, past experience, perceived behavioral control, and subjective norms, as well as socio-demographic variables (gender, type of settlement, age, education,

Table 1. Sample characteristics

		Frequency	Percentage (% of total)
Total	Total sample size	1,415	100%
Gender	Male	634	44.81%
	Female	781	55.19%
Type of settlement	Rural	778	54.98%
	Urban	637	45.02%
Age	18-35	336	23.75%
	36-55	473	33.43%
	55-75	522	36.89%
	76+	84	5.94%
Education	No education	30	2.12%
	Elementary school	218	15.41%
	High school	793	56.04%
	College or university	363	25.65%
	Missing	11	0.78%
Marital status	Single	380	26.86%
	Married	872	61.63%
	Divorced	150	10.60%
	Missing	13	0.92%
Personal income	No income	330	23.32%
	1-500	357	25.23%
	501-900	331	23.39%
	901-2000	196	13.85%
	More than 2000	37	2.61%
	Missing	164	11.59%

marital status, and income). Attitude towards the behavior is measured by the question "According to your observations, what is the impact of energy efficiency on the quality of life and living standards of ordinary citizens?", on the scale from extremely unfavorable/negative (1) to extremely favorable (5). In order to simplify the interpretation of the regression results, it was recoded into a dummy variable where 1 represents the case when respondents consider the impact of energy efficiency to be mostly favorable or extremely favorable. Past experience is measured by the number of energy-efficiency measures implemented in the past. Perceived behavioral control (PBC) typically represents a belief that an individual has sufficient capability, resources, and opportunities to perform a given behavior (Suntornsan, Chudech, and Janmaimool 2022). The individuals were asked to report the extent that environmental problems, such as water or air pollution, and climate change, affect their bodies and their health, with answers ranging from absolutely not (1) to a lot (5). This question represents a proxy dummy variable for PBC, assuming that if individuals believe that these environmental concerns cause potential harm, they might be motivated to increase or improve capabilities, and resources and search for opportunities to engage in energy-saving behaviors.

4. Results and Discussion

In this section, we present the main results. First, the meaning of the term energy efficiency is presented, followed by the logistic regression to identify specific socio-demographic characteristics of those individuals with no understanding of the term energy efficiency. The third part reports the results of descriptive statistics and logistic regression in an attempt to analyze the extent individuals are willing to undertake some energy efficiency measures.

4.1. The meaning of the term energy efficiency

The first question was open-ended, i.e., respondents could express the meaning energy efficiency has for themselves. Responses were analyzed following typical qualitative data techniques, i.e. summarizing data, categorizing data, and structuring data. The most common response was related to energy savings, such as financial viability, energy-saving devices, rational consumption, use of cheap tariffs, etc. This response was identified as the meaning behind the term energy efficiency by 39.7% of the respondents. The second most frequent meaning was heating of the house (thermal energy, insulation, facade, etc.), which was identified by 19.2% of all respondents. Interestingly, 17.2% of respondents stated that they do not know the meaning behind the term energy efficiency.

4.2. Who is more likely not to know the meaning behind energy efficiency?

Since 17.2% of respondents reported that they do not know the meaning of energy efficiency, we constructed the logistic regression model to test which

Table 2. In your opinion, what is meant by term energy efficiency?

The meaning	Frequency	Percentage (% of total)
Energy savings (financial viability, energy saving devices, rational consumption, use of cheap tariffs, …)	562	39.7%
Heating of the house (thermal energy, insulation, facade)	271	19.2%
I don't know	243	17.2%
Something about electricity	161	11.4%
Other	101	7.1%
Renewable energy sources (hydropower, wind, solar)	93	6.6%
Utilizing energy in the best way (efficient work, quality energy)	80	5.7%
Pollution reduction (coal, fuel, wood)	66	4.7%
Energy consumption in general	41	2.9%
Human health, body and life energy	19	1.3%
Nothing	14	1.0%
Energy production	10	0.7%

Table 3. Logistic regression results

Variable	Odds ratio	Standard Error	z	P>|z|
Gender (male as a reference group)				
Female	1.31	0.23	1.52	0.13
Type of settlement (rural as a reference group)				
Urban	1.01	0.17	0.03	0.975
Age (18-35 as a reference group)				
36-55	0.81	0.19	-0.85	0.397
55-75	0.57	0.15	-2.15	0.031**
76+	0.92	0.35	-0.21	0.834
Education (No education as a reference group)				
Elementary school	0.48	0.20	-1.77	0.077*
High school	0.16	0.07	-4.43	0.000***
College or university	0.06	0.03	-5.80	0.000***
Marital status (Single as a reference group)				
Married	1.15	0.25	0.65	0.52
Divorced	1.17	0.37	0.51	0.61
Personal income (No income as a reference group)				
1-500	1.24	0.27	1.02	0.398
501-900	1.28	0.29	1.12	0.264
901-2000	0.62	0.21	-1.39	0.165
More than 2000	0.27	0.28	-1.26	0.208
Const	1.09	0.52	0.18	0.854

Number of observations = 1,236; Pseudo R^2 = 10.03%

personal characteristics could increase the odds of belonging to that group. The results are presented in Table 3. Our results indicated that education level plays an important role in predicting whether an individual would report a lack of knowledge about the meaning of energy efficiency. The odds for individuals with elementary education are about 52% lower than those with no education, and with an increase in education levels, the odds ratio is decreasing. The odds for individuals with a high school degree are about 84% lower than those with no education, and with a college or university education, the odds are 94% lower. Other variables are mostly insignificant, except the age group 55-75. The odds that an individual in this age group will not understand the meaning of energy efficiency are 43% lower than in a reference group (18-35 age group).

4.3. The extent individuals are willing to undertake some energy efficiency measures

Typical activities individuals are willing to undertake energy efficiency measures analyzed in this paper includes heating-related measures, the use of electricity, and overall investing in house unit (quality windows, exterior insulation, alternative energy sources, new heating systems) and home appliances. The most common measure that is typically undertaken by almost everyone is turning off the light source in rooms that are rarely used or not used (91.31%), followed by the use of so-called energy-saving light bulbs (84.82%) and turning off radiators and heating sources in rooms that are rarely used (84.03). The measures that are considered to be the least prevailing among respondents are the investment in alternative energy sources (45.58%) and choosing a lower temperature level when heating housing units. The extent individuals are willing to undertake some energy efficiency measures are shown in Table 4.

Table 4. The extent individuals are willing to undertake some energy efficiency measures

To what extent are you personally willing to undertake some of these typical activities?	Frequency	Percentage	Rank
A. Heat your housing unit during the winter heating season to a level of 18 degrees Celsius.	699	49.40%	9
B. Replace all classic light bulbs in the housing unit with so-called energy-saving light bulbs.	1,196	84.82%	2
C. Use large electricity consumers (washing machine, dishwasher, water heater, electric heaters) only at night	954	67.42%	6
D. Invest in quality carpentry – windows (PVC / ALU)	1,075	75.97%	4
E. Turn off radiators and heating sources in rooms that are rarely used	1,189	84.03%	3
F. Turn off the light source in rooms that are less or not used	1,292	91.31%	1
G. Invest in home appliances (dishwashers, stoves, refrigerators, water heaters) that have energy efficiency certificates	922	65.16%	7
H. Invest in better exterior insulation of the walls of a residential unit / building	1,016	71.80%	5
J. Invest in new / modern heaters with lower energy consumption	829	58.59%	8
K. Invest in alternative energy sources (solar panels on the roof of the building; biomass heaters...)	645	45.58%	10

Respondents believe that improving the quality of insulation of the external walls of the building is the measure with the most impact on reducing energy consumption, i.e. a total of 40% of the respondent ranked this measure as the first or the second in terms of their impact. The second measure, identified by 35.2% of respondents, is the utilization of solar power or solar panels, followed by the installation of modern/quality carpentry.

Table 5. The most efficient measures in terms of their impact

The energy-efficiency measure	1st rank	2nd rank	1st and 2nd rank combined	%
Improving the quality of insulation of the external walls of the building (modern insulation)	276	290	566	40.0%
Utilization of solar power / solar panels	351	147	498	35.2%
Installation of modern / quality carpentry (windows and doors)	183	286	469	33.1%
Usage of energy-saving bulbs	209	192	401	28.3%
Use of large consumers of electricity (washing machines, water heaters, radiators) mostly at night (at a lower rate)	125	132	257	18.2%
Removing coal and wood as heat sources energy	83	76	159	11.2%
Usage of energy efficient home appliances	59	92	151	10.7%
Using natural gas for space heating and cooking	47	78	125	8.8%
Switching off light and heat sources in rooms that are less frequently used	51	62	113	8.0%
I don't know	31	29	60	4.2%

4.4. Who is more likely to undertake some typical energy-efficiency measures?

In this section, we present the results of several logistic regression models with dependent variables representing the willingness of respondents to undertake certain policy measures. First, we present results and discuss the role of socio-demographic variables, followed by three components of TPB.

Gender plays a significant role in predicting the wiliness of individuals to adjust the heating temperature of the housing unit in the winter season at 18 degrees Celsius (Model 1). In particular, the odds for women to adjust heating temperatures to 18 degrees are about 20% lower than the odds for men. This might be because female participants might experience different levels of thermal dissatisfaction because of behavioral and physiological reasons (Wang et al. 2018). Physiological reasons are related to metabolic rate in cold exposure, stroke volumes, and blood circulation to the extremities in cold exposures (Wang et al. 2018). Other models show no statistically significant relationships between gender and the willingness to undertake some policy measures, but the coefficients (odds) of the four models are below 1, which might be indicating that women are less likely to undertake some policy measures than men. These models are typically associated with the use of more energy-efficient bulbs, turning off the light sources in rooms that are rarely used, and investing in better exterior insulation of a building. While the results are insignificant ($p>0.1$), the odds in the remaining models (6 out of these 10 models) might indicate that men are slightly more likely to implement energy efficiency measures (1-12% higher odds).

The type of settlement is significant only in two models (models 3 and 10). In comparison to rural respondents, the odds for urban respondents are 39% higher in the case of using large electricity consumers only at night, but 22% lower in the case of investing in alternative energy sources. This might be explained by the different lifestyles of urban and rural respondents. For example, Kohatsu et al. (2009) found an association between short sleep duration and higher BMI in the rural population, while the results of Yang et al. (2009) show that the average sleep time in urban children was shorter than in the children from rural areas. On the other hand, the higher probability of the rural respondent investing in alternative energy sources might come from ownership of larger properties and the type of activities involved in the rural lifestyle, which might require higher energy consumption. Other models show no statistically significant relationships between the type of settlement and the willingness to undertake some policy measures. However, the coefficients for eight out of 10 models are higher than 1, which might indicate that urban respondents are more willing to undertake energy-efficiency policy measures compared to rural respondents. Urban respondents, due to their exposure to various campaigns on different media, might be more aware of energy efficiency measures.

The age of respondents is the variable that is found to influence individuals' willingness to undertake policy measures in almost all models. In seven out of 10 models, age has a statistically significant influence on the individuals' willingness to undertake policy measures. However, there is no consistent direction of the coefficient. With a one-year increase in age, we expect to see about a 1% decrease in the odds of being willing to undertake energy-efficiency measures in the following cases: investing in quality windows (model 4), investing in home appliances that have energy efficiency certificates (model 7), investing in better exterior insulation of the walls of a residential unit/building (model 8); invest in new/modern heaters with lower energy consumption (model 9); and investing in alternative energy sources (model 10). We argue that these types of investments are typically implemented at the younger period of life as individuals are in the process of purchasing housing units, and as they age, their intention to invest more money is reduced. As such, these results might be as expected because as people age, their comfort with what they own increases, making it harder to pursue these investments. On the other hand, our results indicate that with a one-year increase in age, we expect to see about a 1% increase in the odds of being willing to undertake energy-efficiency measures such as setting up the room temperatures to 18 degrees, turning off radiators and heating sources in rooms that are rarely used. Again, the possible explanation might be that individuals taking care of such behaviors can make some differences as their lives become more stable over years, and as they become more aware of the potential of energy-saving opportunities in their everyday life.

In term of education, the more educated an individual is, it seems the odds of engaging in various energy efficiency measures increases. However, results are significant only for two models: with a one-year increase in education, we expect to see about a 1% increase in the odds of being willing to invest in quality carpentry – windows; and 7% in home appliances that have energy efficiency certificates. A possible explanation might involve a better understanding of the potential cost savings made by these two investments.

For other models, the results are insignificant but the value of coefficients in seven out of 10 models might be a good indication that spending more time in formal education can result in higher chances of accepting more energy-efficient behaviors.

Being married is found to increase the willingness for energy efficiency measures in five models. In four models, the odds for married persons are between 34 and 39% higher than the odds of single persons in case of their engagement in some sort of investment, such as new windows (model 4), home appliances with energy-efficient certificates (model 7), better exterior insulation of the walls (model 8), and alternative energy sources (model 10). Overall, being married is associated with higher chances of increasing the odds of engaging in energy-efficient practices in seven out of 10 models, but not all results are statistically significant. On the other hand, the odds for divorced persons to engage in such behavior are typically lower than for single persons, but the results are significant only for three models. We argue that married persons might engage in this type of behavior due to joint decision-making and improvement of living conditions for their family. However, the odds for married persons are 34% lower than the odds for single persons in the context of their willingness to change the room temperature to 18 degrees Celsius, significant at 5%. A possible explanation might include care for the family and kids and, consequently, increasing the temperature to make their family members more comfortable.

Personal income is found to increase the willingness to implement energy efficiency measures in five models, but not all observed income levels are found to be statistically significant. The overall conclusion is that the odds for individuals with higher income to engage in energy-efficiency measures are higher than for those without income. This is a logical conclusion since we expected that individuals with higher incomes are more prone to engage in energy efficiency measures due to better financial situations. While the results are statistically insignificant, the only case where the odds are decreasing with income increase is in model 3 (the use of large electricity consumers at night). As electricity prices are typically lower in Bosnia and Herzegovina, the effort to save energy by using this energy efficiency measure is not motivating enough due to relatively lower savings compared to their income. However, as the informal economy in Bosnia and Herzegovina is relatively large, with an average value of 34% of GDP for 1998-2015 (Pasovic and Efencic 2018), the problem of undeclared work and personal earnings related to it should be noted. The survey used in the research required respondents to report their income, which might vary based on whether respondents included undeclared work in their responses.

Attitude towards the behavior is measured by the question "According to your observations, what is the impact of energy efficiency on the quality of life and living standards of ordinary citizens?" on the scale from extremely unfavorable/negative (1) to extremely favorable (5). The variable is statistically significant in the second model, indicating that the odds for those who have a positive attitude are 35% higher than for those without such an attitude. While the results are statistically insignificant in other models, the odds for individuals with a positive attitude to engage in energy-efficiency measures are higher compared to the reference group in eight out of 10 models.

Past experience is measured by the number of energy-efficiency measures implemented in the past. Our results indicated that past experience is the single most important predictor of intention, i.e. in most cases, it shows that with a one-unit increase in the number of implemented measures, we expect to see between 18-68% increase in the odds of being willing to undertake energy-efficiency measures. The non-significant results are only found in model 1 (setting the temperature at 18 degrees Celsius) and in model 10 (investing in alternative energy sources).

Perceived behavioral control (PBC) typically represents a belief that an individual has sufficient capability, resources, and opportunities to perform a given behavior (Suntornsan, Chudech, and Janmaimool 2022). Our results indicate that the odds for those individuals with greater PBC are between 48% and 102% higher than for those with the opposite PBC, in five out of ten models. In the remaining models, the PBC has no statistically significant impact, but the coefficients are mostly in favor of a higher probability of being willing to undertake energy-efficiency measures.

Subjective norms are significant in only two models, most coefficients are higher than 1, potentially indicating that subjective norms can increase the odds of being willing to undertake energy-efficiency measures.

Table 6. The results of logistic regression models, dependent variable willingness of respondents to undertake certain policy measures

Variable	M1 (TEMP)	M2 (EE_BL)	M3 (EL_N)	M4 (WIN)	M5 (HEAT)	M6 (LIGHT)	M7 (I_HA)	M8 (I_IW)	M9 (I_H)	M10 (I_AES)
Female	**0.8 (0.1*)**	0.81 (0.15)	1.17 (0.16)	1.02 (0.16)	1.01 (0.18)	0.96 (0.23)	1.18 (0.17)	0.94 (0.14)	1.13 (0.15)	1 (0.13)
Urban settlement	1.19 (0.15)	1.03 (0.18)	**1.39 (0.19**)**	1.15 (0.17)	1.23 (0.22)	1.08 (0.25)	1.19 (0.16)	0.93 (0.13)	1.03 (0.13)	**0.78 (0.1**)**
Age	**1.01 (0*)**	0.99 (0.01)	0.99 (0)	**0.99 (0.01*)**	**1.02 (0.01**)**	1.01 (0.01)	**0.99 (0**)**	**0.99 (0**)**	**0.98 (0***)**	**0.99 (0**)**
Years of education	0.96 (0.03)	0.96 (0.04)	1.02 (0.03)	**1.1 (0.03**)**	1.00 (0.04)	0.97 (0.05)	**1.07 (0.03**)**	1.02 (0.03)	1.02 (0.03)	1.04 (0.03)
Married	**0.66 (0.11**)**	1.01 (0.23)	1.12 (0.19)	**1.41 (0.27*)**	0.95 (0.21)	0.87 (0.24)	**1.49 (0.26**)**	**1.47 (0.26**)**	1.02 (0.17)	**1.34 (0.21*)**
Divorced	0.67 (0.17)	**0.56 (0.19*)**	0.82 (0.22)	0.99 (0.29)	0.86 (0.32)	2.01 (1.22)	**0.62 (0.17*)**	0.95 (0.26)	**0.64 (0.17*)**	0.81 (0.22)
Income										
1-500	1.08 (0.19)	1.24 (0.31)	1.21 (0.24)	0.97 (0.2)	1 (0.25)	0.98 (0.32)	1.09 (0.21)	1.02 (0.2)	1.09 (0.2)	1.06 (0.19)
501-900	**1.39 (0.25*)**	1.1 (0.27)	1.15 (0.22)	1.15 (0.24)	1.18 (0.29)	1.06 (0.33)	1.27 (0.24)	1.23 (0.24)	**1.50 (0.28**)**	1.27 (0.23)
901-2000	1.24 (0.25)	1.38 (0.42)	0.92 (0.2)	1.42 (0.38)	1.30 (0.39)	1.40 (0.56)	**2.12 (0.51**)**	**1.88 (0.47**)**	**1.79 (0.39**)**	1.39 (0.29)
More than 2000	1.61 (0.63)	1.56 (1.02)	0.67 (0.27)	1.77 (1.01)	1.24 (0.72)	0.75 (0.51)	**3.58 (2.03**)**	**2.70 (1.52*)**	**2.52 (1.16**)**	**2.85 (1.17**)**
Attitude (proxy)	0.99 (0.13)	**1.35 (0.24*)**	1.1 (0.15)	1.04 (0.16)	0.98 (0.18)	1.41 (0.32)	1.11 (0.16)	0.99 (0.14)	**1.09 (0.15)**	1.11 (0.15)
PBC (proxy)	0.91 (0.13)	**1.85 (0.35***)**	1.32 (0.2*)	**1.48 (0.24**)**	1.23 (0.24)	**2.02 (0.47**)**	**1.46 (0.22**)**	0.96 (0.16)	**1.45 (0.22**)**	1.21 (0.17)
Subjective norms (proxy)	1.1 (0.21)	1.08 (0.29)	1.16 (0.24)	1.25 (0.29)	**0.58 (0.14**)**	1.04 (0.36)	**1.75 (0.38**)**	1.08 (0.23)	**1.44 (0.29*)**	1.35 (0.25)
Past experiences	1.01 (0.04)	**1.39 (0.08***)**	**1.27 (0.06***)**	**1.25 (0.06***)**	**1.33 (0.08***)**	**1.68 (0.14***)**	**1.18 (0.05***)**	**1.2 (0.06***)**	**1.19 (0.05***)**	1.05 (0.04)
Constant	1.47 (0.65)	2.32 (1.45)	0.53 (0.25)	**0.38 (0.2*)**	0.79 (0.49)	0.88 (0.7)	**0.32 (0.16**)**	1.42 (0.7)	0.87 (0.4)	0.55 (0.25)
Pseudo R^2	0.02	0.06	0.04	0.06	0.05	0.10	0.08	0.04	0.06	0.03

The dependent variable in each model measures the willingness of respondents to **M1**. Heat your housing unit during the winter heating season to a level of 18 degrees Celsius; **M2**. Replace all classic light bulbs in the housing unit with so-called energy-saving light bulbs; **M3**. Use large electricity consumers (washing machine, dishwasher, water heater, electric heaters) only at night; **M4**. Invest in quality carpentry – windows (PVC / ALU); **M5**. Turn off radiators and heating sources in rooms that are rarely used; **M6**. Turn off the light source in rooms that are less or not used; **M7**. Invest in home appliances (dishwashers, stoves, refrigerators, water heaters) that have energy efficiency certificates; **M8**. Invest in better exterior insulation of the walls of a residential unit / building; **M9**. Invest in new / modern heaters with lower energy consumption; **M10**. Invest in alternative energy sources (solar panels on the roof of the building; biomass heaters...)

***Significant at 0.01 level. **Significant at 0.05 level. *Significant at 0.10 level.

5. Conclusions

This paper focuses on the analysis of the extent individuals are willing to undertake energy efficiency measures, with the main focus on the sample from a developing country. More precisely, the study analyses the willingness of individuals to support ten different energy efficiency measures at home. Understanding how individuals differ in terms of their support for these measures might help us better shape policy toward a more sustainable future.

5.1. Main findings

Individuals from Bosnia and Herzegovina associate energy efficiency with energy savings from electricity and heating of the housing unit. Interestingly, 17.2% of respondents stated that they do not know the meaning of energy efficiency. The typical person with no idea about energy efficiency is one with a lower education level and probably a younger individual. Individuals are willing to undertake many measures to become energy efficient, but the most common are the ones that are the least mentally demanding, such as turning off the light bulbs, using energy-saving bulbs, and not heating rarely-used rooms. Investment in alternative energy sources and heating the room at lower temperatures are among the least popular measures. However, individuals believe that these are not the most efficient measures in terms of their impact, i.e., improving the quality of insulation of the external walls and utilization of solar panels, and installation of modern windows and doors are perceived to be the measures with the most impact on reducing energy consumption. Nevertheless, our logistic regression models found no statistically significant predictor across all ten measures used in the study. Our regression models aimed to test whether individuals' characteristics can contribute to the explanation of variability in individuals' willingness to support ten energy-related measures. Our results indicated that past experience is the single most important predictor of intention to implement energy-efficiency measures, i.e., in most cases, it shows that with a one-unit increase in the number of implemented measures, we expect to see between 18-68% increase in the odds of being willing to undertake energy-efficiency measures. The second most common predictor is age, found to be statistically significant in seven models. Interestingly, our results indicate that age can both increase and decrease odds for certain energy-saving behaviors. Being married is also found to be an important predictor, in most cases increasing the odds for energy-saving types of behaviors. The proxy we used to measure perceived behavioral control is found in the majority of models to be an important predictor. Other variables were only found to play a statistically significant role in some models.

5.2. Policy implications

These results might be beneficial in defining policies in order to promote energy-saving behaviors. For the purpose of informing policy-decision makers, Table 7 provides the overview of the most common predictors across models with their indicative direction of the effect.

Our first policy recommendation concerns the role of an individual's previous experience in energy-saving measures. As individuals with more past experience are more likely to engage in energy-saving behaviors, providing suitable examples in the form of possible savings or providing financial and non-financial support to implement some measures might be a good starting point to increase energy savings initiatives further. In order to gain the first experience, financial incentives for the replacement of old appliances are found relevant in the existing literature, including various incentives (De Almeida, Fonseca, Schlomann, and Feilberg 2011): reducing VAT on highly energy-efficient products, rebates, and subsidies, demand side management programs, tax credits given to manufacturers and white certificates. Other methods to gain first experience could also come by utilizing existing policy recommendations in the literature (De Almeida, Fonseca, Schlomann, and Feilberg 2011): raising awareness about labeling schemes and expanding the energy label to include more products and increasing minimum standards. From the perspective of employers, mirror flourishing and personal/individual approaches (Glavas, 2012) can be used to engage employees for higher sustainability practices in the organization. Similarly to the practices within the organization, these practices might be used broadly, i.e., being applied to the overall population. Mirror flourishing, a practice being used in the organizational context, is defined as "the consonant flourishing or growing together that happens naturally and reciprocally to us when we actively engage in or witness the acts that help nature flourish, others flourish, or the world as a whole to flourish." (Cooperrider and Fry 2012, p.24). Jointly with the action of raising awareness, managers and key staff could demonstrate energy-efficient behavioral patterns in order to experience the effects of mirror flourishing. As such, new policies should ensure the first experience in applying

Table 7. The most common predictors across models with their indicative direction of the effect

Independent variable	Frequency*	%	The indicative direction of the effect
Past experience	8	80%	Individuals with past experience are more inclined to implement energy-saving measures.
Age	7	70%	Older individuals might be less inclined to implement energy-saving measures.
Marital status	7	70%	Being married is associated with higher chances of increasing the odds of engaging in energy-efficient practices.
Perceived behavioral control (PBC)	5	50%	Individuals with greater PBC might be more inclined to implement energy-saving measures.
Income	5	50%	Individuals with higher incomes might be more inclined to implement energy-saving measures.
Subjective norms	3	30%	Individuals with higher subjective norms might be more inclined to implement energy-saving measures.
Type of settlement	2	20%	Urban individuals might be more inclined to implement energy-saving measures.
Years of education	2	20%	More educated individuals might be more inclined to implement energy-saving measures.
Gender	1	10%	Inconclusive
Attitude toward the behavior	1	10%	Individuals with a positive attitude might be more inclined to implement energy-saving measures.

* Note: Frequency refers to the number of times the predictor has a statistically significant influence on dependent variables across ten models.

any energy-efficiency practice, to promote behavioral changes further.

In addition to these policy recommendations, individuals of different ages and marital statuses process information and make decisions differently. Some investments are typically implemented early in life when individuals or married couples invest in purchasing housing units. However, their intention to replace or change these products is reduced as they age, making investing in more energy-efficient solutions harder. However, aging also brings wisdom and awareness of the potential of energy-saving opportunities. Policy measures should promote behavioral changes at the earliest age, starting with the formal educational system. However, awareness-raising campaigns should consider different factors that influence every stage of an adult's life and the potential for savings in these stages, considering the different needs of married couples, single individuals, and individuals of different ages. Awareness-raising campaigns should consider who the decision-maker is, i.e., if the decision is made by an individual or jointly. The existing literature notes that cross-cultural variations significantly influence consumer behavior, with some products being adopted regardless of cultural differences (Timokhina, Urkmez, and Wagner 2018).

If an individual does not have the capability, resources, and opportunities to perform a given behavior, it is not rational to expect changes in behavior. In that regard, decision-makers should identify and then remove or reduce obstacles that are found to influence perceived behavioral control. Promoting the reduction of the heating temperature in the largest canton in Bosnia and Herzegovina (Canton Sarajevo) without being able to experience the benefits of such behavior is rather a waste of public money. For example, the price for the consumption of the central heating system, used by 34% of households in Canton Sarajevo (as noted by Midžić Kurtagić, Arnaut, and Mahmutović 2019), is calculated solely based on the square meters, which does not account for energy-efficiency measure implemented in the building or how individuals behave.

5.3. Limitations

The paper has several shortcomings. As we used data already collected to draw some useful conclusions, our model did not include some useful psychological variables. This is a shortcoming that might be addressed by future papers. We also used proxy variables for PBC and subjective norms, which might limit the interpretation of our results.

Endnotes

1 Belgium, Bulgaria, Czech, Denmark, France, Germany, Greece, Hungary, Norway, Portugal, and Romania

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HRM PRACTICES AND ORGANIZATIONAL PERFORMANCE: MEDIATION EFFECT OF INNOVATION

Lejla Turulja, Amra Kožo, Emir Kurtić, Mirjana Pejić Bach

Abstract

The main aim of this study is to explore the mediating effect of innovation in the relationship between human resource management (HRM) practices and organizational performance. HRM practices are observed through selective hiring, training, participative decision-making, and rewarding. Innovation is conceptualized over behavioral, product, process, and market innovation. The study relies upon the principles of social exchange theory and resource-based theory. Data were collected from 408 managers in an emerging economy context. The proposed conceptual model is evaluated with structural equation modeling using Lisrel 8.8 and SPSS 22. Study findings suggest that innovation influences the relationship between selective hiring, training, and participative decision-making and organizational performance. However, no mediating effect of innovation was found in a relationship between rewarding and organizational business performances. Since human resources and innovation are among the leading sources for building competitive advantage for companies, the study findings contribute to HRM and innovation.

Keywords: *Innovation, Human Resource Management Practices, Organizational Business Performance*

JEL classification: *M1, M12, M15*

Lejla Turulja, PhD
Associate Professor
University of Sarajevo
School of Economics and Business
Sarajevo, Bosnia and Herzegovina
E-mail: lejla.turulja@efsa.unsa.ba
ORCID: https://orcid.org/0000-0003-1493-8318

Amra Kožo, PhD (corresponding author)
Assistant Professor
University of Sarajevo
School of Economics and Business
Address: Trg oslobođenja Alija Izetbegović 1
Sarajevo, Bosnia and Herzegovina
E-mail: amra.kozo@efsa.unsa.ba
ORCID: https://orcid.org/0000-0002-9756-1378

Emir Kurtić, PhD
Associate Professor
University of Sarajevo
School of Economics and Business
Sarajevo, Bosnia and Herzegovina
E-mail: emir.kurtic@efsa.unsa.ba
ORCID: https://orcid.org/0000-0002-4846-7991

Mirjana Pejić Bach, PhD
Full Professor
University of Zagreb
Faculty of Economics & Business
Zagreb, Croatia
E-mail: mpejic@net.efzg.hr
ORCID: https://orcid.org/0000-0003-3899-6707

1. Introduction

Nowadays, organizations face a dynamic business environment characterized by increased global competition, rapid technological change, and changing customer demands (Duodu and Rowlinson 2019). In such complexity, innovations are often observed as one of the pillars for achieving and maintaining competitive advantage (Lee, Lee, and Garrett 2019) and business performance (Exposito and Sanchis-Llopis 2018). Their role is especially emphasized in a time of uncertainty, which was evident during the COVID-19 pandemic when digital innovations became the backbone of personal and professional life (Verma and Gustafsson 2020). The architects of innovative ideas in organizations are employees who, through their work, promote, test, implement and improve both innovative and all business processes in organizations. Depending on their strategic orientations, organizations apply different human resource management (HRM) activities by implementing various HRM practices to attract, recruit, select, engage, and maintain those employees who have been assessed as the best fit for organizations.

Human resources (HR) are both the drivers and the bonds for many organizational processes. Their role is crucial in achieving successful business performance (Jiménez-Jiménez and Sanz-Valle 2008), and strategic HRM practices are recognized as sources of sustainable competitive advantage (Boselie, Dietz, and Boon 2005). Since HRM practices might influence organizational outcomes, it is essential to study and observe the relationship between them to determine the most valuable practices for reaching organizational goals.

The research on the relationship between HRM practices and organizational performance has become a topic of interest in academic research during the 1990s (Lee, Lee, and Wu 2010). The vast majority of published studies provide evidence of a positive relationship between HRM and business performance, but the causal relationship results are ambiguous (Saridakis, Lai, and Cooper 2017). In addition, the literature has recognized the positive impact of innovation on business performance (e.g., Arranz *et al.* 2019; Ferreira, Fernandes, and Ferreira 2019). While Engelsberger *et al.* (2021) discuss the growing interest in exploring the influence of HRM practices on the organizational capacity for innovation, Jotabá *et al.* (2022) argue that even though HR practices are essential for innovation, empirical research examining HRM and innovation is quite scarce. Moreover, Kutieshat and Farmanesh (2022) discuss the mediating role of organizational innovation between new HRM practices and innovation performance. In addition, Farouk *et al.* (2016) recognized the mediating role of innovation in an HRM and organizational business performance relationship.

Considering that human resources are the foundation of business processes, this study observes how HRM practices encourage innovation and how HRM practices and innovation (re)shape business processes and contribute to organizational performance. While the relationship between HRM practices and innovations is recognized, the influence of different HRM practices on organizational business performance with innovation's mediating role is still unclear and insufficiently explained. There is a clear gap in the literature related to the synergistic effect of individual HRM practices on innovation capability and business performance. An analysis of their interrelationship is particularly important, given that individual HRM practices may influence employees' innovative behavior differently. Therefore, the present study aims to empirically examine the influence of recruitment, training, employee participation in decision-making, and the reward system (Perez Lopez, Montes Peon and Vazquez Ordas 2005; Hsu *et al*. 2007) on organizational business performance with the mediation effect of innovation in the relation between HR practices and business performance. This study contributes to the ongoing debate about HRM practices and organizational innovation. It discusses innovation as a predictor of organizational performance and explains its role as a mediator.

2. Literature Review

2.1. Innovation

According to Van de Ven (1986), Amabile (1996), Damanpour and Schneider (2006), and Fay *et al.* (2015), innovation is observed as the development or adaptation and implementation of an idea that is useful and new for an organization at the time of adoption. Sanders and Lin (2016, p. 32) define innovation as "a strategic orientation involving the regeneration of product, process, services and/or strategies." Dibrell, Craig, and Neubaum (2014) address innovation as an organization's focus on technological development, new products and services, or improving production and other business processes to achieve competitive advantage. Innovation involves multiple types: behavioral, product, process, and market innovation.

Behavioral innovation is "an organization's behavioral proclivity or willingness to change" (Alpay *et al.* 2012). Behavioral innovation is viewed through individuals, teams, and management commitment and

enables the creation of an innovative culture, which is a fundamental prerequisite for generating new ideas and innovations (Ellonen, Blomqvist, and Puumalainen 2008). *Product innovation* refers to something new and innovative, with the products being marketed simultaneously (Wang and Ahmed 2004). It has been considered one of the main drivers of value creation (Visnjic, Wiengarten, and Neely 2016). *Process innovation* relates to an original way of doing business (Un and Asakawa 2015). Gunday *et al.* (2011) point out that while product introductions are typically assumed to have a clear, positive impact on revenue growth and employment, process innovations may have an unclear effect. *Market innovation* represents new ways for entering and exploiting the target market (Ellonen, Blomqvist, and Puumalainen 2008). It is closely linked to product innovations, so they are often analyzed together in the literature (Wang and Ahmed 2004).

2.2. Human Resource Management Practices

Human resources management comprehends all the activities that manage people in an organization (Boxall and Purcell 2008). Mäkelä *et al.* (2013) view HRM as an organization's ability to implement and maintain appropriate HRM practices in performance management, education and development, and employee compensation and reward programs. HRM practices are the main assets used by organizations to influence employees' skills and behaviors to achieve organizational objectives (Prieto and Pérez-Santana 2014). Different authors perceive HRM practices from different standpoints, therefore not always encompassing the same practices within their operational definitions. Snape and Redman (2010, p. 1222) state that HRM practices are "formal integrated systems of HR activities that include selective recruitment and selection, extensive training and development of regular performance appraisal, performance-contingent rewards, and high levels of employee involvement." According to Becker and Huselid (1998), organizational performance is enhanced when a firm adopts recruiting and selection system, reward system, and training and development system.

To explore HRM practices that are positively associated with organizational performance while bearing in mind the role of innovation and the tie between HRM practices and innovation, in this study, the concept of HRM capability observed through HRM practices is adopted. Perez Lopez, Montes Peon, and Vazquez Ordas (2005) indicate that the most significant practices that contribute to the development of organizational HRM capability are selective recruitment, training, employee participation in decision-making, and a rewarding system. Also, Delery and Doty (1996, p. 805) argue that HRM practices should be theoretically and empirically related to overall organizational performance.

Selective recruitment refers to the criteria for hiring with the primary aim of recruiting the best individuals in terms of their potential (Perez Lopez, Montes Peon, and Vazquez Ordas 2005). It ensures that the selected employees possess the knowledge and skills necessary for the job and enables person-organization fit in terms of values, goals, and personality (Chang, Gong, and Shum 2011). Moreover, Michie and Sheehan-Quinn (2001) discuss an indirect link between selective hiring and organizational performance manifested through strengthening internal bonds between managers and employees, creating the right culture for higher productivity. *Training* refers to the organization's planned effort to facilitate the acquisition of particular knowledge, skills, competencies, and behaviors that employees need to conduct their current jobs successfully (Goldstein 1993). Training enhances relevant skills and abilities and increases employee satisfaction with their current job and workplace. *Participative decision-making* comprehends control of employees "over their own job tasks and an enhanced understanding of and participation in organizational decision-making" (Probst 2005). Participation in decision-making refers to HR practices, where the influence between superiors and subordinates is shared. It enables employees to be informed about business processes and creates a sense of belonging to the organization (Perez Lopez, Montes Peon, and Vazquez Ordas 2005). Finally, *rewarding* comprehends a compensation system based on equality principles and contains incentive programs related to goal achievement (Perez Lopez, Montes Peon, and Vazquez Ordas 2005). The incentive is performance-dependent and improves employee motivation by aligning employee and organization interests (Jiménez-Jiménez and Sanz-Valle 2008).

2.3. Organizational Business Performance

Organizational business performance is typically considered as the extent to which an organization achieves its desired goals and objectives, such as increasing revenue, profit, market share, return on investment, customer satisfaction, and employee productivity (Chen, Tsou, and Huang 2009). In addition, performance can be measured in relation to the

competition, which indicates the extent to which an organization can outperform or match the performance of other firms in the same industry or market (Cruz-González *et al*. 2015). This includes comparing the organization's performance metrics with those of its competitors. Typically, a combination of financial and non-financial indicators, such as sales growth, profitability, return on investment, employee turnover, customer retention, and brand recognition, is used to evaluate an organization's business performance. This paper used financial indicators of business performance in relation to the competition.

3. Hypotheses Development

3.1. The Interplay of Social Exchange and Resource-Based Theories

This study draws on the social exchange theory (SET) and the resource-based view (RBV) to explain the interplay between HRM practices and innovation and their impact on organizational business performance. SET provides a foundation for a better understanding of HRM practices and their role in establishing commitment and positive work attitudes (Ko and Hur 2014). The SET premise states that social and material resource exchange is a basic form of human interaction (Blau 1964). According to Shaw *et al.* (2009), SET comprehends economic and socioeconomic exchanges such as consideration of employee well-being, stability, career advancement, and intangible issues such as perceptions of fairness. The present study observes social exchange between an organization (HRM practices) and employees (workplace behavior). When HRM practices are positive, employees adopt and manifest a positive attitude toward the workplace (Ko and Hur 2014; Shaw *et al.* 2009). Hence, HRM practices are essential for social exchange from an employee perspective.

In addition to SET, the resource-based view (RBV) is integrated into this study. According to RBV, organizational superior business performance depends on its resources and uses during operations (Barney and Clark 2007). Resources should be valuable, rare, inimitable, and non-substitutable (Javalgi and Todd 2011). They are controlled by an organization that enables it to devise and implement strategies created to improve its effectiveness and efficiency (Mahdi, Nassar, and Almsafir 2018). Therefore, relying on SET, this study describes the influence of HRM on innovation. On the other hand, RBV explains the effects of HRM and innovation on organizational performance.

3.2. Innovation, HRM and Business Performance

In the relationship between HRM, innovation, and performance, HRM enhances innovation while innovation positively contributes to business performance (Farouk *et al.* 2016). Pradana, Pérez-Luño, and Fuentes-Blasco (2020), in the light of the resource-based view, examined the positive relationship between human capital and innovation and the positive relationship between innovation and performance. Several studies have addressed the mediating effect of innovation between HRM and the firm's performance (e.g., Chowhan 2016; Farouk *et al.* 2016; Diaz-Fernandez, Bornay-Barrachina, and Lopez-Cabrales 2017). The rationale of the mediation is that HRM investment aims to promote the necessary behavior among employees to make companies more competitive and consistently more profitable (Diaz-Fernandez, Bornay-Barrachina, and Lopez-Cabrales 2017). If HRM practices enhance innovation performance and influence organizational performance, innovation is observed as the driver between HRM and the firm's performance (Farouk *et al.* 2016). Human resources use knowledge to develop sustainable competitive advantage and successful performance based on innovation processes (Martinez-Sanchez, Vicente-Oliva, and Pérez-Pérez 2020). In line with the discussion, it is hypothesized that innovation mediates the relationship between HRM practices and business performance.

H1. Innovation mediates the relationship between HRM and organizational business performance.

Bäckström and Bengtsson (2019) discuss the HRM-related activities related to hiring, selecting, and rewarding employees and how various financial incentives influence innovative behavior. Gope, Elia, and Passiante (2018) discuss HR practices, such as recruiting and selection activities and training programs, in the context of knowledge management strategy and organizational strategy and their contributions to the innovation activities of an organization. Li, Zhao, and Liu (2006) discuss how employee training, non-material motivation, and process control positively influence technological innovation, while material motivation and outcome control negatively influence technological innovation. Similarly, Chang, Gong, and Shum (2011) found that hiring and training significantly influence incremental and radical innovation among hotel and restaurant companies. Knoke and Kalleberg (1994) argue that training leads toward positive organizational outcomes, while Ling and Nasurdin (2010) state that training positively and significantly

influences organizational innovation. Jotabá *et al.* (2022) discuss how innovation occurs when HR activities are focused on learning and development. Hill, Tedards, and Swan (2021) argue that innovation should be driven by better decision-making, while Flores-Garcia *et al*. (2021) explore decision-making approaches while implementing process innovation. According to Maier *et al.* (2014), a proper reward system is a powerful tool for commitment, professional growth, and innovative corporate culture. Therefore, in line with the discussion on the relationship between innovation, HRM, and organizational performance, and relying on studies that have analyzed the relationship between individual HRM practices and innovations, and using SET and RBV as foundation theories, a mediation model with the following hypotheses is proposed.

H1a. Innovation mediates the relationship between employees' selection and organizational business performance.

H1b. Innovation mediates the relationship between the training of employees and organizational business performance.

H1c. Innovation mediates the relationship between employees' participation in decision-making and organizational business performance.

H1d. Innovation mediates the relationship between a rewarding system and organizational business performance.

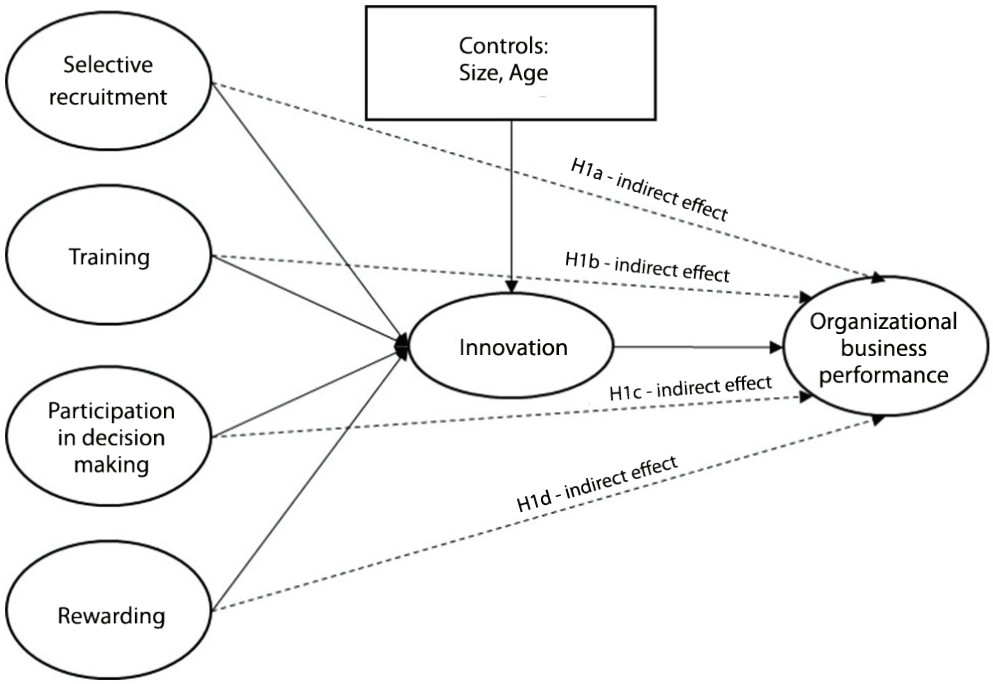
4. Research Methodology

Confirmatory factor analysis (CFA) and structural equation modeling (SEM) were selected as data analysis methods. CFA was used to verify the reliability and validity of measurement models, while SEM was used to test hypotheses and analyze the structural model (Hair *et al.* 2014).

4.1. Measures

Indicators of measurement scales are adopted from validated empirical studies. The psychometric properties of measures have been evaluated by accepted practices (Anderson and Gerbing 1988; Bagozzi, Yi, and Phillips 1991), and the content, nomological, discriminant, and convergent validity of constructors were verified. Content validity refers to a clear understanding of the meaning and content of each variable (Hair *et al*. 2014). It is tested before conducting the research, together with nomological validity, which implies confirmation that the correlations between the constructs have theoretical meaning. Content and nomological validity tests are conducted during and after the operationalization of the measurement scales. All indicators have to be carefully revised in terms of text, specificity, and length to ensure relevance to the research context. Content validity and relevance are justified by a panel of experts consisting of two managers and four scholars.

Figure 1. Proposed conceptual mediating model



Innovation is assessed with the different types of innovation an organization generates. The reflective indicators are adopted from Ellonen, Blomqvist, and Puumalainen (2008). HRM practices are conceptualized through selective recruitment, training, employee participation in decision-making, and rewarding (Perez Lopez, Montes Peon, and Vazquez Ordas 2005). All dimensions consisted of three reflective indicators, each adopted from Perez Lopez, Montes Peon, and Vazquez Ordas (2005). Chen, Tsou, and Huang (2009) adopted reflective indicators for organizational business performance. Respondents were asked to indicate the extent to which they strongly agree or disagree with items related to analyzed concepts using a seven-point Likert scale.

The usual control variables, namely the size and age of the organizations, are included in the model. Firm size is measured as the firm-wide number of employees and firm age with the years the organization has been in business (Lu and Ramamurthy 2011). Earlier research has confirmed differences in organizations' innovativeness depending on age and size. While Mothe and Uyen Nguyen Thi (2010) argue that firm size positively influences the propensity to innovate, Jiang, Wang, and Zhao (2012) indicate that increasing size may create uncertainties that demand innovative behavior. Large firms may have access to a broader range of knowledge and human capital skills, enabling innovation.

4.2. Data Collection and Sample

An online survey collected data from organizations in an emerging economy context. The managerial sample was chosen since they create a setting that shapes employees' experience within an organization (Yukl 1989). The general managers of the companies were identified as key respondents based on two primary criteria: i) possessing sufficient knowledge and ii) an adequate level of involvement in the concepts being analyzed (Campbell 1955). Following the letter of invitation, two reminders were sent at 12 and 16-day intervals. Also, the respondents were guaranteed anonymity and were informed that the research results would be presented collectively and for scientific research purposes. After excluding observations from multiple missing values, 408 remained for the analysis, considered an adequate sample size (Hair *et al.* 2014). The sample consists of 11% micro firms, 37% small and 37% medium-sized firms, and 15% large firms. The average age of firms is 22, while the average number of employees is 152.

5. Research Results

Data analysis was performed in several steps. First, the data were examined for assumptions of multivariate techniques following Hair *et al.* (2014). Then, the CFA was used to test the reliability and validity of the measurement model. Finally, the hypotheses and the conceptual mediation model were evaluated using SEM following Anderson and Gerbing's (1988) two-step approach. The results were further validated using the Sobel test (Sobel 1981) and bootstrapping method in SPSS (Hayes 2013). First, the measurement model's unidimensionality, reliability, convergent, and discriminant validity were assessed using CFA and Lisrel 8.8 software (Diamantopoulos and Siguaw 2000). A structural model was assessed in the second phase based on the measurement models estimated in the first phase (Andreeva and Kianto 2012).

Since data were gathered from a single key informant in an organization, there was a risk that they could suffer from common method bias (CMB). Following Podsakoff *et al.*'s (2003) suggestions, two procedural and one statistical remedy were used to control potential CMB. First, respondents' anonymity was guaranteed in the invitation letter to reduce evaluation apprehension. Vague concepts were avoided, and items were kept simple, specific, and concise when translating (Tsai and Yang 2013). Harman' s single-factor test was conducted for the statistical remedy by specifying a hypothesized method factor as an underlying dimension of all the indicators (Podsakoff *et al.* 2003). The results of the CFA with the twenty-eight indicators loading onto a single factor (χ^2/df=4,766.151/405=11.77; RMSEA=0.163; SRMR=0.107; CFI=0.842; NFI=0.826) showed a poor fit, suggesting that the single factor does not account for all of the variances in the data (Pérez-López and Alegre 2012).

5.1. Reliability and Validity Analysis

Results of the assessment of unidimensionality, reliability, discriminant, and convergent validity are presented in Tables 1 and 2. Composite reliability (CR) for each construct was greater than 0.70 confirming the constructs' reliability (Hair *et al*. 2014). Convergent validity is assessed by confirming that the values of each variable's standardized factor loadings on the proposed construct (Anderson 1987) are greater than 0.6 (Hair *et al.* 2014). Also, the average variance extracted (AVE) indicators above 0.5 confirmed good convergence. Finally, discriminant validation is assessed by comparing the square root value of the AVE indicator with the correlation values of that all other constructs

Table 1. CFA factor loadings

Construct	Items	λ
Human Resource Management (Perez Lopez *et al.* 2005)	*Selective recruitment* – In my firm...	
	The members of the department or team, which the new worker will be part of, participate in the selection of candidates.	0.700
	In the process of selecting candidates for recruitment, knowledge, and experience are valued.	0.818
	In the process of selecting candidates for recruitment, teamwork skills, and propensity for continuous learning are evaluated.	0.863
	Training – In my firm...	
	Employee training and development policies cover all the employees in the firm.	0.814
	Training programs are mainly based on firm-specific knowledge.	0.843
	Every employee receives training during his/her professional life.	0.757
	Participation of the employees in the decision-making – In my firm...	
	Employees participate in the decision-making process.	0.651
	Employees are regularly informed of the firm's economic and strategic information.	0.767
	There is a high degree of personnel empowerment.	0.833
	Rewarding system	
	The organization has a mixed system of rewarding: fixed + variable.	0.696
	The firm offers incentives to employees, depending on their job performance alone.	0.845
	The firm offers incentives to employees, depending on their effort and commitment.	0.813
Innovation (Ellonen *et al.* 2008)	*Behavioral innovation* – In my firm…	
	Employees get a lot of support from managers if they want to try new ways of doing things.	0.781
	Individuals who do things in a different way are accepted and tolerated.	0.717
	People are willing to try new ways of doing things and seek unusual novel solutions.	0.884
	People are encouraged to think and behave in original and novel ways.	0.830
	Product Innovation	
	During the past five years, my firm has introduced more innovative products and services than its competitors have.	0.901
	In new product and service introductions, my firm is often first-to-market.	0.967
	The new products and services of my firm are often perceived as very novel and innovative by customers.	0.834
	Process Innovation	
	My firm improves its business processes constantly.	0.853
	During the past five years, my firm has developed many new management approaches.	0.817
	When a problem cannot be solved using conventional methods, people in my firm invent new methods.	0.666
	Market innovation	
	In comparison with its competitors, my firm's most recent product/service marketing program is revolutionary in the market.	0.762
	In the new product and service introduction, my firm is often at the cutting edge of technology.	0.779
Organizational Business Performance (Chen *et al.* 2009)	Rating realized profits compared to its main competitors in the past 3 years.	0.929
	Rating realized sales compared to its main competitors in the past 3 years.	0.853
	Rating realized return on investment compared to its main competitors in the past 3 years.	0.821
	Rating realized the planed market share in the past 3 years.	0.648
Firm's age	Assessed by the number of years since the firm was founded.	
Firm's size	Assessed by the number of employees (natural logarithm).	
$\chi 2/df<3$; RMSEA<0.08; SRMR<0.08; CFI>0.95; NFI>0.9		
Notes: λ – CFA factor loadings; All items significantly load to their reflective constructs.		

Table 2. Reliability and validity assessment

#	Dimensions	CR	AVE	1	2	3	4	5	6	7	8	9
1	Recruitment	0.838	0.635	**0.797**								
2	Training	0.847	0.649	0.682	**0.805**							
3	Participation	0.797	0.569	0.605	0.684	**0.754**						
4	Rewarding	0.829	0.620	0.389	0.373	0.465	**0.787**					
5	Behavioral innovation	0.880	0.649	0.467	0.511	0.600	0.329	**0.805**				
6	Product innovation	0.929	0.814	0.443	0.485	0.569	0.312	0.548	**0.902**			
7	Process innovation	0.825	0.613	0.569	0.623	0.731	0.401	0.704	0.668	**0.783**		
8	Market innovation	0.745	0.594	0.498	0.545	0.640	0.351	0.616	0.584	0.751	**0.771**	
9	Business Performance	0.889	0.671	0.323	0.354	0.416	0.228	0.400	0.379	0.488	0.426	**0.819**
	Age			-0.157	-0.068	-0.066	-0.070	-0.159	-0.151	-0.194	-0.170	-0.110
	Size			-0.169	-0.004	-0.002	0.040	-0.046	-0.044	-0.057	-0.049	-0.061

Notes: Squared-root AVEs are shown on the diagonal in bold; CR = Composite reliability; AVE = Average Variance Extracted; Construct correlations are shown below the diagonal.

(the AVE value should be higher) (Fornell and Larcker 1981) (see Table 2). Also, the Goodness of Fit (GoF) indicators of the measurement model reveal an acceptable fit (χ2/df<3; RMSEA<0.08; SRMR<0.08; CFI>0.95; NFI>0.9).

5.2. Hypotheses Testing

The hypotheses were tested by applying structural equation modeling techniques (Diamantopoulos and Siguaw 2000). First, the assessment of the structural model resulted in an acceptable model fit (χ2/df=1,010.309/381=2.65; RMSEA=0.0637; SRMR=0.0623; CFI=0.971; NFI=0.954) (Hair *et al*. 2014). According to Hair *et al*. (2014, p. 583), "the researcher should report at least one incremental index and one absolute index, in addition to the χ2 value and the associated degrees of freedom". The most commonly used absolute index is RMSEA, while the incremental indicator most often used to represent model fit is CFI.

Parameter estimates and their corresponding significance levels for hypotheses testing are provided in Table 3 and Table 4. As expected, innovation mediates the relationship between selective recruitment and organizational business performance (H1a: β=0.053, p<0.1). The results also support H1b and confirm the mediating role of innovation between training and firm performance (β=0.099, p<0.01). The indirect impact of employee participation in decision-making through innovation is also supported by study findings (H1c: β=0.299, p<0.01). Finally, the results failed to confirm the indirect impact of rewards on organizational performance (H1d: β=0.026, p>0.1).

Table 3. Path analysis estimates

Hypotheses	*Paths*	*Stand. Coeff.*	*T – value*
H1a	Recruitment → INNO → OBP	0.053*	1.508
H1b	Training → INNO → OBP	0.099***	2.527
H1c	Participation → INNO → OBP	0.299***	6.485
H1d	Rewarding → INNO → OBP	0.026	1.036
Age	Age → INNO	-0.073***	-3.507
Size	Size → INNO	-0.003	-0.124
R^2 (INNO) = 68.8; R^2 (OBP) = 27.7			
χ^2/df=1,010.309/381=2.65; RMSEA=0.0637; SRMR=0.0623; CFI=0.971; NFI=0.954			
***p<0.01; ** p<0.05; * p<0.1			

Table 4. Decomposition of effects

Path	Unstandardized coefficients (t-values)			Standardized coefficients		
	Total Effect	Direct Effect	Indirect Effect	Total Effect	Direct Effect	Indirect Effect
H1a	0.106* (1.508)		0.106 (1.508)	0.053		0.053
H1b	0.152*** (2.527)		0.152 (2.527)	0.099		0.099
H1c	0.594*** (6.485)		0.594 (6.485)	0.299		0.299
H1d	0.137 (1.036)		0.137 (1.036)	0.026		0.026
Age	-0.00518*** (-3.507)	-0.00518 (-3.507)		-0.073	-0.073	
Size	-0.00568 (-0.124)	-0.00568 (-0.124)		-0.003	-0.003	
***p<0.01; **p<0.05; *p<0.1; one-tailed for hypotheses and two-tailed for controls						

The findings show that firm size does not influence firm innovation (β=-0.003, p>0.1), whereas age has a negative impact (β=-0.073, p<0.01). This is in line with some earlier research that argues that innovation may decrease with the aging of a firm since younger firms are more prone to innovation while older ones are less innovative (Jiang, Wang, and Zhao 2012).

Furthermore, the PROCESS (Hayes 2013) in SPSS was used to conduct a mediation analysis to confirm the indirect effect of the independent variables on the dependent variable through the INNO mediator. Composite mean scores of latent variables were created (Kianto, Sáenz, and Aramburu 2017; Tsou and Cheng 2018) and then used to produce a bias-corrected 95% level (90% for H1, following results of SEM estimation) bootstrap CI for the indirect effects. If zero is absent from the interval for an indirect effect, with a 95% confidence, that mediated relationship is significantly different from zero. Mediation models were estimated separately by hypothesis using bootstrapping (5,000 resamples) to calculate bias-corrected and accelerated confidence intervals (Cis) for the indirect effect.

The subsequent PROCESS analysis confirmed the findings of the SEM analysis by providing additional evidence of the mediating role of innovation in the relationships between selective recruitment and organizational performance, training and firm performance, and employee participation in decision-making and organizational performance. The importance of HRM practices for business performance and innovation was also highlighted by the mediation models' discovery of significant indirect effects. The use of bootstrapping to calculate bias-corrected and accelerated confidence intervals provided substantial support to these findings. The results, however, did not support the hypothesis that rewards indirectly affect organizational performance via innovation.

Overall, the results provide support for the hypothesized mediation model, in which the three independent variables, dimensions of HRM practices have significant indirect effect on the organizational performance through innovation.

Finally, the mediating effect of innovation between HRM and organizational business performance was tested using the bootstrapping method proposed by Preacher and Hayes (2008) in SPSS 22. The results confirm that innovation fully mediates the relationship between HRM and OBP (β=0.4619, BootSE=0.0577, BootLLCI=0.3509, BootULCI=0.5796).

Table 5. A mediation analysis (Hayes 2013)

H	Path	Effect	BootSE	BootLLCI	BootULCI
H1a	Recruitment → INNO → OBP	0.0787	0.0459	0.0030	0.1536
H1b	Training → INNO → OBP	0.1659	0.0359	0.0978	0.2392
H1c	Participation → INNO → OBP	0.2043	0.0401	0.1295	0.2862
H1d	Rewarding → INNO → OBP	0.0357	0.0223	-0.0062	0.0817

6. Discussion

This study was conducted in an emerging economy context on a managerial sample. The managerial structure of the sample could be of particular importance since Searle and Ball (2003) discuss how HR policies related to innovative behavior are mainly oriented towards employees, perhaps with an implicit expectation that managers should innovate anyway.

The study findings confirm that HRM practices contribute to organizational performance which is in line with other studies (e.g., Chowhan 2016; Sheehan 2014; Zhou et al. 2020). Moreover, innovation plays a mediation role in HRM – organizational performance relationships. While, Kutieshat and Farmanesh (2022) confirmed the mediation effect of innovation on the relationship between new human resource management practices and innovation performance in the companies, Prange and Pinho (2017) exhibit partial mediation of organizational innovation in a relationship between personal and organizational drivers and international performance of small and medium-sized enterprises. The present study results emphasize the importance of selection, training, and participative decision-making. Appropriate selection criteria help organizations recruit candidates that are the best fit for the organization. Training programs develop the skills of employees, and participative decision-making empowers employees. These HRM activities encourage innovative behavior and lead to innovation within the organizations. Study findings suggest that rewarding does not influence innovation or performance. More likely, observed organizational incentives and current rewarding systems do not significantly influence innovation and overall organizational performance.

Although there is a clear view in the literature about the positive relationship between HRM and innovation (Arranz *et al.* 2019; Lee, Lee, and Garrett 2019), the question of how to manage human resources to improve innovation has received little attention (Fu *et al.* 2015), especially considering the synergistic effect of individual HRM practices on innovation capability, and ultimately on business performance. Our findings show that innovation fully mediates the relationship between HRM and the firm's performance. This result is in line with some previous studies (Farouk *et al.* 2016; Fu *et al.* 2015) and adds additional confirmation to innovation's mediating role. This study, however, took a step further and tested the mediating role of innovation between individual HRM practices and organizational business performance. In this regard, the results show that selective recruitment indirectly impacts a firm's performance by promoting different types of innovation. Then, employee training positively impacts organizational innovation and overall business performance. Natalicchio *et al*. (2018) argue that the success of innovation practices is not in the recruitment of highly qualified workers; instead, it is related to employee training activities (as cited in Jotabá *et al.* 2022). Overall, the results highlight the importance of employee development, similar to Soomro, Mangi, and Shah (2020), who argue how crucial it is to encourage personal mastery and its development to enhance organizational innovation. Hence, employee learning has been confirmed as a significant determinant of innovation capability and overall business performance, and in our study, it is given priority over the reward of employees. Study findings depict that innovation mediates participative decision-making and organizational performance relationship. The top management team's participative decision-making positively contributes to management innovation (Su *et al.* 2022), and participation in decision-making is one of the team climate factors for innovations (West and Sacramento 2018).

The study results provide additional validation for SET and RBV in the organizational context of predicting the effects of management practice on employees' attitudes (Gould-Williams and Davies 2005). In other words, our results indicate the value of intangible social exchange between the organization and the employees. The organization recruits candidates by providing an organization-employee fit. Then, the organization provides personal development to employees through training programs and encourages them to participate in decision-making. On the other side, the employees develop a sense of obligation toward the organization and reciprocate the job performance in innovation. Innovation directly contributes to business success but also drives other organizational performance. Our study empirically confirms some theoretical discussions that incentives do not alter the attitudes underlying the individual's behavior (Kohn 1993). Incentives motivate people, but they drive them to get rewards (Kohn 1993), not to initiate and participate in creative activities that are prerequisites for innovation. Hayton (2005) argues that literature reports some contradictions regarding rewards systems, claiming there is no consensus on which type of rewards should be considered within a high-performance work system. Moreover, Svačina (2020) discusses that the appropriate rewarding of inventions is risky, with great potential for employee-employer conflict.

6.1. Managerial Implications

This research contributes to managerial practices in a few ways. First, the study findings confirmed that HRM practices predict organizational performance, indicating that managers should empower their HRM departments to develop and maintain a system of HR practices. Second, since innovation enhances an HRM – organizational performance relationship, managers and HR professionals should create an organizational context that promotes, encourages, and sustains employees' innovative behavior. Notably, the highlight should be on selection, training, and participative decision-making since these activities are related to innovative behavior and, together with innovation, contribute to overall organizational performance. Thus, the study findings might be used for strategic planning and decision-making within organizations.

6.2. Limitations and Directions for Further Studies

The limitations of this study are potential directions for further work. Since the study was conducted on the managerial sample, the employees' side of the story should also be investigated. Moreover, the interplay between HRM, innovation, and organizational performance among employees, should include different career stages of employees and employees at distinct professional positions within organizations. More detailed insight into the relationship between selection, training, participative decision-making, rewarding, innovation, and organizational performance would be obtained since employees in different career stages need different approaches concerning recruiting, training, rewarding, or decision-making. Moreover, in different career stages, employees might exhibit different innovative behavior.

7. Conclusion

Our research's primary value is the empirical evidence of the synergistic effect of individual HRM practices on innovation and organizational business performance. The results are particularly important for transitional and emerging economy contexts, especially those where innovation and HR practices are yet in the early development stages. This study adds to both HRM literature and innovation literature. First, this study highlights the importance of selective hiring, training, and participation in decision-making for organizational innovation and business performance. In the context of innovation literature, the results of this study clarify which HRM practices are a predominant source of innovation. Finally, our study offers practical implications by suggesting that HR professionals should support and develop consistent HR policies and practices to enhance innovative behavior and better organizational performance.

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WEALTH INEQUALITY AND INSTITUTIONAL DEVELOPMENT: MACROECONOMETRIC EVIDENCE FROM A GLOBAL SAMPLE

Rijad Kovač, Miroslav Verbič

Abstract

This paper examines the empirical relationship between institutions, particularly financial institutions, and wealth inequality using a global panel data set for the period 2010–2016. We conduct a dynamic econometric analysis of these relationships based on the Credit Suisse and World Bank data. Our results reveal that control of corruption and government effectiveness do not have statistically significant effects on wealth inequality. However, the findings indicate an unfavourable effect of domestic credit on wealth inequality as measured by the Gini coefficient for wealth. The long-run effect of domestic credit is persistent and cumulates over time. We also find evidence of relationships between wealth inequality on one hand, and inflation rate, employment in agriculture and government expenditure on the other. The findings imply that policy makers need to re-examine the role and rules in the financial intermediation sector to address the issue of wealth inequality and equal opportunities.

Keywords: *wealth inequality, institutions, financial development, financial intermediation, dynamic panel data analysis.*

JEL classification: *C23, D02, D31.*

1. Introduction

It is the wealth that Adam Smith wrote about in his work that paved the way for the modern science of economics. Individual or family wealth is one of the most important determinants of human well-being, and the interest in its distribution is natural, especially from the perspective of economic science. The popularity of Piketty's (2014) work *Capital in the Twenty First Century* among laypeople and academics serves as evidence that the issue of wealth inequality remains unresolved, but recognition of wealth as an important independent dimension of social stratification is now widely accepted (Killewald 2017). Simultaneously, we witness an era of growing wealth inequality and for example in United States the period from 1980 to 2020 was a period with extraordinary wealth accumulation (Saez and Zucman 2020).

The wealth is what we own in the current value of assets that is generated by inheritance brought down from a previous period or generations, and what we earn as income minus all consumption and liabilities we service. The average wealth for the population

Rijad Kovač, PhD (corresponding author)
Deputy Director
Federal Institute for Development Programming
Dola 15, 71000 Sarajevo
Bosnia and Herzegovina
E-mail: rijad.kovac@fzzpr.gov.ba

Miroslav Verbič, Phd
Professor of Econometrics
School of Economics and Business, University of Ljubljana & Institute for Economic Research
Kardeljeva ploščad 17, 1000 Ljubljana, Slovenia
E-mail: miroslav.verbic@ef.uni-lj.si
ORCID: 0000-0001-5506-0973

may be the same in many different distributions, but different distributions may result in widely different social outcomes in terms of individual well-being, public health, poverty, social unrest, crime rate, and so forth. About 50% of the world adult population altogether own less than 1% of the total world wealth (Credit Suisse 2017). Even in the member countries of Organisation of Economic Co-operation and Development, real assets in the form of housing constitute the main form of wealth among individuals with both low and high levels of wealth, contributing to approximately 75% of the total value of assets on average. It is only at the top of the distribution that assets such as stocks and financial holdings appear as an important form of wealth (OECD 2015). Without understanding the patterns of distribution, we may not be able to fully understand the economic and social situation of any society.

As argued by Galbraith (2012), who investigated the link between inequality and financial stability since the Great Depression, there has been no serious work done on the macroeconomic effects of wealth inequality. Others, such as Stiglitz (2015), also argue that the inequality is the fact and discussions should be focused on its importance. Furthermore, according to the International Monetary Fund (2015), an increase in inequality may have a significant impact on the economic development, growth and stability. This is because the concentration of wealth may lead to the concentration of political power and induce crises, instability, reduce investment, and lead to suboptimal use of resources.

Institutions play a critical role in shaping the costs of production and operational efficiency of markets; they are the "rules of the game" in a society (Efendic and Pugh 2008). In this paper, we address the institutional and financial system, which is a man-made construct, and its impact on the level of wealth inequality, which is currently at extreme levels and may lead to poverty, destruction of civil liberties, and deterioration of the equality of opportunity with regard to education and politics. The main interest of this paper can be summarized in the claim that "economic inequality is largely the by-product of a system's structures and not the result of major differences in individual or group talents, characteristics, and motivations" (Hurst 1997, as cited by Boix 2010).

This research provides a nexus of institutions, finance, employment and growth relationships to wealth inequality. The aim of the paper is thus to determine the relationship between wealth inequality and the institutional development, in particular financial intermediation, and to reconsider and highlight the role of institutions in creating the wealth inequality in economic and social development. In order to achieve this, we consider and synthesize available theoretical and applied research and use newly available data and methods to analyse whether and to what extent institutions in general and financial intermediaries in particular affect wealth inequality. The main research question of this paper is whether institutional quality and development, with a focus on the development of financial intermediaries, are important explanatory factors of wealth inequality. Our findings challenge the existing assumptions and contribute to the knowledge and literature on the drivers of wealth inequality and its relationship to financial institutions. Moreover, our research provides novel insights that can inform policy interventions aimed at reducing the wealth inequality.

The data for this research were obtained from the Credit Suisse and World Bank publications and databases. The data on the wealth distribution as the dependent variable, measured by the Gini coefficient for wealth, is available from the Credit Suisse *Reports on Global Wealth* for the years 2010–2016. The data on the control of corruption is available from the Worldwide Governance Indicators prepared by Kaufmann, Kraay, and Mastruzzi (2010), whereas the data for all other variables are available from the World Bank (2022b) *World Development Indicators*. For empirical analysis, we employ the generalized method of moments (GMM), formalized by Hansen (1982), in order to estimate dynamic panel data models. The GMM does not require a complete knowledge of the distribution of the data, and is suitable to deal with potential problems, such as unobserved country specific effects or reverse causality, omitted variable bias, and institutional measurement error.

The structure of the paper is as follows. Section 2 provides the theoretical underpinnings of the wealth inequality determinants, whereas Section 3 summarizes empirical evidence on the introduced wealth inequality determinants. The two sections together provide a historical and theoretical overview with relevant theories. Section 4 provides a discussion of the methodology, with a focus on the estimation procedures and the model specifications. Section 5 addresses the data sources and the variables used in the model specifications. It also provides the descriptive statistics. Section 6 presents the empirical results of the research, with a focus on estimation results, model diagnostics and sensitivity analysis. Finally, Section 7 concludes the research with the key findings and policy recommendations.

2. Theoretical underpinnings of the wealth inequality determinants

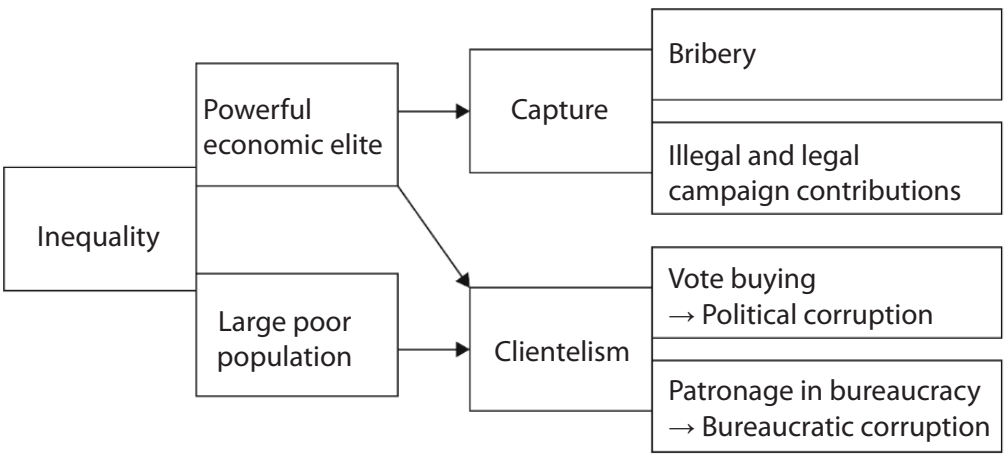
Wealth is defined as the "marketable value of financial assets plus non-financial assets (principally housing and land) less debts" (Credit Suisse 2018). The question of relationship between wealth inequality and institutions is explored in the political economy models. Do (2002) presents a model where the mechanism between the inequality and quality of institutions works through rent dissipation or competition among elites that makes them less effective at extracting rents. Other theoretical models critically relay on the saving motives of individuals, and put forward some factors that may explain wealth inequality, but without a single theoretical model or outline (Iftekhar, Horvath, and Mares 2020).

The theoretical framework of You (2015) for linking inequality and corruption in democracies is presented in Figure 1. He argues that corruption increases inequality, and points to the possible reverse causality issue, i.e., to the ambiguity in the literature of whether inequality increases corruption or corruption influences inequality or they have a mutual effect on each other. The model presents the mechanism that links inequality and corruption through the formation of a "powerful economic elite", which ensures "capture" that is linked to "bribery" and "illegal and legal campaign contributions". In addition to this channel, "powerful economic elite" also leads to "clientelism" and finally to "political corruption" and "bureaucratic corruption". According to Williams and Gashi (2022), corruption is often related to resource misallocation, and resource misallocation is usually related to the misuse of public office, state capture and preferential access to public goods and services (Efendic and Ledeneva 2020).

Piketty (2014) gave a historical overview of the works on inequality in the last couple of centuries, and he argues that David Ricardo and Karl Marx both believed that a small social group – landowners for Ricardo, industrial capitalists for Marx – would inevitably claim a steadily share of output and income. Furthermore, he argues that Marx's principal conclusion might be called "principle of infinite accumulation" or tendency of capital to accumulate and become concentrated in a few hands, with no natural limit to the process, which is for Marx a basis for the end of capitalism. His conclusion is that we should have diminishing returns on capital (killing the engine of accumulation) or an indefinite increase in capital's share in national income. Piketty (2014, p. 72-83) also introduces his idea of "the law of cumulative growth", which can bring significant results with very small rates of change (return on capital). Later, he put this idea as the central thesis of the book, where "apparently small gap between the return on capital and the rate of growth can in the long run have powerful and destabilizing effects on the structure and dynamics of social inequality".

In addition, a theoretically founded model presented by Kumhof and Rancière (2011) provides an explanation on the relationship between financial crisis and credit growth and inequality. The additional part of the income of high-income households and its transfer in the form of loans to poor population is the key mechanism of growth in the size of financial sector and latter crisis. If there is no growth and recovery of the economy and growth of the income of the middle and low-income groups, loans and size of the financial sector will grow up to the point of crisis. They find evidence in the periods of two crisis, 1920-1929 and 1983-2008, in which, due to the change in

Figure 1. Causal mechanism linking inequality to corruption



Source: You (2015).

bargaining powers, the income share of the wealthy increased. Low-income individuals and households take loans in order to sustain their consumption levels "at least for a while".

Furthermore, theoretical literature focuses on mechanisms behind the thick-tailed wealth distribution. Benhabib and Bisin (2018) present a model with wealth distribution induced by labour earnings, by individual wealth processes and random rate of return, and a model of expansive accumulation, with linear savings or savings rates that increase in wealth. Our focus is on "the principle of infinite accumulation" and "the law of cumulative growth" or on the last class of models where returns on savings may generate high levels of wealth inequality by multiplication or compounding over time through financial institutions. Formally, wealth at the time t is given by w_t, and can only be invested in an asset with return process r_{t+1}, whereas the earning process is given by y_{t+1}. Let c_{t+1} denote consumption at $t + 1$, so that the savings at $t + 1$ are given by $y_{t+1} - c_{t+1}$. The wealth accumulation equation is provided by the following expression:

$$w_{t+1} = r_{t+1}w_t + y_{t+1} - c_{t+1}.$$

If we assume that saving and consumption are linear in wealth, $c_{t+1} = \psi w_t + x_{t+1}$, and that $\psi, x_{t+1} \geq 0$, then the above expression transforms to:

$$w_{t+1} = (r_{t+1} - \psi)w_t + (y_{t+1} - \chi_{t+1}),$$

which is a framework of the wealth accumulation process. If we further assume the constant relative risk aversion (CRRA) preferences over consumption at any date t, we obtain the utility function:

$$u(c_t) = \frac{m_t^{1-\sigma}}{1-\sigma}.$$

This framework can be further reduced and according to Benhabib and Bisin (2018), wealth distribution is easily obtained with explosive wealth accumulation processes, but such processes do not converge to a stationary solution. For any (r_t, y_t), a skewed distribution can be obtained and w_{t+1} is non-stationary infinite explosive process, independent of the distribution of y_t, if $y > 0$ and $E(r_t) - \psi > 1$ for any $t \geq 0$.

The simplest representation of such explosive wealth accumulation equation can be given by:

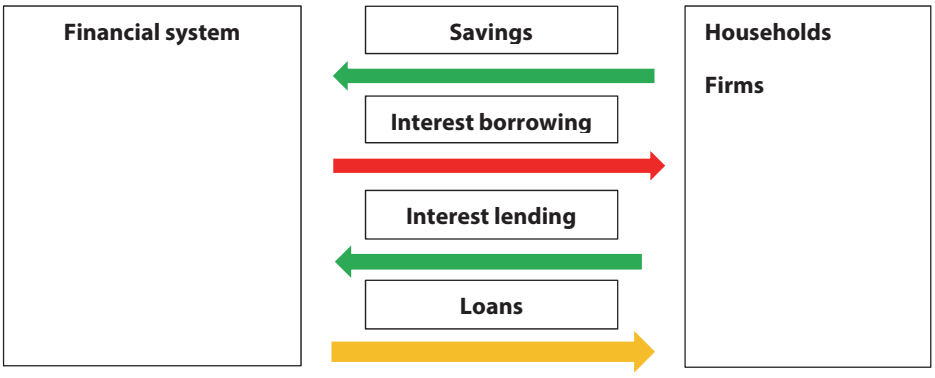
$$w_{t+1} = r_{t+1}w_t,$$

where there are no labour earnings, r_t is deterministic and $r_{t+1} = r > 1$, even if only for a sub-class of agents in the economy. This is also the case if r_{t+1} exhibits normal i.i.d. distribution and $E(r_t) > 1$. Returns to wealth follow Gibrat's law[1] that in finite time t a log-normal distribution is induced around its mean, with a mean and variance increasing and exploding in t:

$$ln\, w_t = ln\, w_0 + \sum_{j=0}^{t-1} ln\, r_j.$$

Non-stationarity is also induced in cases when saving is strictly convex, or consumption is strictly concave, and/or the rate of return on wealth is increasing in wealth. Within the given conditions, this process cannot exhibit stationarity, except if we are able to introduce another process that can slow down the expansion. According to Benhabib and Bisin (2018) these can be fiscal policies, decreasing returns on wealth, or birth and death processes with re-insertion at exogenous low level of initial wealth. The main channel of this accumulation is the institutional framework, in particular the financial sector. In essence, institutions of financial intermediation borrow short term

Figure 2. Simplified flow of funds in an economy



Source: Authors' representation.

and lend long term, with interest charged. The interest lending is higher than the interest borrowing and that is how the institutional system of financial intermediation is set.

Financial intermediaries channel this flow as those institutions "that acquire funds from one group of investors and make them available to another economic unit" (Kolb and Ricardo 1996, p. 269). In the well-functioning institutional framework, this flow between the elements of the system is continuous; the borrowing-landing process is not static in nature, meaning that every time banks borrow and land, the institutional system assumes and guarantees these flows. With even very small difference between lending and borrowing we may have the case of growth in size of financial intermediaries and infinite accumulation or tendency to accumulate wealth of individuals who save, with no natural limit to the process. Besides the fiscal policies, which are mentioned as a force to impact the process of infinite accumulation (Solow 1956, as cited by Piketty 2014, pp. 11-10), considers growth as counterbalance to the infinite accumulation argument that was also used by Marx. In an overview of the empirical determinants of wealth inequality in the next section we discuss some additional determinants that may impact inequality.

3. Empirical evidence on the wealth inequality determinants

The main task of the empirical work is to understand the thick-tailed distribution in the data. Benhabib and Bisin (2018) argue that the distribution of earnings cannot even partially contribute to the understanding of wealth inequality and that we should focus on stochastics return on wealth and on explosive wealth accumulation. Stochastic returns on wealth mainly relate to returns from residence ownership and unincorporated private business equity and investment in real estate. These returns are characterized by large standard deviations, as documented by Case and Shiller (1989) and Moskowitz and Vissing-Jorgensen (2002). Increasing savings in wealth may be the driver of explosive accumulation and the trigger for savings may be bequests (Cagetti and De Nardi 2008).

In addition, based on United States data, Saez and Zucman (2016) argue that a sudden increase in top incomes leads to a rise in wealth concentration. This is based on a cycle of high savings and the corresponding increase in capital income that lead to a snowballing effect over time. Their second finding is that the key driver of declining wealth of the bottom 90% of wealth owners lies in the plummeting of their savings rates, which may be due to the low rate of income growth, predatory lending or behavioural bias. For example, based on the US data, the top 1% of wealth-holders save 20-25% of their big incomes on average, while the 90% of wealth-holders save 3% of their income (Saez and Zucman 2016). Findings of Fagereng et al. (2019), based on a Norwegian panel data set, confirm the proposition that the savings are increasing in wealth when capital gains are included in the definition of saving, and that the wealthy accumulate more wealth through capital gains.

Tanzi (1998) identifies the fundamental determinants of income and wealth inequality as market forces, social norms, ownership of real and human capital, and the role of government. Ignoring temporary factors, such as natural catastrophes, the main "systematic" factors are social norms or institutions, broad economic change, and the role of government. Reuveny and Li (2003) further advocate that the key factors to reduce inequality are democracy and trade.

Glaeser, Scheinkman, and Shleifer (2003) find that in unequal societies the rich are enabled to subvert institutions in line with their interests, in terms of political, regulatory and legal aspects. Furthermore, inequality has adverse effects on ensuring property rights and growth. These issues are discussed in works on how those in power design institutions to stay in power by Acemoglu and Robinson (2002), Acemoglu and Robinson (2001), Glaeser and Shleifer (2002a) and (2002b) on efficient regulatory schemes and legal systems. This finding is also in line with Gupta, Davoodi, and Alonso-Terme (2002), who argue that corruption increases inequality and poverty. Additionally, Ali et al. (2021) find weak, though significant negative correlation between wealth inequality and institutional quality, while looking into the association between wealth inequality and socioeconomic outcomes.

According to Lee (2005), who examines the relationship between democracy, size of the public sector and inequality, public sector expansion reduces inequality. Lindert (1994; 2004) provided evidence on an implicit negative relationship between democracy and redistribution and on how spending on social needs, in particular on cash benefits and benefits in kind, such as spending on education and health, can reduce poverty and social exclusion. Benhabib, Bisin, and Zhu (2011) show that capital tax and estate tax, which are the source of latter spending, have an effect on inequality and wealth distribution. Namely, these taxes decrease the wealth inequality by affecting the top percentiles of the wealth distribution. The authors employed simulation and found that this effect is potentially very strong. Tax collection and expenditures relationship can reduce or increase inequality, and

generally, if the tax is proportional and the spending is flat per person, it reduces inequality (Saez and Zucman 2020). Government expenditure also tightly relates to the discussion on earnings and schooling. According to Hermann (2014), the public sector is a main factor that should address the issue of inequality. The government may impact the distribution of wealth by collecting the funds by taxation or borrowing and spending the funds on transfers, social services and providing public infrastructure. In addition, Kessler and Wolff (1991) attribute higher concentration of wealth in the United States (US), compared to France, to a lower share of capital in the public sector in the US.

Research done by Beck, Demirgüç-Kunt, and Levine (2007), where they used private sector credit as a measure for financial depth, suggests that financial depth contributes significantly to lowering income inequality. However, Jauch and Watzka (2012) find a positive effect of financial development on income inequality, verified by several robustness checks. Jaumotte, Lall, and Papageorgiou (2008) find positive and significant coefficients for financial development in different specifications and they confirm a positive relationship between income inequality and financial development. They used private credit over GDP as a control variable.

Piketty (2014, p. 103) concludes that inflation led to redistribution among social groups, often in a chaotic, uncontrolled manner. Spant (1987) finds that price changes accounted for a 20% increase in wealth for the wealthiest 0.2% of Swedish households between 1975 and 1983. In addition, Takayama (1991), Weicher (1995, pp. 14-15) and Wolff (1992) studied price effects on wealth inequality, with the conclusion that the long-run factors play the major role, such as saving, bequest behaviour and tax policy, while price changes play a role in short-term variations in inequality.

Robert Solow (1956) considers growth as a counterbalance to the notion of infinite accumulation argument and rise of inequality. However, if growth in population and productivity are low, the impact of accumulated wealth is more important (predominant). According to Mendes (2013), the theoretical relationship between inequality and growth is inconclusive and an unsettled topic. As explained by Aghion, García-Peñaloza, and Caroli (1999) a fundamental trade-off between productive efficiency (and/or growth) and social justice exists, and redistribution would reduce differences in income and wealth, but it also diminishes the incentives to accumulate wealth. According to Changkyu (2006) the relationship between growth of GDP per capita in real and nominal terms and income inequality is negative. Nonetheless, Barro (2008), in his work *Inequality and Growth Revisited*, which is an update of his previous work on inequality, confirms the evidence for Kuznets inverse U-shaped relationship between income inequality and GDP per capita.

Benhabib and Bisin (2018) claim that the distribution of earnings will not even partially contribute to the thickness of the tails of wealth distribution, and Boix (2010, p. 491) argues that famous Kuznets conjecture "does not contain a complete theory of the emergence and dynamics of inequality – it simply relies on some kind of exogenous technological shock that generates changes in factor sizes and incomes.". However, Jain-Chandra et al. (2018) find the movement from agriculture to industry as contributing to the decline in inequality. We take into consideration the theoretical argument of Kuznets (1955), who relates the increase in inequality to the size of agricultural sector and income growth. Kuznets' relationship between inequality and development has induced substantial empirical research, but with inconclusive results.

Reuveny and Li (2003) argue that democracy and trade reduce inequality. However, as presented in Easterly (2005), globalization and trade may somehow "naturally" benefit the rich, but with total gains for all. Another case is when, due to productivity differences, the richer countries can export labour intensive goods (productivity advantages offsets labour scarcity). Then trade would reduce inequality within the rich countries, but would increase inequality among the countries.

Hopkins (2004) underlines that there is no consensus in the economic theory on what are the most important determinants of inequality, despite the proposition of various underling mechanisms that sustain this high inequality levels. Different proposals of the underlining mechanisms are another sign of lack of robust research foundations on the causes of inequality. Furthermore, lack of consensus or a leading theory brings us to non-existence of the generally accepted empirical specification. Finally, he argues that this requires from the researcher a formal acknowledgment of the uncertainty involved in determining for the appropriate model specification.

4. Data

Our dataset consists of an unbalanced global panel data for the period 2010–2016. The data is provided by Credit Suisse and the World Bank. Not all the countries have available data for all years, thus the choice of countries as well as the selected time frame

is determined by the availability of data. The following countries are included in the final econometric estimation: Albania, Argentina, Armenia, Australia, Austria, Azerbaijan, Bahamas, Bangladesh, Belarus, Belgium, Belize, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, Burkina Faso, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chile, Colombia, Congo, Costa Rica, Cote d'Ivoire, Croatia, Cyprus, Czechia, Denmark, Egypt, El Salvador, Equatorial Guinea, Estonia, Fiji, Finland, France, Gabon, Georgia, Germany, Ghana, Greece, Hungary, Iceland, India, Indonesia, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Kenya, Republic of Korea, Kyrgyz Republic, Latvia, Lebanon, Lesotho, Lithuania, Madagascar, Malaysia, Mali, Malta, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Myanmar, Namibia, Nepal, Netherlands, Nicaragua, North Macedonia, Norway, Panama, Paraguay, Peru, Philippines, Poland, Portugal, Russian Federation, Rwanda, Samoa, Saudi Arabia, Senegal, Serbia, Singapore, Slovak Republic, Slovenia, Solomon Islands, South Africa, Sri Lanka, Sudan, Sweden, Switzerland, Tanzania, Thailand, Togo, Tunisia, Türkiye, Uganda, Ukraine, United Arab Emirates, United Kingdom, United States, Uruguay, Vanuatu, and Zambia.

Table 1 provides an overview of the definitions and sources for the variables used in model estimation. We use the Gini coefficient for wealth as a measure (proxy) of wealth inequality, the dependent variable of the model specifications. The data of the Gini coefficient for wealth is published by Credit Suisse in the Global Wealth Databook (authored by Davies, Lluberas, and Shorrocks 2017). Wealth is defined as the "marketable value of financial assets plus

Table 1. Description of the variables used in the empirical models

Variable	Description	Source
Dependent variable		
Gini coefficient for wealth	Measure of wealth inequality, based on the Lorenz curve, which plots the share of population against the share of wealth. By construction, it has a minimum value of zero (everybody has the same amount of wealth) and a maximum value of one (one person owns everything).	1
Variables of institutional quality and financial development (depth)		
Control of corruption	Capturing perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.	2
Government effectiveness	Reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies.	2
Domestic credit provided by the financial sector (% of GDP)	"Credit provided by the financial sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The financial sector includes monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other financial corporations are finance and leasing companies, money lenders, insurance corporations, pension funds, and foreign exchange companies" (World Bank 2017).	3
Control variables		
GDP growth (annual %)		3
Inflation rate, GDP deflator (annual %)		3
Employment in agriculture (% of total employment, modelled ILO estimate)		3
Government expenditure (% of GDP)		3
GDP per capita (constant 2015 US$)		3
Trade (% of GDP)		3

Sources: 1. Global Wealth Report (Credit Suisse 2017; 2018); 2. Worldwide Governance Indicators (World Bank 2022a); 3. World Bank Indicators (World Bank 2022a).

Table 2. Descriptive statistics of the main variables used in the empirical models

Variable	Mean	Std. dev.	Min	Max	Observations
Gini coefficient for wealth					
overall variability		0.07	0.45	0.99	$N = 1{,}130$
between variability	0.72	0.06	0.54	0.92	$n = 171$
within variability		0.04	0.49	0.93	$\bar{T} = 6.60$
Control of corruption					
overall variability		28.19	0.47	100	$N = 1{,}116$
between variability	49.40	28.33	1.42	99.72	$n = 169$
within variability		3.89	30.35	64.11	$\bar{T} = 6.60$
Domestic credit as % of GDP					
overall variability		60.75	–60.40	345.14	$N = 1{,}047$
between variability	74.15	60.58	–22.45	327.98	$n = 165$
within variability		10.98	–2.31	175.53	$\bar{T} = 6.35$

Source: Authors' calculations with the "xtsum" routine in Stata.

non-financial assets (principally housing and land) less debts" (Credit Suisse 2018). The explanatory variables are introduced and described in Table 1.

The period of analysis covers the years 2010 to 2016, during which the global economy experienced a slow recovery from the Great Recession with the global growth rate of around 3%, without significant growth in global trade, and with political turmoil, particularly evident in the Arab Spring protests in the Middle East and North Africa. The descriptive statistics of the main variables used in the dynamic panel-data models are presented in Table 2 for those years where data on the dependent variable of wealth inequality is available[2]. Wealth inequality refers to the distribution of wealth within nations and is related to different socio-economic outcomes.

The average Gini coefficient for wealth, a commonly used measure for inequality that ranges from 0 (perfect equality) to 1 (perfect inequality), exhibited a relatively high average and minimum values of 0.72 and 0.45, respectively. These high average and minimum values suggest that the wealth inequality is an important issue in the sample of countries being studied. The range of values for the Gini coefficient for wealth with the minimum of 0.45 and the maximum of almost perfect inequality (0.99) highlights a wide variation in the wealth inequality across countries. The within-country standard deviation amounted to 0.04 (deviations from the country average for each country) and the between-country standard deviation was 0.06 (deviations in terms of country averages). The average domestic credit as percentage of GDP amounted to 74.15, with between-country standard deviation of 60.58 and within-country standard deviation of only 10.98. The average value for control of corruption, represented on the scale from 0 to 100, was 49.40, with between-country standard deviation of 28.33 and within-country standard deviation of only 3.89. The variable with the lowest number of observations overall was the government expenditure as percentage of GDP, with 772 observations.

5. Methodology

Our estimation is based on a panel data set. According to Hsiao (2003) and Klevmarken (1989), as cited in Baltagi (2008), there are several advantages of using panel data compared to time series or cross-section data alone. In empirical estimation, we rely on the generalized method of moments (GMM), formalized by Hansen (1982). In particular, we employ the estimators that were developed for dynamic models of panel data by Holtz-Eakin, Newey, and Rosen (1990), Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998), and Roodman (2009). In this paper, we rely on the system GMM estimator, as implemented in the "xtabond2" routine in Stata, written by Roodman (2009).

The GMM does not require a complete knowledge of the distribution of the data, but rather derives only specified moments from an underlying model. It is suitable to deal with potential problems, such as unobserved country specific effects or reverse causality, omitted variable bias, and measurement error. Use of instrumental variables addresses potential endogeneity issues and can lead to consistent parameter estimates, even in the case of measurement errors or omitted explanatory variables that are constant over time. We shall control for endogeneity by using internal instruments based on lagged levels and lagged differences of the instrumented explanatory variables.

In addition, a dynamic model will allow us a separate analysis of the short-run and long-run effects of institutions on wealth inequality, which is not possible in a static model framework.

As stated by Leszczensky and Wolbring (2022), the Arellano-Bond approach accounts for reverse causality and is able to identify the true causal effects of both the lagged and the contemporaneous value of an explanatory variable. Furthermore, it provides a powerful toolbox to tackle endogeneity problems caused by both reverse causality and unobserved heterogeneity (Hsiao 2007). However, Leszczensky and Wolbring (2022) also address shortcomings of the approach in an empirical setting. These include requiring sufficient amount of within variation, unreliable inference in case of serial correlation, and issues with convergence (especially in a case of an unbalanced panel with missing values, such as ours). We perform a two-step estimation, where a weighting matrix of residuals is used in the second step to re-estimate the variance.

The empirical model of wealth inequality, proxied by the Gini coefficient for wealth, is constructed based on the theoretical underpinnings presented in Section 2 and existing empirical evidence presented in Section 3. There, we provided the relevant theoretical framework that links our estimation model with the main institutional variables of interest – control of corruption and financial development. Furthermore, we provided an overview of the empirical studies on the relationship between inequality and the variables that we use in our model. The relevant forces of the mentioned research efforts are examined in isolation, without an assessment of its relative importance. We thus evaluate hereinafter a concise model that includes these different determinants. We could not rely solely on the previous studies since, as pointed out by Iftekhar, Horvath, and Mares (2020, p. 4), only a few papers exist on this topic. The model is given by the following expression:

$$\log(WGINI_{it}) = \beta_0 + \beta_1 \log(WGINI_{it-1}) + \beta_2 \log(INST_{it}) + \beta_3 \log(FIN_{it}) + X_{it}'\beta + \Phi_t + u_{it},$$

where $\log(WGINI_{it})$ is the Gini coefficient for wealth in logarithms, $\log(INST_{it})$ is the control of corruption in logarithms (a proxy institutional variable), $\log(FIN_{it})$ is the domestic credit as percentage of GDP (a proxy variable for financial development), and x_{it} is a set of control variables. The latter include GDP growth, agricultural employment, GDP per capita, trade as a measure of openness, inflation as a measure of price change, and government expenditure as a measure of the government presence in the economy. Φt includes a full set of time dummy variables in order to prevent the presence of contemporaneous (cross-individual) correlation, whereas u_{it} represents a disturbance term.

The lagged Gini coefficient for wealth in logarithms, $\log(WGINI_{it\text{-}1})$, is treated as endogenous and thus instrumented, whereas the other explanatory variables are treated as exogenous. Roodman (2007) strongly recommends reporting the number of instruments used in the dynamic panel, since these models can generate an enormous number of potentially "weak" instruments that can cause biased estimates. In order to prevent "instrument proliferation", we employ option "collapsed" and restrict the number of lags for instruments to three. As a result, the number of instruments is much lower than the number of groups in all model specifications. As argued by Baltagi (2008), a small panel sample may produce a "downward bias of the estimated asymptotic standard errors" in the two-step procedure, thus we report the corrected estimates using the option "robust" that implements the Windmeijer correction (Windmeijer 2005, as cited in Baltagi 2008).

We also calculate the long-run effects of the explanatory variables on wealth inequality. The long-run regression coefficients $\hat{\beta}_{j,\,long}$ are being calculated based on the respective short-run regression coefficients $\hat{\beta}_{j,\,short}$ and the regression coefficient on the lagged dependent variable $\hat{\beta}_1$ in the following way (Efendic and Pugh 2015):

$$\hat{\beta}_{j,\,long} = \hat{\beta}_{j,\,short} \cdot \frac{1}{1-\hat{\beta}_1}, \qquad j > 1.$$

6. Empirical results

In this section, we present the empirical results of the research, with a focus on estimation results, model diagnostics and sensitivity analysis. The methodology of the GMM in dynamic panel data estimation framework is specially developed to address potential biases and endogeneity, as described in Section 4. The estimation is performed based on the Credit Suisse and World Bank data for a global sample of countries for the period 2010–2016, as presented in Section 5. In addition, we distinguish between short-run (contemporaneous) estimation results and long-run estimation results.

Table 3 presents the short-run (contemporaneous) results of the empirical estimation of four different model specifications, each with the Gini coefficient for wealth as the dependent variable. Each model specification consists of a given set of explanatory variables of institutional quality and financial development (depth), a given set of control explanatory variables,

Table 3. Results of the empirical estimation of the Gini coefficient for wealth

Explanatory variable	Model 1	Model 2	Model 3	Model 4
Constant term	–0.059342 (0.041666)	–0.076873 (0.040602)	–0.072035* (0.042303)	–0.125230 (–0.054054)
Lagged Gini coefficient for wealth (in logs)	0.817472*** (0.067560)	0.802587*** (0.076960)	0.811230*** (0.072004)	0.801782*** (0.072540)
Control of corruption (in logs)	–0.000194 (0.006666)	–	–0.000451 (0.007009)	–0.000627 (0.007130)
Government effectiveness	–	0.000185 (0.000230)	–	–
Total domestic credit as percentage of GDP (in logs)	0.012669*** (0.004190)	0.011148*** (0.004311)	0.012180*** (0.004111)	0.011402*** (0.004372)
GDP growth	0.000538 (0.000815)	0.000578 (0.000931)	0.000642 (0.000889)	0.000659 (0.000831)
GDP per capita (in logs)	–	–	–	0.006814 (0.004822)
Inflation rate	0.000996** (0.000497)	0.001103*** (0.000513)	0.001048** (0.000489)	0.001219** (0.000554)
Share of employment in agriculture (in logs)	0.005882** (0.002851)	0.007180*** (0.003291)	0.005095* (0.003041)	0.010606*** (0.003711)
Government expenditure as a share of GDP (in logs)	–0.012150** (0.006114)	–0.013940*** (0.006692)	–0.012341** (0.006219)	–0.014478** (0.007273)
Trade as percentage of GDP (in logs)	–0.004398 (0.005444)	–0.006197 (0.005852)	–0.005645 (0.005783)	–0.003782 (0.005711)
Dummy for year 2011	0.004436 (0.010233)	0.011372 (0.010591)	0.012698 (0.010716)	–0.004662 (0.010012)
Dummy for year 2012	0.016831*** (0.005091)	0.001328 (0.004934)	0.001820 (0.004857)	–0.016383*** (0.005067)
Dummy for year 2013	–0.029470*** (0.007230)	–0.011920 (0.006380)	–0.011620 (0.006430)	–0.029001*** (0.007130)
Dummy for year 2014	0.017350*** (0.004690)	0.016720*** (0.004686)	0.017350*** (0.004690)	–
Dummy for year 2015	–0.018650*** (0.004580)	–	–	–0.017780*** (0.004549)
Dummy for year 2016	–0.037860*** (0.008970)	0.057750*** (0.009520)	–0.072030*** (0.042300)	0.038500*** (0.008947)
Number of observations	581	583	583	581
Number of groups	110	111	111	110
Number of instruments	17	17	17	18
F–test of joint significance: H_0: Coefficients are jointly equal to zero.	$F = 2{,}933.5$ $p = 0.000$	$F = 3{,}090.0$ $p = 0.000$	$F = 3{,}280.7$ $p = 0.000$	$F = 2{,}345.8$ $p = 0.000$
Arellano–Bond test for AR(1): H_0: There is no first–order serial correlation.	$z = -3.59$ $p = 0.000$	$z = -3.56$ $p = 0.000$	$z = -2.51$ $p = 0.012$	$z = -3.59$ $p = 0.000$
Arellano–Bond test for AR(2): H_0: There is no second–order serial correlation.	$z = 0.55$ $p = 0.581$	$z = 0.56$ $p = 0.574$	$z = 0.55$ $p = 0.581$	$z = 0.56$ $p = 0.576$
Hansen *J*–test of overidentifying restrictions: H_0: Restrictions are valid.	$\chi^2 = 1.09$ $p = 0.780$	$\chi^2 = 4.50$ $p = 0.212$	$\chi^2 = 4.56$ $p = 0.207$	$\chi^2 = 0.92$ $p = 0.821$

Notes: Corrected standard errors are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$ and * $p < 0.1$.

Source: Authors' calculations with the "xtabond2" routine in Stata.

and a set of time dummy variables for the analysed years. The latter capture the time-specific fixed effects that are common to all countries.

The first model specification (Model 1) includes the control of corruption as a variable representing the institutional quality. In the second model specification (Model 2), we replace the control of corruption with another variable representing institutional quality, i.e., the government effectiveness. The other explanatory variables are the same in both specifications. They are estimated by the system GMM estimator employing the first-differences transformation. The third model specification (Model 3) is similar to the first one, but employs the forward orthogonal deviations transformation instead of the first-differences transformation. In the fourth model specification (Model 4), we control for the level of development by including GDP per capita as a control variable. The other explanatory variables are the same as in the first and the third specification, whereas the first-differences transformation is employed again.

Let us address model diagnostics (lower part of Table 3) before transitioning to the interpretation of regression coefficients (upper part of Table 3), as the former is instrumental for consistency and unbiasedness of the latter. First, the GMM estimator implies first-order serial correlation, but requires that there is no second-order serial correlation in the disturbances (Arrelano and Bond 1991, as cited in Efendic and Pugh 2015). Our results in Table 3 indeed indicate the presence of first order auto-correlation and absence of second order auto-correlation in all four model specifications. Moreover, we perform the Hansen test of overidentifying restrictions, with the null hypothesis that these restrictions (orthogonality conditions) are valid. We find that the null hypothesis is not rejected in any of the model specifications, which gives us some confidence about instrument validity. In addition, according to Roodman (2007, p. 12, as cited in Efendic and Pugh 2015), the estimated coefficient on the lagged dependent variable in the model should indicate convergence by having a value less than one. As can be seen from Table 3, this is satisfied in all four model specifications.

Our model incorporates the long-term perspectives by taking into consideration the entire history of wealth inequality, institutional changes, as well as all relevant explanatory variables. Table 4 presents the long-run results of the empirical estimation of the first model specification (Model 1) only, focusing on the explanatory variables with statistically significant short-run effects.

We can now turn to the interpretation of regression coefficients, starting with the variables of institutional quality and financial development (depth). As can be seen from Table 3, control of corruption and government effectiveness are not statistically significant determinants of wealth inequality in any of the four model specifications. Conversely, the total domestic credit as percentage of GDP as a measure of financial development has a statistically significant "positive" contemporaneous effect on wealth inequality in all four model specifications (values between 0.011 and 0.013). This "positive" effect, even though relatively small, is unfavourable, as more credit as percentage of GDP leads on average, *ceteris paribus*, to more wealth inequality. As can be seen from Table 4, the long-run coefficient is also positive (0.069) and statistically significant. The long-run estimate, conditional on the entire history of the variable, thus demonstrates that the effect is persistent and cumulates over time.

In terms of control variables, we find no statistically significant effect of GDP on wealth inequality in any of the four model specifications, neither in terms of GDP per capita nor in terms of GDP growth. Likewise, trade as percentage of GDP also did not turn out to be a statistically significant determinant of wealth inequality. However, we find evidence of effects of the other control variables, such as the inflation rate, the share of employment in agriculture, and government expenditure as a share of GDP. These effects turned out to be statistically significant contemporaneously in all four model specifications, but not in the long run

Table 4. Long-run effects of determinants of the Gini coefficient for wealth

Explanatory variable	Long-run coefficient	Std. error	*z*–statistic	*p*–value
Total domestic credit as percentage of GDP (in logs)	0.06941	0.03228	2.15	0.032
Inflation rate	0.00546	0.00328	1.66	0.097
Share of employment in agriculture (in logs)	0.03223	0.02208	1.46	0.145
Government expenditure as a share of GDP (in logs)	–0.06656	0.03847	–1.73	0.084

Source: Authors' calculations with the "nlcom" routine in Stata based on Model 1.

(at least not at the 5% significance level).

Previous research is not clear about the sign and strength of the effect of prices on wealth inequality. For example, the Royal Commission on the Distribution of Income and Wealth (1979), which decomposed the impact of change in prices and quantities of wealth components, found that changes in prices of houses and shares in the period 1960–1972 in the United Kingdom cancelled out, or accordingly, prices had no strong effect on wealth inequality. Our findings suggest, as can be seen from Table 3, that the inflation rate has a statistically significant "positive" contemporaneous effect on wealth inequality (values around 0.001). This "positive" effect is again relatively small and unfavourable, as more inflation leads on average, *ceteris paribus*, to deepening the wealth inequality. These findings are in line with Spant (1987), who found that price changes account for an increase in wealth for the wealthiest households. Also, Takayama (1991), Weicher (1995), and Wolff (1992) concluded that the long-term factors play the major role, such as saving, bequest behaviour and tax policy, while price changes play a role in shorter-term variations in inequality.

Our findings from Table 3 also suggest that the share of employment in agriculture has a statistically significant "positive" effect on wealth inequality (values between 0.005 and 0.011). This "positive" effect is, once more, small and unfavourable, as more employment in agriculture leads on average, *ceteris paribus*, to more wealth inequality. However, this is a short-run effect only, since it does not accumulate into a statistically significant long-run effect. There is a cluster of literature that discuss the Kuznets theory and possible explanation may be in line with Llavador and Oxoby (2005), who argue that policies can be created to sustain abundant (and cheap) labour for the rural sector, where agrarian societies or land elite use explicit or implicit policies to prevent migration out of the rural sector. By doing this, the elites keep wages low and extract value from agricultural products with cheap labour inputs. This is the way of preventing rural people to move to the cities and to profit from the urban possibilities.

Hermann (2014) considers the public sector as the main factor that should address the issue of inequality. He provides evidence that the low-income, and we can assume also fewer wealthy residents benefit more from using public services, since the value provided represents a higher share of their income. The government may impact the distribution of wealth by collecting the funds by taxation or borrowing and spending these funds on transfers, social services, education and providing public infrastructure. This is a way to substitute the expenditure of the poor and to redistribute. This is congruent with our results in Table 3. Namely, we find that the government expenditure as a share of GDP has a statistically significant negative short-run effect on wealth inequality (values between –0.012 and –0.014). More government expenditure thus leads on average, *ceteris paribus*, to less wealth inequality.

We also performed a vast number of robustness checks. First, we changed (decreased to two and increased to four) the number of lags for instrumental variables in the GMM estimation, but found no substantial changes in terms of sign and statistical significance of the effects of key explanatory variables. Second, we allowed the variables of institutional quality and financial development, in particular the control of corruption, to have not only a contemporaneous effect, but also a lagged effect on wealth inequality (up to three years in length). It turned out that the lagged effects were not statistically significant, whereas the other results were fairly robust to the change. Third, we compared the dynamic panel estimates to ordinary least squares (OLS) estimates and fixed effects (FE) estimates, as proposed by Bond (2002). It turned out, as expected, that the estimated regression coefficient on the lagged dependent variable from the GMM estimation was between the values obtained from the other two estimators[3].

Lastly, we ran estimation with split sample into two groups. The first group consisted of countries with low and lower-middle income (up to 4,035 USD p.c.), whereas the second group consisted of countries of upper-middle and high income (above 4,035 USD p.c.). We found no substantial changes in terms of sign and statistical significance of the effects of the explanatory variables in the second group compared to the whole sample. Moreover, the coefficients for the variables representing domestic credit, inflation, employment in agriculture and government expenditure were significant at the 5% level in both the short run and the long-run. In the first group, however, we obtained statistically insignificant results for key explanatory variables. This was somewhat expected due to substantially decreased sample size in this group after sample splitting, as argued by Edelstein and Kilian (2007).

7. Concluding remarks

This paper examines the impact of institutional development on the inequality of wealth. More precisely, we consider the impact of quality of institutions represented by control of corruption and financial

development represented by domestic credit as percentage of GDP on the Gini coefficient for wealth. For this purpose, we construct a global panel data set for the period 2010–2016 and employ dynamic panel data models to conduct an econometric analysis of these relationships based on the Credit Suisse and World Bank data.

We do not find a statistically significant effect of control of corruption or government effectiveness on wealth inequality, but we do find unfavourable statistically significant contemporaneous and long-run effects of domestic credit as percentage of GDP on wealth inequality. The latter long-run estimate, conditional on the entire history of the variable, thus demonstrates that the effect is persistent and cumulates over time. We also find evidence of statistically significant relationships between wealth inequality on one hand, and inflation rate, employment in agriculture and government expenditure on the other. In the short-run, inflation and employment in agriculture have statistically significant unfavourable effects on wealth inequality. At the same time, government expenditure as a share of GDP has a favourable short-run effect on wealth inequality.

The deepening of wealth inequality through the financial institutional framework is a concerning trend. Our research provides policy-relevant findings and directions to decrease wealth inequality. Economic policy mechanisms, such as policies that target inflation, transition of labour to the industrial sector or changes in government expenditure, can have an impact on wealth inequality in the short run. However, to ensure a long-term impact, the capital should not have an institutionally guaranteed return, as this can lead to infinite accumulation or the so-called snowball effect. Specifically, as our findings suggest, redistribution policies are needed, but may not be effective in the long-run if applied in isolation, without addressing the root cause of expanding wealth gap. There is a need to re-examine the policies governing financial intermediation, as financial intermediaries can be both the source and the driver of an infinite accumulation process.

We performed various robustness checks and found that the results are robust. Nonetheless, we have encountered some constraints during our research, primarily related to issues with availability of high-quality data and endogeneity issues in dynamic panel data estimation. We need a longer time span in order to increase the number of observations. This will also improve the use of (internal) instrumental variables to deal with the endogeneity issue and enable additional robustness checking of particular determinants of wealth inequality.

Endnotes

1 The law of proportionate growth gives rise to a wealth distribution that is log-normal.

2 Before performing the empirical analysis, we adjusted the dataset by dropping outliers for GDP growth and inflation, defined by five standard deviations in both tails. In this process, we lost 14 observations for GDP growth and 5 observations for inflation.

3 In particular, based on Model 1, the estimated regression coefficient on the lagged dependent variable amounted to 0.827 in the case of OLS estimation and to 0.170 in the case of FE estimation.

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MODELLING NATIONAL ECONOMIC SYSTEM: A CASE OF THE CROATIAN ECONOMY

Siniša Sovilj, Marina Tkalec, Dominik Pripužić, Zvonko Kostanjčar

Abstract

In this study we evaluate a national economic model using a system dynamics approach. We use a set of macroeconomic data for a transition economy to validate the model behaviour in the past, and then simulate the alternative paths of key macroeconomic variables. Instead of studying only a fraction of the economy, or using simple and abstract models, we build a large-scale national economic model. As the study is based on system dynamics information feedback, it provides additional insights about the macroeconomic effects of the economic policy, making it a valuable tool for economic policy analysis. Such insights are instrumental for understanding the total effects of economic policies and their full economic consequences. To demonstrate this, we have simulated one actual economic policy intervention and its alternative scenario.

Keywords: *national economic model, system dynamics, macroeconomics, economic policy analysis*

JEL Classification: *C63, C65, O41, E62, E47*

Siniša Sovilj, PhD (corresponding author)
Associate Professor
Faculty of Informatics
Juraj Dobrila University of Pula
(Address: Rovinjska 14, 52100 Pula), Croatia
E-mail: sinisa.sovilj@unipu.hr
ORCID: 0000-0001-7416-0152

Marina Tkalec, PhD
Senior Research Associate
Institute of Economics
Croatia
E-mail: mtkalec@eizg.hr
ORCID: 0000-0001-7974-9345

Dominik Pripužić
Economic Analyst
Croatian National Bank
Croatia
E-mail: dpripuzic@hnb.hr
ORCID: 000-0003-3377-9260

Zvonko Kostanjčar, PhD
Full Professor
Faculty of Electrical Engineering and Computing
University of Zagreb
Croatia
E-mail: zvonko.kostanjcar@fer.hr
ORCID: 0000-0002-2519-3115

1. Introduction

Mainstream economics has become increasingly criticized for its unrealistic assumptions and high level of abstraction, in the light of the most recent global financial and economic crisis. The academia and the public are questioning the standard economics' paradigm and are calling for a wider application of sometimes neglected concepts such as complexity, dynamics, nonlinearity, psychology, etc. for example, as Forrester (2003) suggested, the economics should become a systems profession, such as management, by focusing on the proper policy analysis aimed at the improvements in economic policy making. Such reasoning has motivated us to apply a system dynamics (SD) approach to the issue of national economic modelling.

Having in mind that economic systems are dynamic, complex, nonlinear, and composed of many interacting agents, one should take a holistic approach to modelling a complete national economy (Cavana 2021). Our approach is based on the SD type of a structural national economic model (for a transition economy) developed by Yamaguchi (2013). We calibrate the model for a small open transition economy, Croatia, simulate an interesting fiscal policy scenario, discuss potential forecasting benefits of this type of model, and emphasize the usefulness of such model as an economic policy management tool and also as an aid in education as in Wheat (2007).

The main contribution of the paper is that, to the best of our knowledge, it delivers the first complete Croatian SD national economic model calibrated on real historical data. Besides, our results also provide an additional insight into the functioning of the Croatian economy and offer economic policy advice based on the simulation of different possible scenarios.

The model incorporates elements of older behavioural models for the SD national model of the US economy (Forrester 1980, Sterman 2000), and the accounting SD approach to macroeconomic modelling (Yamaguchi 2013). Model features a number of economic behaviour equations, including both real and monetary sector, implementation of feedback loops, and, most importantly, endogeneity by construction. On the other hand, most of the conventional general equilibrium type of models, rely on a number of highly restrictive assumptions about economic behaviour and describe economic systems which are exposed to entirely exogenous shocks (LeBaron and Tesfatsion 2008). According to some criticism by Colander (2011), the latter feature is the reason for poor performance of dynamic stochastic general equilibrium (DSGE) type models in explaining real world phenomena, especially related to the latest (2007-2009) global financial crisis.

The complete version of the Yamaguchi national economic model comprises the labour market and six different economic sectors: the central bank, commercial banks, consumers (households), producers (firms), the government and the foreign sector. These sectors interact in a dynamic monetary economy by exchanging goods and services for money. As these economic transactions between sectors have feedback effects, which are an important feature of the real-world economic systems, a national economic model should aim to include all transactions among all sectors, in order to ensure a consistent relational framework. As suggested by Yamaguchi (2013), the main analytical tool for such a model is the double entry accounting system, also used in the system of national accounts. System of national accounts (IMF 2008) is an internationally agreed comprehensive system used to organize all economic flows between sectors of the national economy, as well as resulting changes in the stocks, and thereby provide a consistent complete and comparable picture of a particular national economy (Keen 2011).

Failing to consistently entail the multitude of interconnections between economic sectors of the economy causes causal loopholes, an often case in some of the more abstract standard macroeconomic models - such as neoclassical DSGE and New Keynesian models. Moreover, a complete and holistic national economic SD model provides a synthesis of neoclassical and Keynesian school of economics, treating them as different behaviours of the same system, rather than behaviours of structurally and fundamentally different economic systems (Yamaguchi 2013).

SD macroeconomic research is relatively scarce and limited to a couple of studies. For example, Mashayekhi (1991) models the relationship between exchange rate policy and inflation rate for an oil-exporting economy. Klaus (2012) develops an SD version of the Stein's model (Stein 2012), using only one good and three sectors. Among the few attempts to use the SD approach to model a national economy is model by Nadezda (2011) and for the case of Croatia by Garača (2006). However, these models focus only on one sector, or one part of the economy and they are not intended for economic policy consideration. On the other hand, we try to develop a complete national economy model which can then be used for to evaluate economy-wide effects of the particular economic policy.

The rest of the paper is organized as follows. In the next chapter we present the SD model, its behavioural equations, and relations and interaction between economic sectors in the model. This chapter is then followed by the SD national economic model calibrated for the transition economy of Croatia. The last chapter discusses the results and concludes the paper.

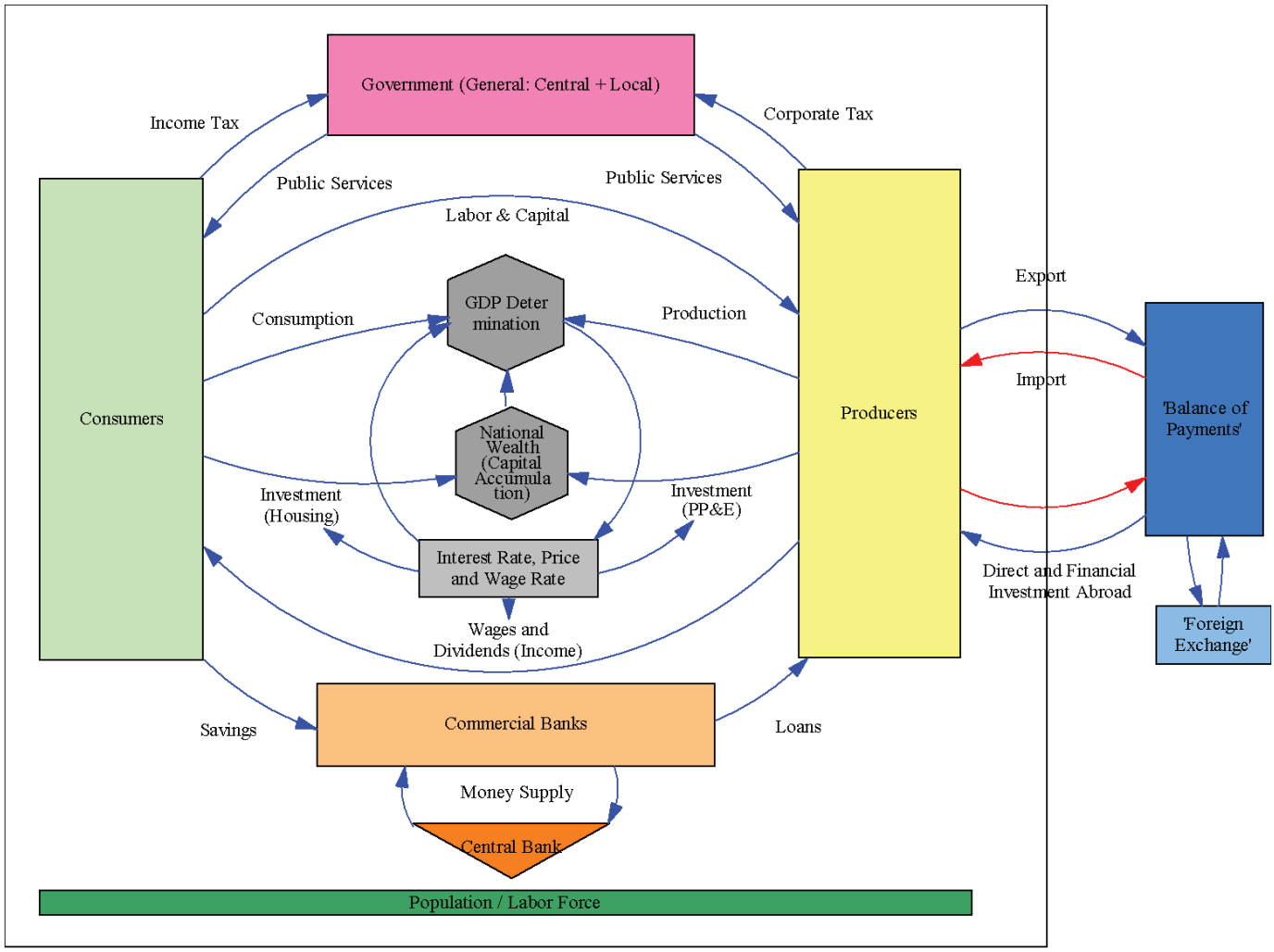
2. Methods

2.1. Model

Our version of SD national economic model comprises five sectors: producers (firms), consumers (households), government, commercial banks, and the central bank (Figure 1). In order to focus on the intra-national relations in the total economy, the foreign sector is modelled exogenously. In addition, due to a number of issues with Croatian labour market data, in the current version of the model we also abstract from the labour market.

In the core of the model there are 15 equations with 15 unknown variables and 12 exogenously determined parameters. These equations are systematically presented below and the names of the variables together with equivalent symbols and values for exogenous fixed parameters can be found in Table 1 of the Appendix.

Figure 1. High level model structure comprising of five sectors: Consumers, Producers, Government (both central and local), Commercial Banks, Central Bank and without an external sector and with the endogenous treatment of the labour market.



$$Y_{full} = AK^{\alpha}L^{\beta} = e^{\kappa t}Y_0\left(\frac{K}{K_0}\right)^{\alpha}\left(\frac{L}{L_0}\right)^{\beta}$$ *(Full Capacity Output)* (1)

$$Y_{potential} = AK^{\alpha}LF^{\beta} = e^{\kappa t}Y_0\left(\frac{K}{K_0}\right)^{\alpha}\left(\frac{L}{LF_0}\right)^{\beta}$$ *(Potential GDP)*

$$Y = Min\left(Y_{full}, Y^D\right)$$ *(Production Decision)* (2)

$$Y^D = \varphi\left(I_{nv}^{*} - I_{nv}\right) + AD_{forecast}$$
$$= \frac{I_{nv}^{*} - I_{nv}}{Time\ to\ Adjust\ Inventory} + AD_{forecast}$$
$$\frac{dAD_{forecast}}{dt} = \frac{AD - AD_{forecast}}{Forecasting\ Adjustment\ Time}$$ *(Desired Production)* (3)

$$\frac{dI_{nv}}{dt} = Y - AD$$
$$I_{nv}^{*} = AD_{forecast} \cdot Normal\ Inventory\ Coverage$$ *(Inventory Adjustment)* (4)

$$AD = C + I + G + X - M$$ *(Aggregate Demand)* (5)

$$C\left(P\right) = C_0 + c\left(P\right)\cdot Y_d$$
$$c\left(P\right) = \frac{c}{\left(\frac{P}{P_0}\right)^{e}}$$ *(Consumption Decision)* (6)

$$Y_d = Y - T$$ *(Disposable Income)* (7)

$$T = T_0 + T_{income} + T_{production} + T_{corporate}$$ *(Tax Revenues)* (8)

$$T_{income} = t_{income}Y - T_r$$
$$= Wages \cdot t_{income}$$ *(Income Tax)*

$$T_{production} = t_{production} \cdot GDP\ /\ (\ 1 + t_{production}\ )$$ *(Production Tax)*

$$T_{corporate} = t_{corporate} \cdot Profit$$ *(Corporate Tax)*

$$I = \frac{K^{*}\left(i\right) - K}{Capital\ Adjustment\ Time} + \delta K$$
$$K^{*}\left(i\right) = \frac{\alpha\left(1 - t_{production}\right)Y^{*}}{i + \delta}$$
$$(\text{or } I_{real}\left(r\right) = \frac{I_0}{r} - \alpha_1 r)$$
$$I = I_{real}\left(r\right)\cdot P$$ *(Investment Decisions)* (9)

$$\frac{dK}{dt} = I - \delta \cdot K$$ *(Net Capital Accumulation)* (10)

$$\frac{dG}{dt} = g \cdot G_0 \quad (\text{or } G = \beta_{PB}\text{T}) \qquad \textit{(Government Expenditures)} \qquad (11)$$

$$\frac{dP}{dt} = \psi_1\left(Y^D - Y_{full},\ I_{nv}^{\ *} - I_{nv}\right) + \psi_2\left(\frac{\log(w)}{dt}\right)$$
$$= \frac{P^* - P}{Delay\,Time} \qquad \textit{(Price Adjustment)} \qquad (12)$$
$$P^* = \frac{P}{\left[(1-\omega)\frac{Y_{full}}{Y^D} + \omega\frac{I_{nv}}{I_{nv}^{\ *}}\right]^e}$$

$$m^s = \frac{M^s}{P}V \qquad \textit{(Real Money Supply)} \qquad (13)$$
$$(\text{or } M^s = Currency\ in\ Circualtion + Deposits)$$

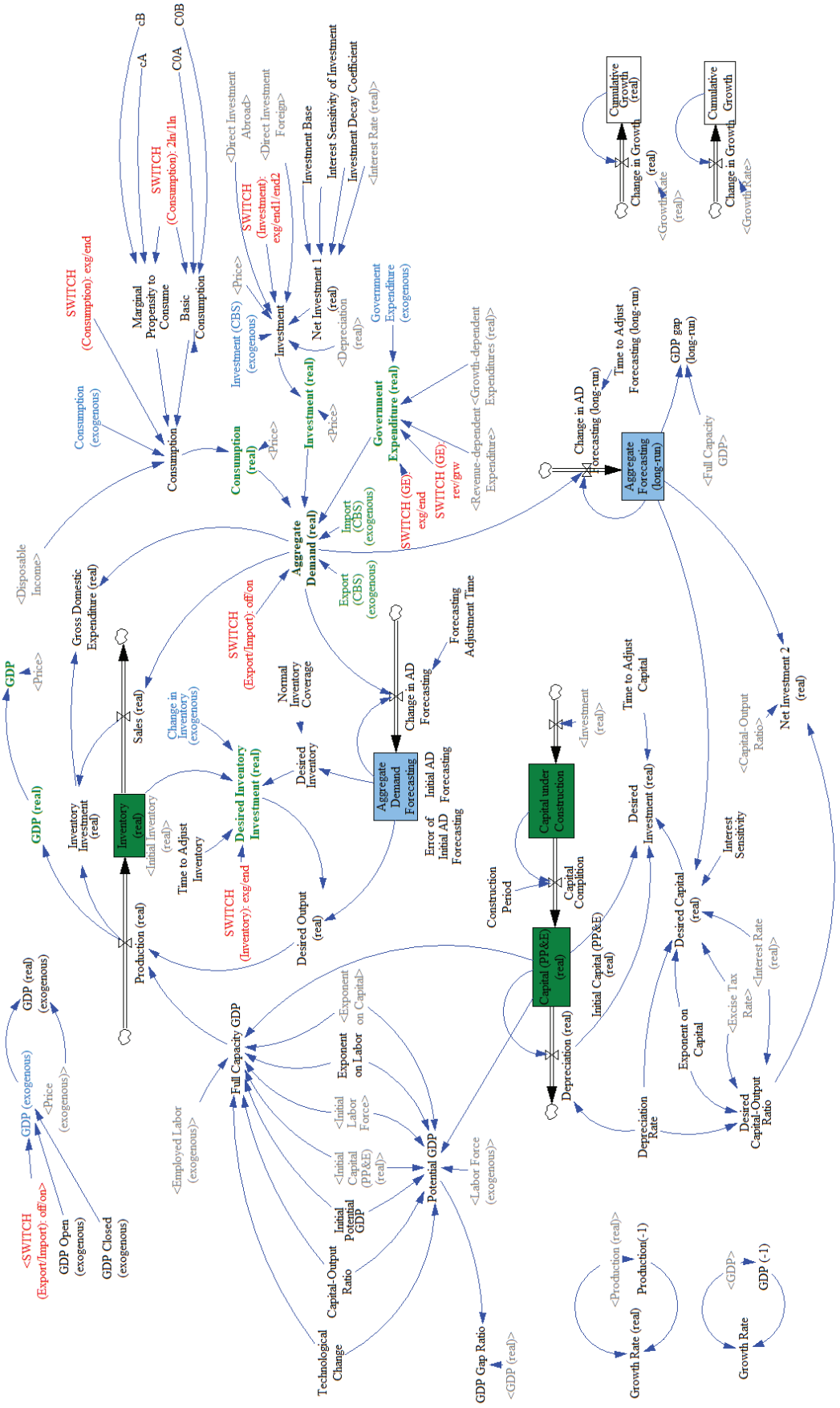
$$m^d = a \cdot Y / P - b \cdot r$$
$$(\text{or } M^d = Demand\ for\ Money(Consumers)$$
$$+Demand\ for\ Money(Producers) \qquad \textit{(Real Money Demand)} \qquad (14)$$
$$+Demand\ for\ Money(Governmet)$$
$$+Demand\ for\ Money(Banks))$$

$$\frac{dr}{dt} = \Phi\left(m^d - m^s\right)$$
$$= \frac{r^* - r}{Delay\,Time} \qquad \textit{(Interest Adjustment)} \qquad (15)$$
$$r^* = \frac{r}{(m^s / m^d)^e}$$
$$i = r + \pi$$

In addition to the core equations presented above, we also introduce supplementary equations that define the relationship between the nominal interest rate *i*, the real interest rate *r*, the inflation rate π, the *premium rate*, and the *premium rate spread*. These relationships are presented as follows:

$$i = r + \pi$$
$$prime\,rate = i + premium\,rate\,spread \qquad (16)$$

Figure 2. GDP determination model.



Note: Rectangular represents stock, double (bold) arrow represents flow, and the variable is connected to stock and flow using the feedback information (thin) arrow.

2.2. GDP Determination

According to the standard production function approach, an economy produces its total output Y_{full}, by using the capital stock K and the labour force L. As there is no guarantee that the temporary Keynesian equilibrium GDP Y^*, is equal to the full production output Y_{full}, the situation $Y^*<Y_{full}$ implies that the capital stock is under-utilized, a part of the labour force is unemployed, and the economy is in a recession (Yamaguchi 2013). It has to be noted that total output can differ from the potential amount of output $Y_{potential}$, which is produced when the amount of existing capital stock K and total available labour force LF used do not create inflation pressures.

Figure 2 illustrates the GDP determination model. Inventory stock I_{nv}, is the key variable of the model because it captures the discrepancy between the production and sales (shipment) and thereby reflects short-term demand fluctuations; this relationship is characterized by equation (4). Mainstream macroeconomics, by treating inventory as undesired investment, equalizes the produced output production and the aggregate demand. In Yamaguchi-type models, however, the introduction of inventory stock allows that aggregate demand and production mismatch the equilibrium, implying an intrinsically cyclical and fluctuating nature of the Keynesian adjustment process, as opposed to smooth adjustment suggested by conventional macroeconomics (Yamaguchi 2013).

Government tax revenues, represented by the equation (8), consist of four types: lump-sum taxes such as property taxes (T_0), income taxes proportional to the level of income ($t_{income} \cdot Y$), with t_{income} the income tax rate, production taxes ($T_{production}$) that are defined by the production tax rate ($t_{production}$), and from which government subsidies (T_r) are deducted, and profit or corporate taxes ($T_{corporate}$).

Investment decision (9) is determined by the capital depreciation δ and the difference between desired K^* and actual capital K level, where desired capital K^* is defined by the interest rate i, exponent on capital α, production tax rate $t_{production}$, depreciation rate δ, and desired output Y^* (18), which is obtained by maximizing producer's profit function Π (17).

$$\Pi=\left[\left(1-t_{production}\right)P\cdot Y_{full}-\left(i+\delta\right)P_K K-wL\right]\cdot\left(1-t_{corporate}\right)$$
$$=\left(1-t_{production}\right)\left(1-t_{corporate}\right)\left(1-\alpha-\beta\right)P\cdot Y_{full} \qquad \textit{(Profit Maximization)} \qquad (17)$$
$$\frac{\partial\Pi}{\partial K}=0 \quad \rightarrow \quad K^* \qquad \frac{\partial\Pi}{\partial L}=0 \quad \rightarrow \quad L^*$$

$$K^*=\frac{\alpha\left(1-t_{production}\right)Y^*}{i+\delta} \qquad \textit{(Desired Capital)} \qquad (18)$$

$$L^*=\frac{\beta\left(1-t_{corporate}\right)P\cdot Y^*}{w^e} \qquad \textit{(Desired Labour)} \qquad (19)$$
$$w^e=w\left(1+\pi\right)$$

Same producers' profit maximization function (17) determines a desired amount of labour L^* (19).

2.3. Interest Rate, Price and Wage Rate

The real interest rate is adjusted dynamically as suggested by (15), and money market equilibrium is reached when money supply m^s (13) is equal to money demand m^d (14). Money velocity is represented by V and it comes in units of *1/year*, M^s is nominal money supply, a is a fraction of income assigned for transactional demand of money, b represents interest sensitivity of demand for money and P is price level.

The interest rate adjustment process can be further specified as:

$$\frac{dr}{dt}=\frac{r^*-r}{DelayTime} \qquad (20)$$

where the desired interest rate i^* is obtained as:

$$r^*=\frac{r}{\left(MoneyRatio\right)^e}=\frac{r}{\left(\frac{m^s}{m^d}\right)^e} \qquad (21)$$

in which e denotes a money ratio elasticity of desired interest rate. Figure 3 illustrates the interest rate adjustment process model.

The price adjustment mechanism (12) is obtained through the adjustment of the GDP gap (discrepancy between full capacity output Y_{full} and desired production Y^D) and the inventory gap (discrepancy between current inventory I_{nv} and desired inventory I_{nv}^*). The weight ratio ω controls the contribution that each of the gaps has on the desired price change, while elasticity e determines the overall effect of gaps on the desired price change.

The nominal wage rate w is determined in the labour market (22), where L^* denotes desired labour (19) and L^s denotes labour supply that is for the moment determined exogenously in the model. Parameter e presents labour market elasticity, while W stands for the total wage bill in the economy.

$$\frac{dw}{dt} = \phi\left(L^* - L^s\right)$$

$$\frac{dw}{dt} = \frac{w^* - w}{Delay\,Time} \qquad (\text{Wage } Rate) \quad (22)$$

$$w^* = \frac{w}{\left(\frac{L^s}{L^*}\right)^e}$$

$$W = w \cdot L_{employed} \qquad (\text{Wages}) \quad (23)$$

$$(or = GDP \cdot Distribution\,Ratio\,of\,Wages)$$

GDP and the interest rate in the aggregate demand equilibrium (Y^*, i^*) are determined by the intersection of the IS curve (that presents the equilibrium condition in the goods market), and the LM curve (that presents the equilibrium condition in the money market), while keeping prices fixed in the short run, as in the typical Keynesian model.

As mentioned previously, this equilibrium (Y^*) is not necessarily equal to the full capacity output level (Y_{full}); in order to achieve full capacity equilibrium where $Y^*=Y_{full}$, prices would need to be flexible. The latter can be easily introduced into the model by setting e to 1.0.

In the following subchapters, we describe five main sectors of the economy, and we explain the transaction between these sectors.

2.4. Producers

Producers are faced with two decisions: how much to produce this year and how much to invest for the future. In our model, production decisions are made by inventory management (3 and 4), while investment decisions are described by (9) and stem from the standard macroeconomic investment function. Based on these two decisions, usual producer's transactions are the following:

(1) producers are constantly in a state of cash flow deficits, and to make new investments they have to borrow money from banks to which they pay interest,
(2) producers pay production tax (value added tax gathered from sales) to the government, gross wages to the workers (consumers), interest to the banks, and deduct the amount of depreciation out of their revenues; remaining revenues become profits before taxation,
(3) producers pay corporate tax to the government, and
(4) remaining profits after corporate tax are paid to the owners as dividends (domestic and foreign depending on the accumulation of capital liabilities from abroad).

Direct domestic investments abroad (I_{DDI}) and direct foreign investment from abroad (I_{FDI}) are treated exogenously in the model. Total investment is a sum of domestic investment and foreign direct investment from abroad.

Figure 4 illustrates the producer's sector in the model.

Figure 3. Interest Rate, Price and Wage Rate adjustment process model.

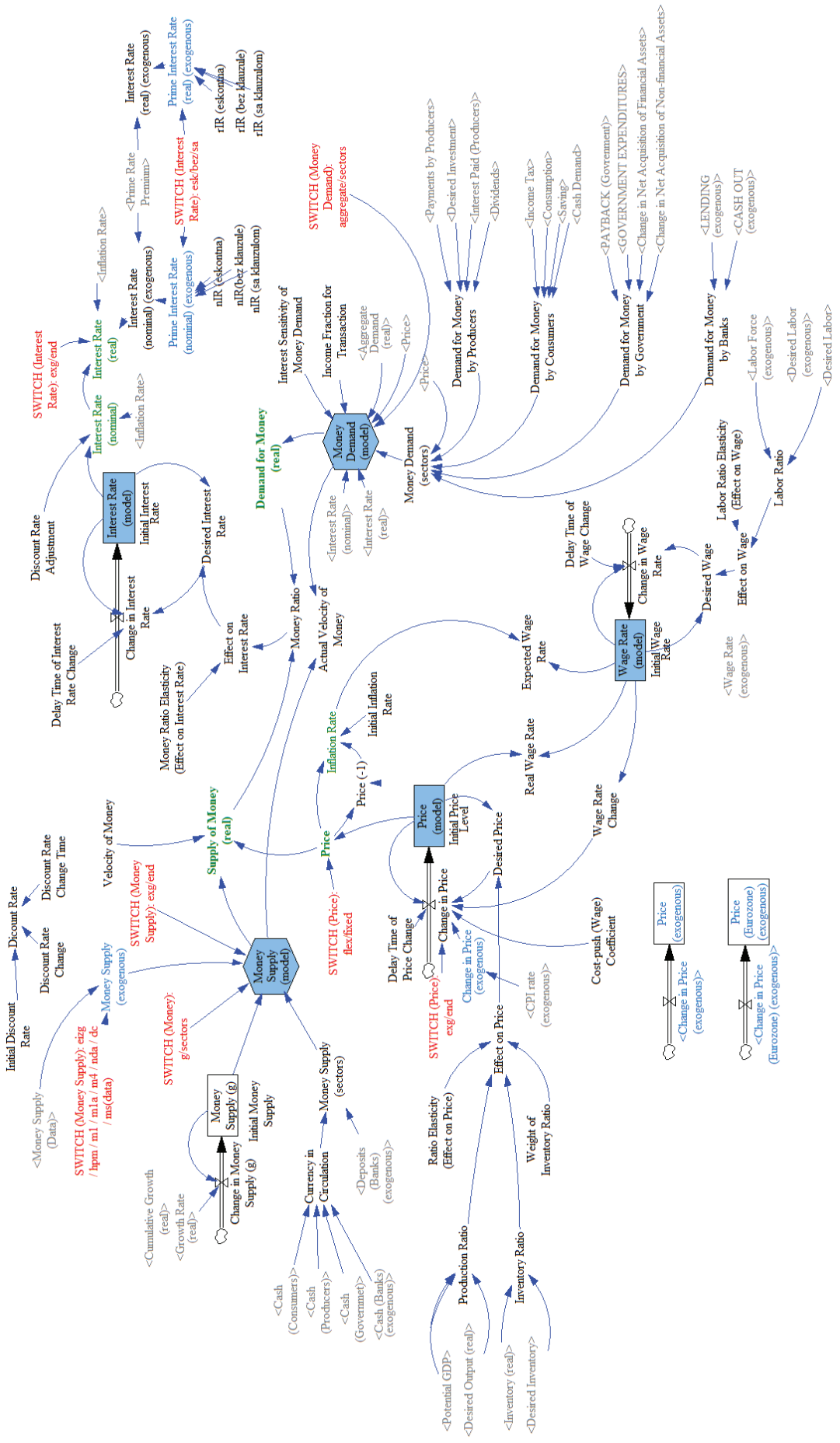
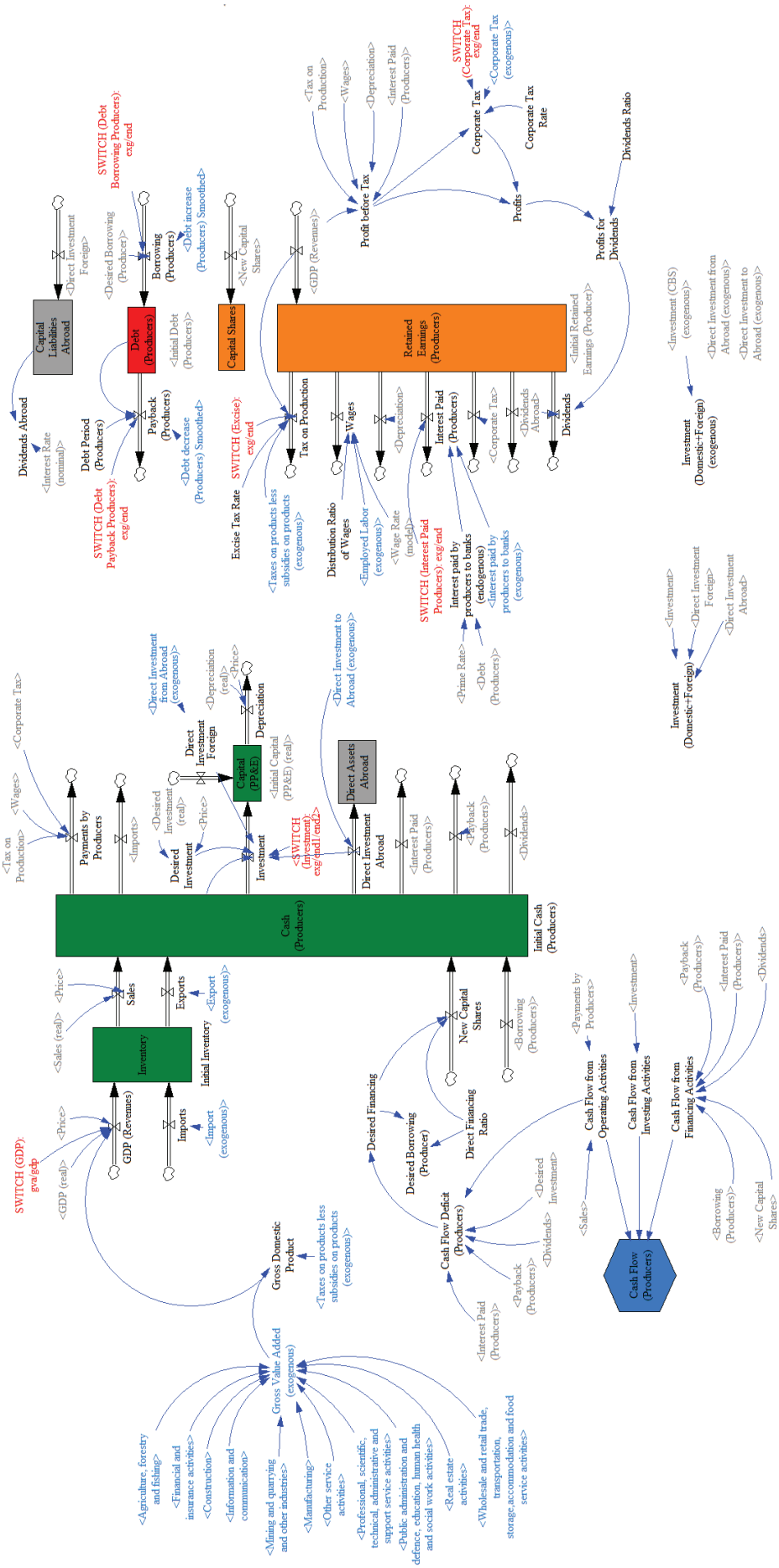


Figure 4. Producer's sector model.



2.5. Consumers

Consumers make two decisions: how much to consume, and how to make a portfolio choice (how much of their remaining income to invest in either saving, newly issued shares, or government securities). The consumption decision is presented by (6), while the portfolio decision is treated exogenously and defined as a simple rule - consumers first save the remaining income as deposits, and then they purchase government securities or newly issued shares in initial public offers. Typical consumer's transactions are the following:

(1) consumers receive wages and dividends from producers and income from abroad (the latter is taken as exogenous),
(2) they receive financial income from interest on deposits from banks, and interest on government securities, while the accumulation of capital gains from the equity market is proportional to the Zagreb Stock Exchange equity index (Crobex),
(3) cash is received when the government partly redeems its securities,
(4) out of the above-defined income, consumers pay income taxes (less government transfers such as subsidies and social benefits), and the remaining amount becomes their disposable income, and
(5) out of this disposable income, they spend on consumption, and then they save or invest in government securities.

We assume consumers do not invest in corporate bonds, and hold cash proportional to the currency ratio. Figure 5 illustrates the consumer's sector in the model.

2.6. Government

As government expenditures G, are determined by a democratic political process they can be treated exogenously in the model. However, they can also become endogenous variables, either by relating them to economic growth, or by relating them to tax revenues. In the former case, governments act procyclical, they change expenditures proportionally to the change in GDP, implying the following set of equations $g(t)=\Delta Y(t)/Y(t)$, such that $dG/dt=g(t)\cdot G$. In the latter case, $G=\beta_{PB}T$, the government targets the primary balance ratio β_{PB}, a ratio of expenditures and tax revenues. The budget is balanced when $\beta_{PB}=1$, and it is in deficit when $\beta_{PB}>1$.

Government faces decisions about its revenues and expenditures; how much taxes to levy to collect revenues, and how much revenues to spend as expenditures. Tax revenues are collected according to (8), while expenditures are defined either by economic growth or revenues as set out in (11). We allow for both rules, the growth-dependent, and the revenue-dependent. Government transactions are as follows:

(1) government receives tax revenues from consumers (income tax), and from producers (corporate tax and tax on production),
(2) government spending consists of expenditures and payments to consumers (partial debt redemption and interest on government securities),
(3) expenditures are determined by either the growth- or revenue-dependent rule,
(4) in case when expenditures exceed revenues (deficit), the government must borrow cash from banks or from consumers by issuing new securities.

Figure 6 illustrates the government sector in the model.

Figure 5. Consumer's sector model.

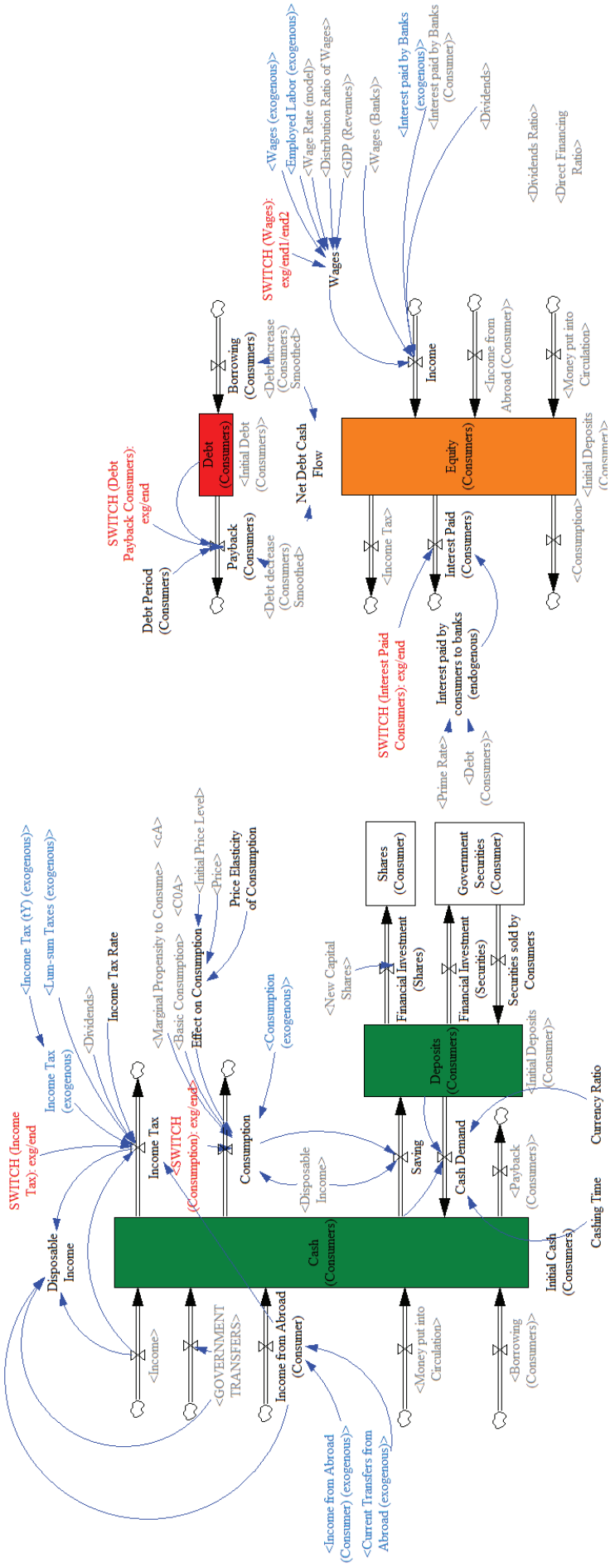


Figure 6. Government sector model.

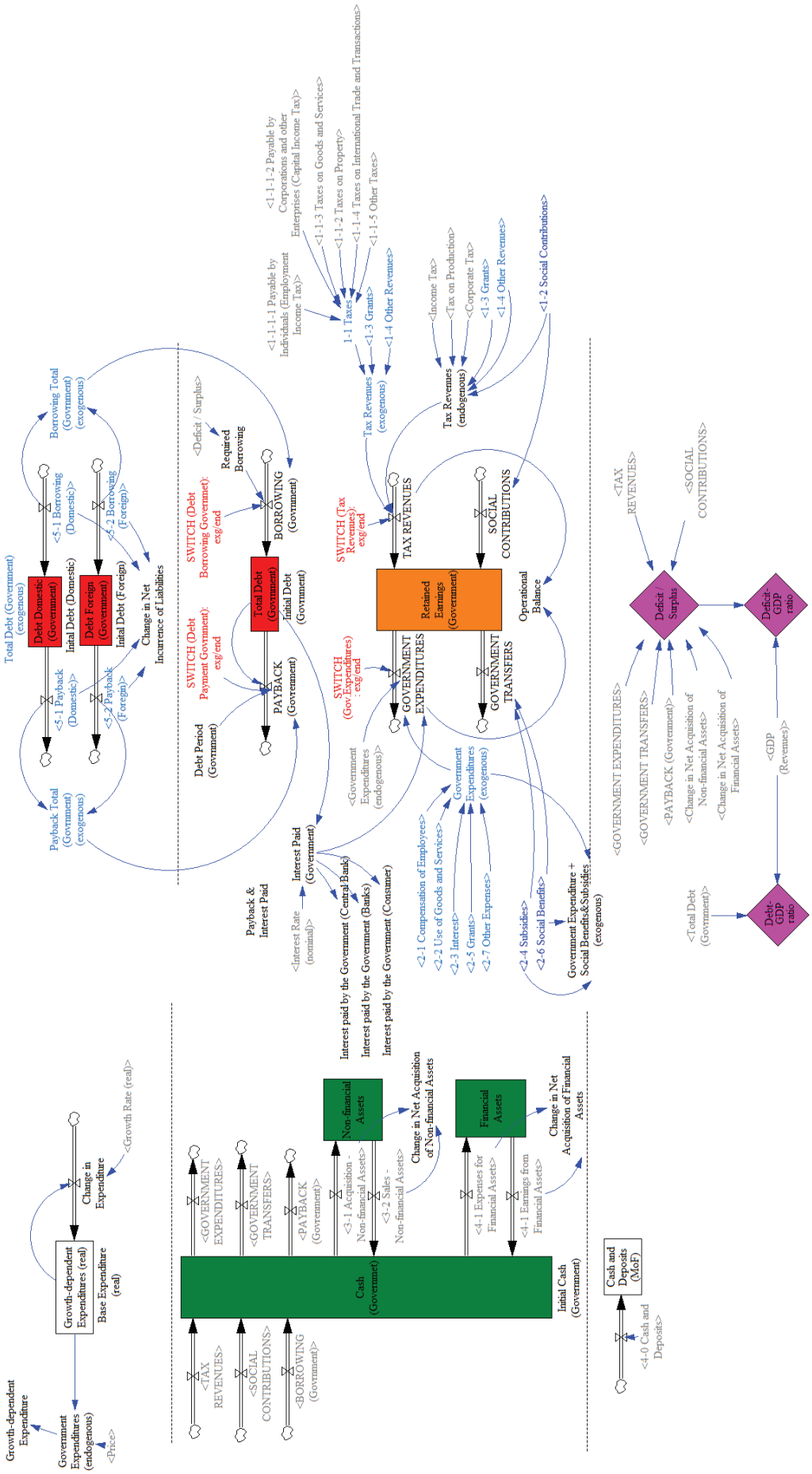
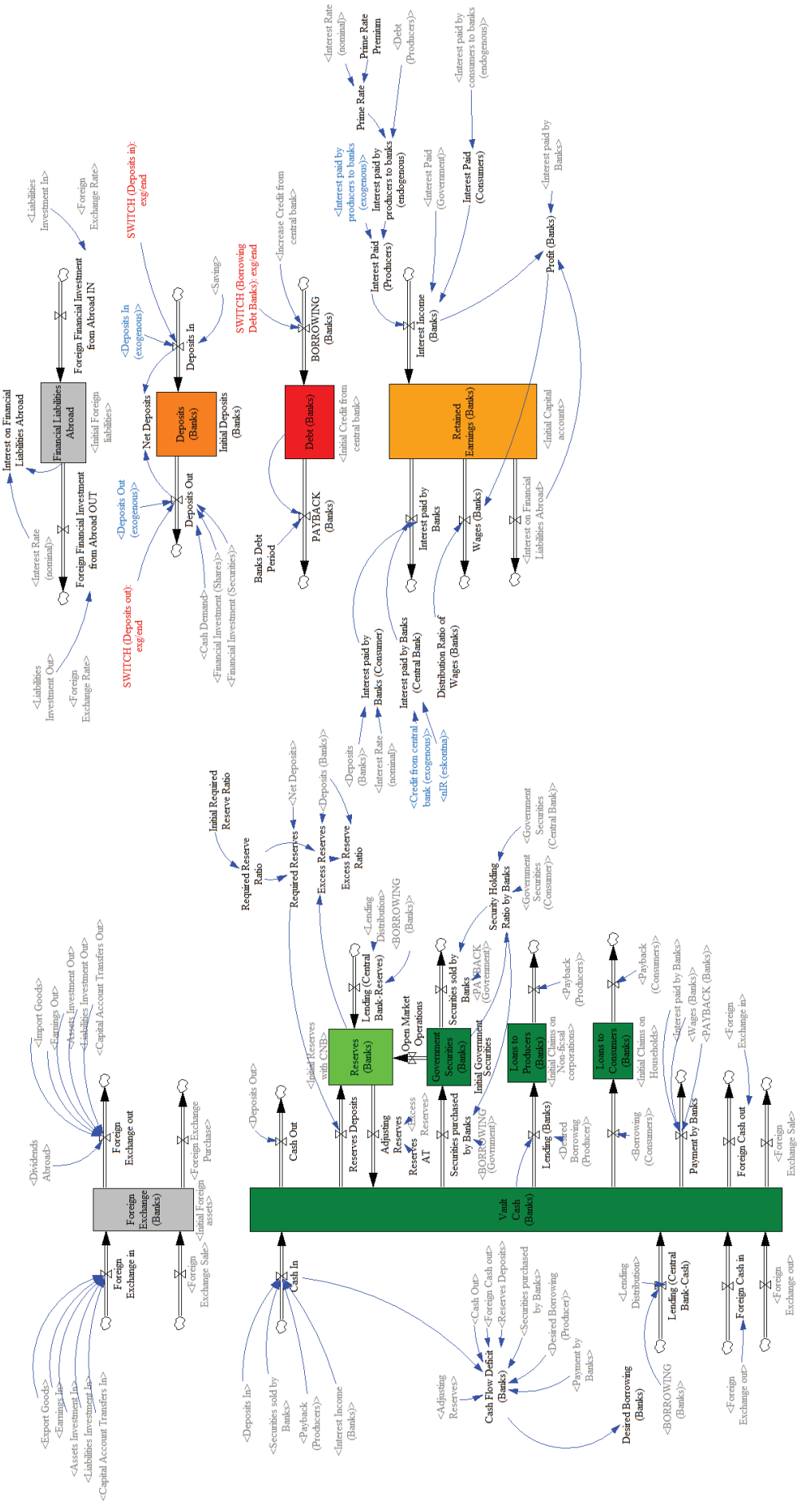


Figure 7. Banking sector model.



2.7. Banks

Banks are part of a fractional-reserve banking system. They make limited portfolio decisions in the sense that they invest in government securities or make loans to producers. Their transactions are the following:

(1) banks receive deposits from consumers against which they pay interest,
(2) they must deposit a fraction of deposits as required reserves with the central bank,
(3) banks invest in government securities out of remaining deposits and receive interest,
(4) banks make loans to producers and receive interest defined as prime interest rate,
(5) bank's retained earnings are equal to interest received from producers and the government, less interest payment to consumers. Positive earnings are distributed among bank owners and workers as consumers.

Figure 7 illustrates the banking sector in the model.

2.8. Central Bank

The central bank controls the money supply by controlling the amount of monetary base consisting of currency outstanding and reserves. The instruments at disposal are the required reserves ratio, open market operations and direct lending control. Assets against which currency is issued can be gold, loans, or government securities, but nowadays money is mostly issued against the debt by the government and commercial banks.

Central bank's transactions are the following:

(1) central bank issues currency against gold deposited at the central bank, by buying government securities from the public, banks, or through open market operations and by making discount loans to banks,
(2) it also withdraws currency by selling government securities and by banks repaying debt,
(3) central bank controls monetary policy using the reserve requirements ratio, open market operations, the discount rate, and discount loans to banks.

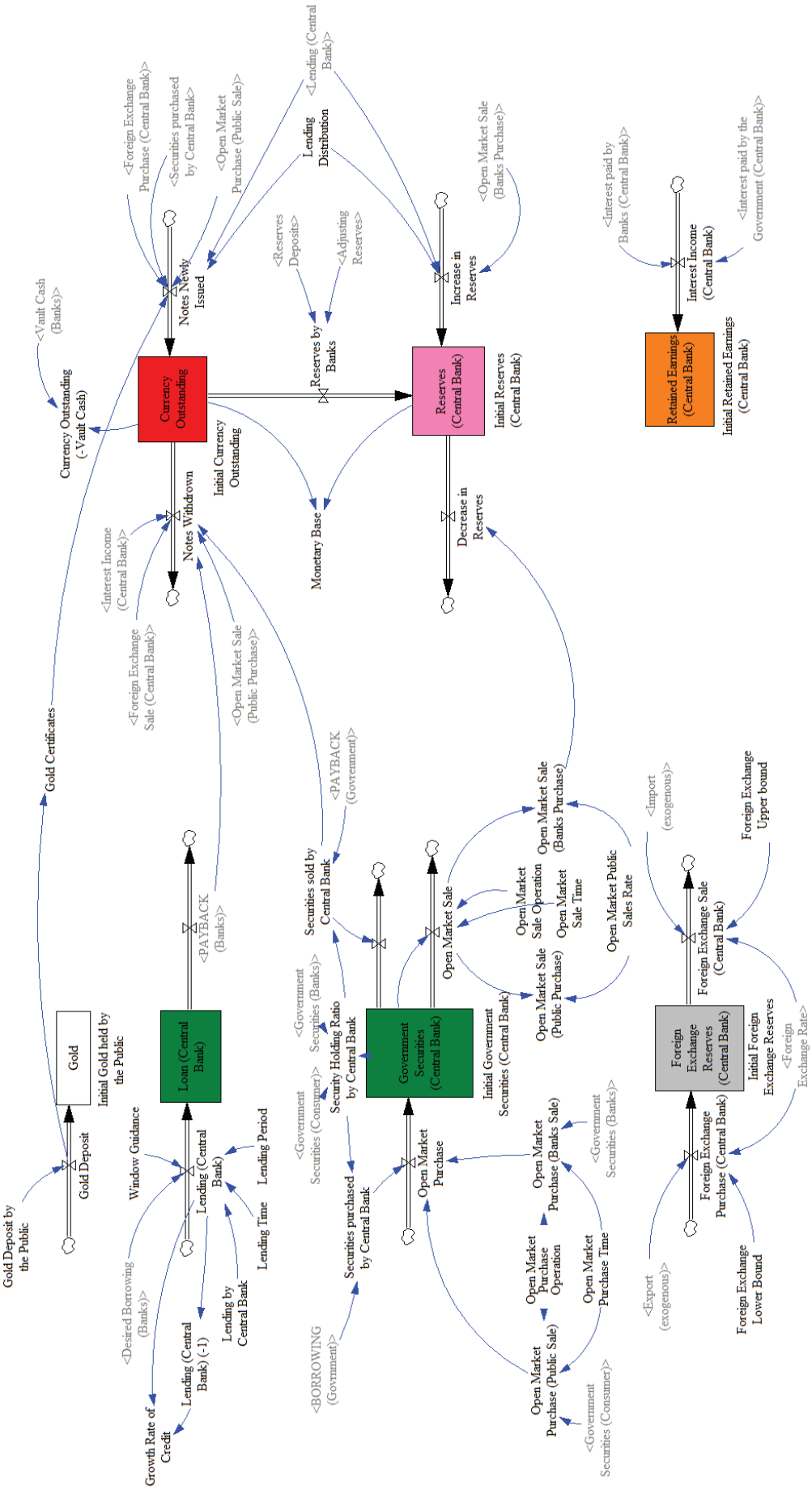
Figure 8 illustrates the central bank sector in the model.

2.9. Model calibration

Model calibration (or optimization of parameters) was done using an optimization algorithm available in *Vensim DLL* modelling software, by the fitting of simulated (endogenously modelled) data with the real (historical) time series data. For the parameters optimization an efficient *Powell's hill climbing* algorithm was used for searching through the space of parameters (or constants) looking for the largest cumulative payoff function, e.g. once we have chosen the constants and their range for optimization, then the chosen optimizer tried to find (within about 1000 iterations) the values for those parameters (constants) that make the chosen payoff as large as possible. In the default case of an ordinary calibration payoff (with only one variable in the payoff definition, without Kalman filtering and assuming normally distributed Gaussian errors), the payoff is calculated as weighted sum of squares of the difference (errors) between the data and the model. Further, the calibration was done in a step-by-step process using switch variables to isolate a part of the model. For example, we isolated consumption by holding all other variables exogenous. Later we gradually expanded the number of variables that are modelled endogenously. The model was completed when the majority of variables were simultaneously modelled endogenously.

In our model we have endogenously modelled the following variables: GDP (nominal/real/full capacity/potential), inventory, investment, consumption, government expenditure/tax revenues, interest rate (nominal/real), wage rate, wages, fiscal deficit/surplus, prices/inflation rate. In the current version of the model, external variables (the variables from the Croatian balance of payments, e.g. export, import, foreign direct investment, domestic direct investment abroad, and income from abroad), the money multiplier and the harmonized index of consumer prices (HICP) of the Eurozone were treated exogenously.

Figure 8. Central bank sector model.



3. Results

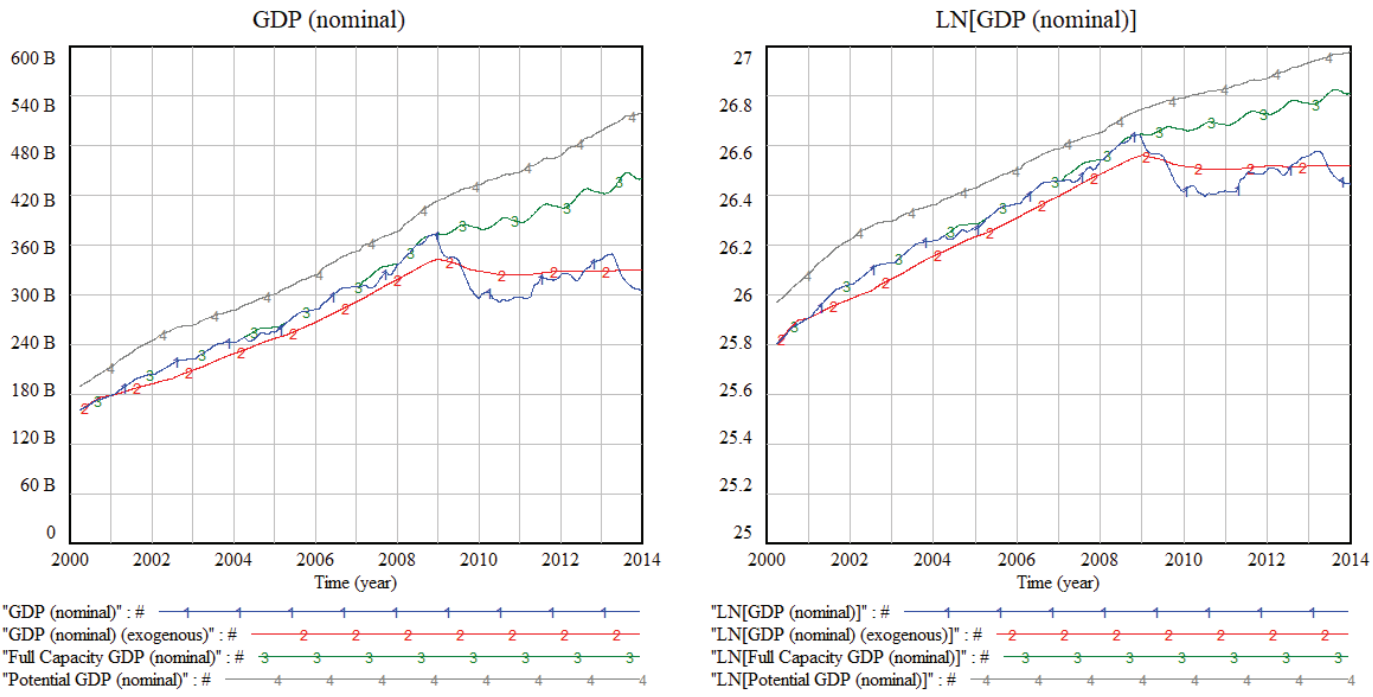
3.1. Model validation

In the baseline results we present simulations from our model obtained for main macroeconomic variables: GDP, interest rate, investment, consumption, inventory, government revenue and expenditure, fiscal deficit, public debt, wages, and prices. In addition, the model can be used to validate economic behaviour in past scenarios, or to estimate future paths of key macroeconomic variables one or more quarter ahead. Furthermore, regarding structural validity, the model was tested and conforms with basic physical realities (all relevant stocks do not become negative), the model was tested using automated dimensional analysis (there are no any strange combination of units or non-dimensional parameters), several extreme values such as zero or infinity (for prices, labour and capital) were tested and the model is robust under these extreme conditions, and lastly we tested the model sensitivity using Monte-Carlo simulations, primarily focusing on the impact of value added tax (VAT) rate, the parameter we consider highly influential in our economy and fiscal policy.

Figure 9 illustrates the results of simulated (modelled, endogenous) data in comparison to the historical data for nominal GDP, achieving a coefficient of determination or R-square (R^2) of 0.907 indicating very good fit between the simulated model data and actual historical data, while comparable goodness of fit was reached in other time series as well (Figures 9 - 18). In addition to nominal GDP Y, full capacity GDP Y_{full} and potential GDP $Y_{potential}$ are also plotted.

We also simulate GDP time series in real terms. Figure 10 illustrates the results of the simulated data in comparison to the historical data for real GDP. In addition to real GDP ($Y_{real}=Y / P$), full capacity real GDP (Y_{full} / P) and potential real GDP ($Y_{potential} / P$) are also plotted. Simulation results show that modelled real GDP follows full capacity real GDP and historical real GDP very well up to the last quarter of 2008 (just after the collapse of Lehman Brothers and the spread of the financial crisis to the global economy) and then it falls more abruptly than the historical real GDP. Moreover, while historical real GDP stagnates in 2011 and in 2012, our simulation points to a temporary recovery followed by another downturn as of the second quarter of 2013. The model shows no signs of recovery by the end of 2013 implying that real GDP growth rate was negative in 2013.

Figure 9. Simulated (modelled, endogenous) time series and historical time series for nominal GDP, full capacity GDP and potential GDP. Two representations are available: in absolute values (left figure) and in logarithmic values (right figure).



Note: Blue lines (also labelled with marker "1") represent simulated (endogenous) data from the model and red lines (also labelled with marker "2") represent historical (exogenous) data given exogenously for comparison.

Figure 10. Simulated (modelled, endogenous) time series and historical (exogenous) time series for real GDP, full capacity real GDP and potential real GDP. Two representations are available: in absolute values (left figure) and in logarithmic values (right figure).

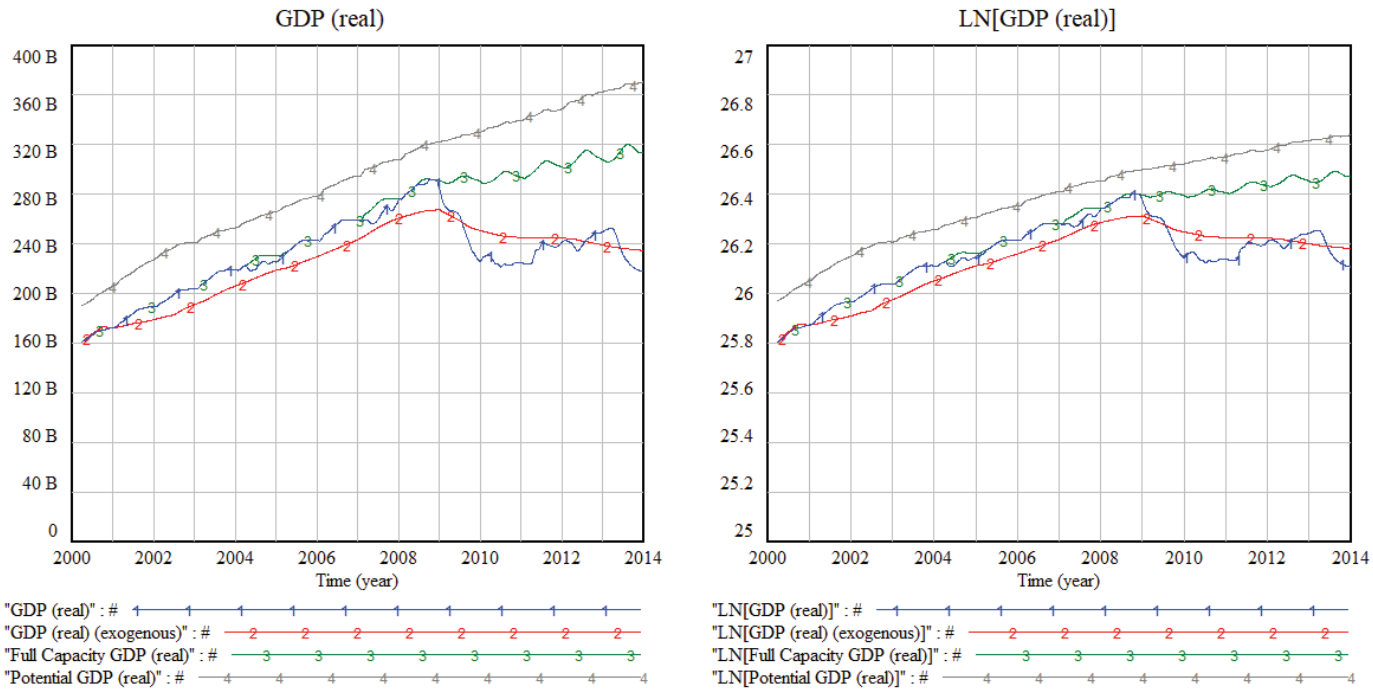


Figure 11 illustrates the results of the simulated data in comparison to the historical data for the nominal interest rate *i* and the real interest rate *r*. As a benchmark nominal interest rate does not exist in Croatia, we use a proxy - the nominal interest rate on short-term Croatian *kuna* enterprise credits not indexed to foreign currency less bank's prime rate premium which is 2.5 percent on average. The (real) benchmark interest rate is calculated by subtracting the exogenous change in prices (measured by the consumer price index, CPI) from the proxied nominal benchmark rate. In this model, the real and the nominal benchmark interest rates were used only for comparison, not for modelling. Both nominal and real interest rate obtained by the simulation follow the historical trend very well, although the historical time series are much more volatile. Understandably, the model cannot capture events, such as the one-time interest rate spike from the first quarter of 2009 when rates jumped due to the central bank decision to withdraw local currency liquidity from the money market in order to contain the HRK/EUR (Croatian *kuna* vis-à-vis the *euro*) depreciatory pressures caused by the sudden capital outflow.

Figure 12 illustrates the results of the simulated data in comparison to the historical data for investment. We allow for two different investment specifications. One obtained through the investment base formulation, and the other based on desired capital investment function. Although these two simulations are fairly similar, investment obtained on the basis of desired capital investment function provides a somewhat better fit to historical data. An even better fit is obtained when we compare the simulation with investment composed of both domestic and foreign investment, although our model still cannot explain total investment. The blue (simulation) line is always below the historical (green), probably because we treat the foreign sector, an important source of investment, as exogenous in the model.

Figure 11. Simulated (modelled, endogenous) time series and historical (exogenous) time series for the nominal interest rate *i* (left figure) and for the real interest rate r (right figure).

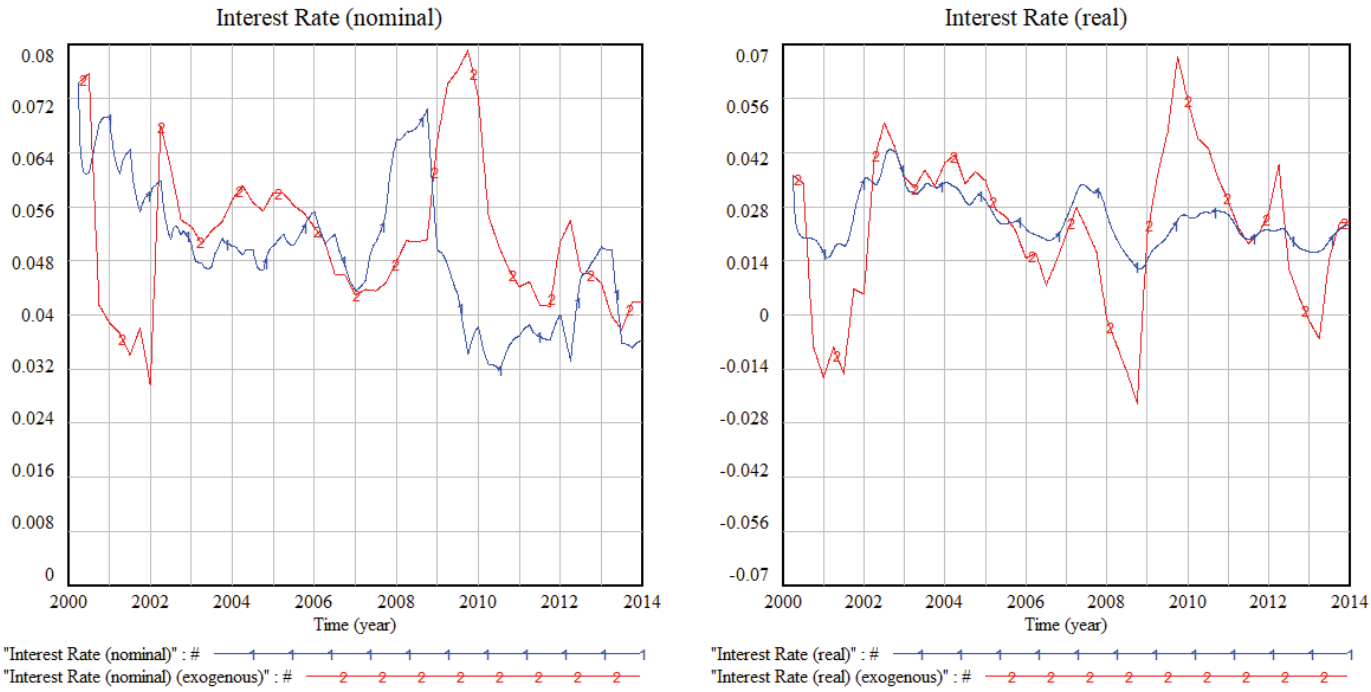


Figure 12. Simulated (modelled, endogenous) time series and historical (exogenous) time series for investment *I*. Two representations are available in which investment is either defined through the investment base formulation in equation 9 (left figure) or through the desired capital investment function in equation 9 (right figure).

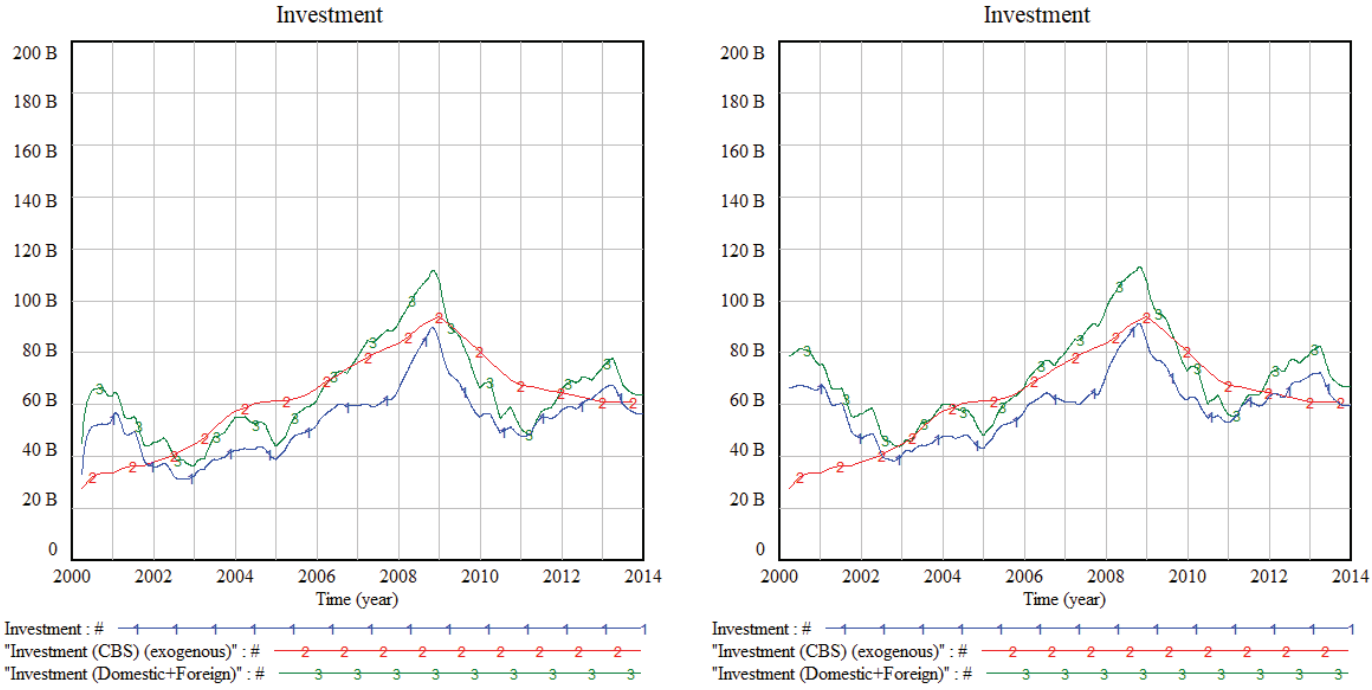
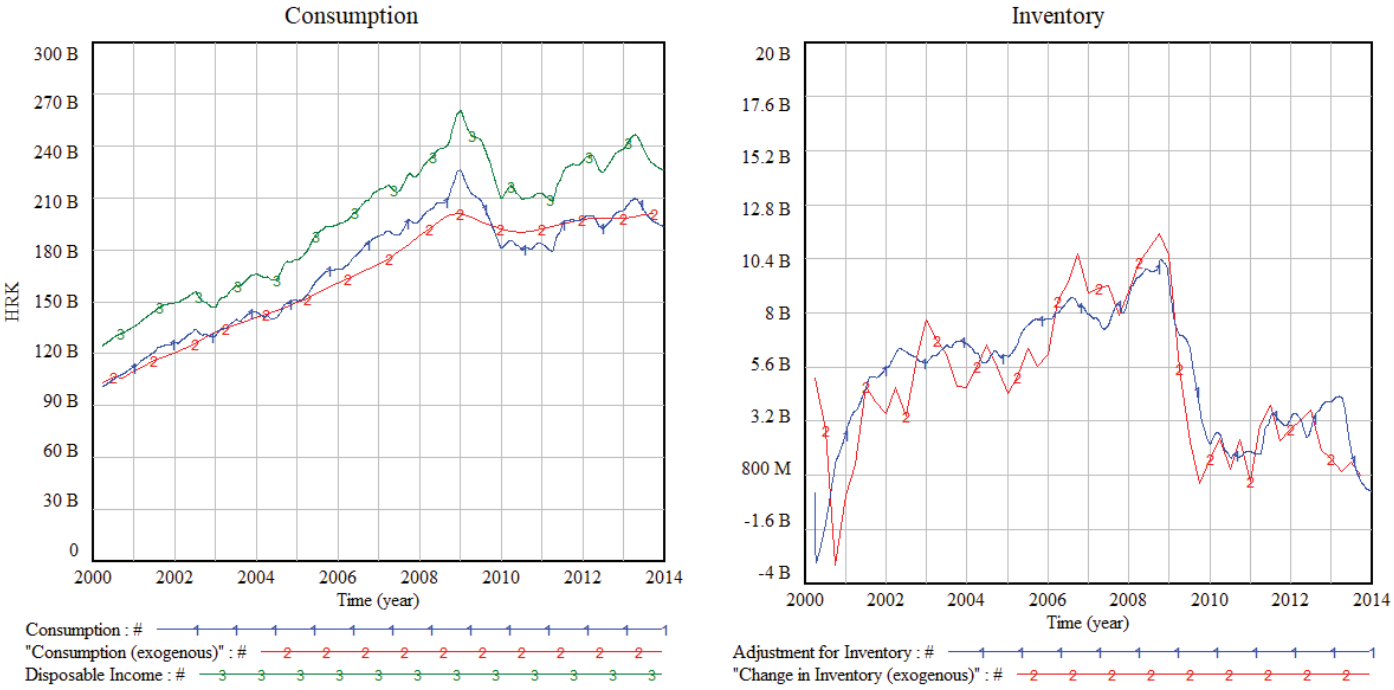
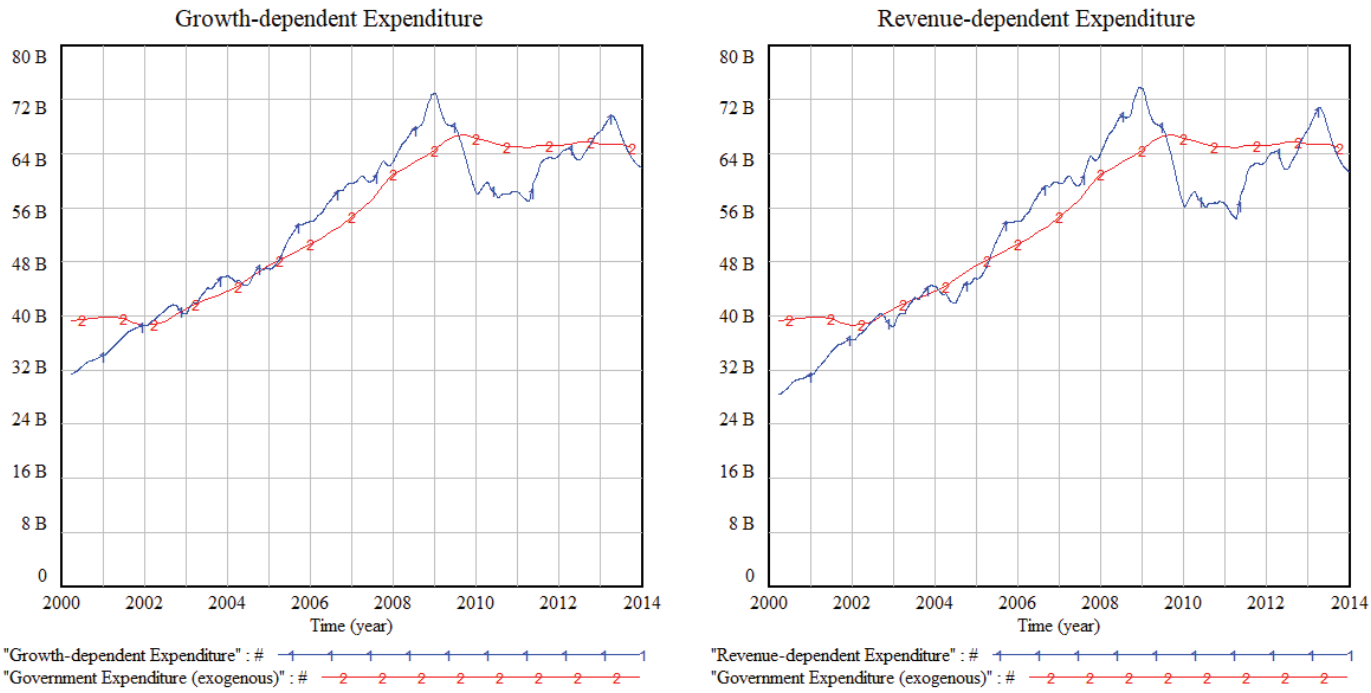


Figure 13. Simulated (modelled, endogenous) time series and real (historical, exogenous) time series for consumption C (left figure) and for inventory I_{nv} (right figure).



Simulated and historical time series for consumption and inventory are presented in Figure 13. Since we define consumption as proportional to disposable income, our simulation closely follows disposable income (consumption follows from below, because we assume that consumers save a part of their income or they invest in government securities), while historical data follow only the trend in disposable income, appearing to be much smoother and a bit below our simulation. It could be the case that official statistics do not record all transactions and that there is a part of consumption that stays in the shadow economy. Regarding inventory, our model manages to completely describe the trend in historical data and even most of the variability. Inventory is the crucial part of our model because it describes the discrepancy between production and sales, therefore reflecting the business cycle.

Figure 14. Simulated (modelled, endogenous) time series and historical (exogenous) time series for government expenditure G. According to (11), two representations are available: growth-dependent expenditure (left figure) and revenue-dependent expenditure (right figure).



We present in Figure 14 both growth-dependent and the revenue-dependent government expenditure. From the figures we can see that both definitions provide very similar fits, which closely follow the revenues trend. Both simulations tend to exaggerate the decrease in expenditures as of 2009, stemming from the fact that this version of the model does not allow for borrowing abroad. Since in reality the government had access to international markets, this allowed more or less constant level of expenditures in the period from 2010-2013.

According to the simulation, the deficit/GDP ratio somewhat underestimates the severity of the poor fiscal position. This is probably so because it overvalues tax revenues due to existence of shadow economy (Figure 15).

Figure 15. Simulated (modelled, endogenous) and historical (exogenous) time series for government revenues T collected through production $T_{production}$, income T_{income}, and corporate $T_{corporate}$ taxes.

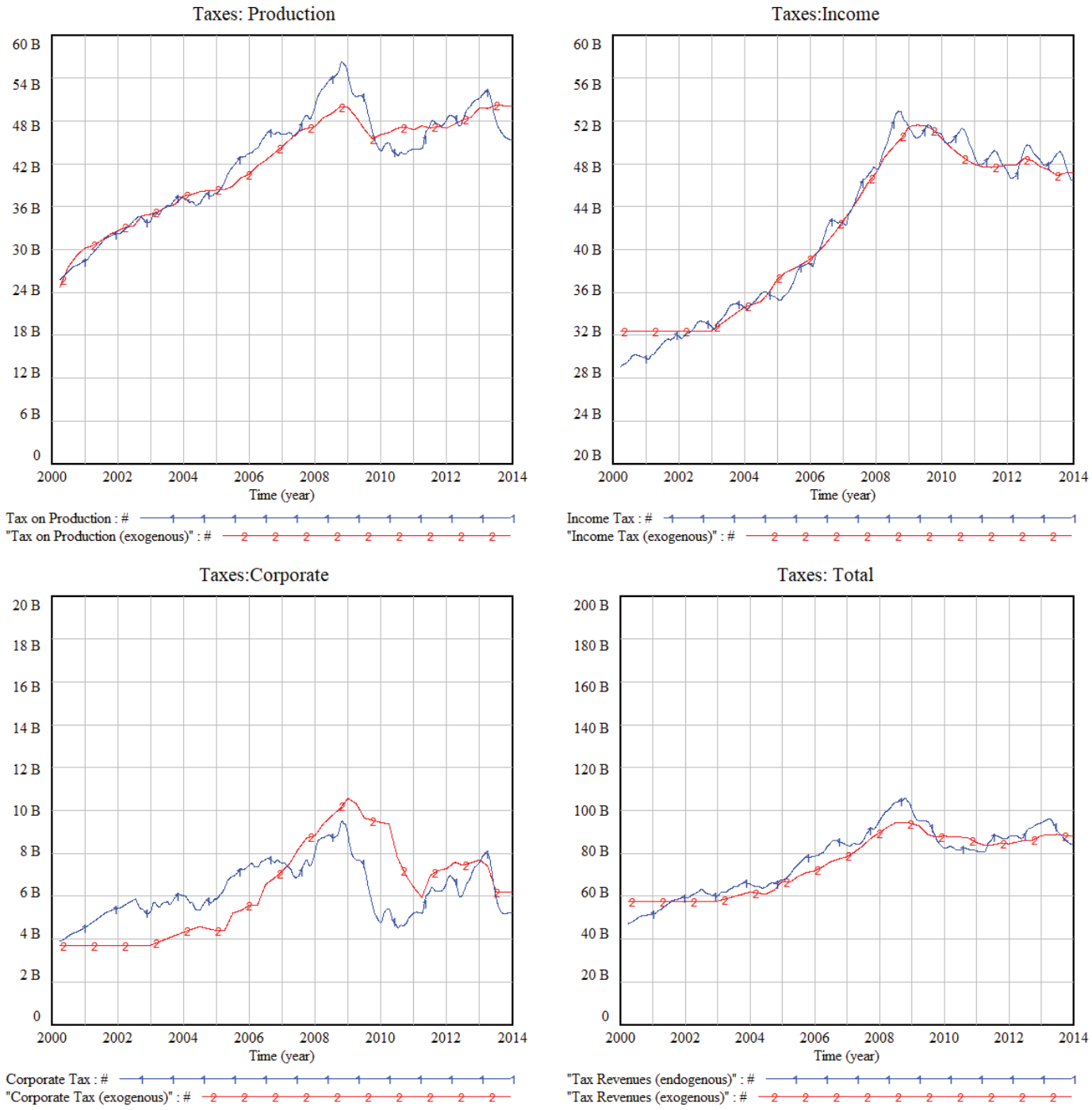
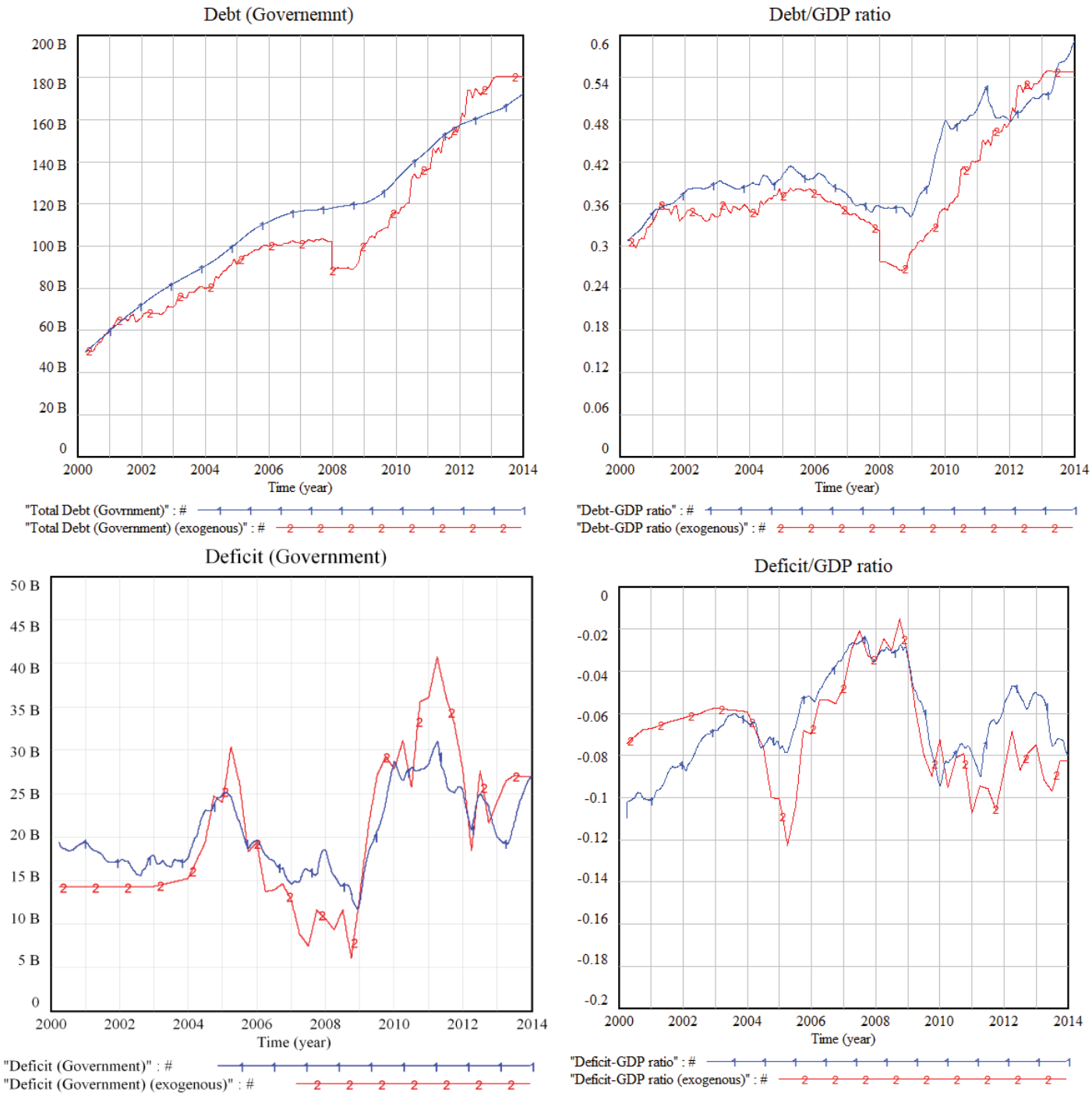


Figure 16. Simulated (modelled, endogenous) time series and historical (exogenous) time series for accumulated government debt *D* (upper left figure) and annual government *Deficit* (lower left figure). *Debt/GDP* ratio is given in the upper right figure, and *Deficit/GDP* ratio in the lower right figure. All series are obtained for the general government (which includes central and local government).



Government debt and deficit together with their shares in GDP are presented in Figure 16. Simulation of government debt follows the trend and more or less the level in government debt up to 2012. However, the model does not manage to pick up a spike in government debt that occurred at the beginning of 2012, but in terms of debt level, the simulation does fairly well. The relative indicator, debt/GDP, mirrors the dynamics in the indicator much better. Moreover, our simulation suggests that in the last quarter of 2013, debt/GDP continued to grow very close to 60 percent of GDP. Our simulation of government deficit follows

historical data satisfactorily. Especially encouraging is the fact that our deficit/GDP simulation coincides with the trend in historical data.

The real wage rate is presented in Figure 17. According to (23), there are two possible representations for wages; one through the exogenously obtained employed labour and wage rate dynamics, and the other through GDP and fixed distribution of wages. Simulation shows that the former definition provides a better fit. This is so because the latter definition provides a more cyclical simulation, and having in mind that wages are rather sticky, i.e. they do

Figure 17. Simulated (modelled, endogenous) time series and historical (exogenous) time series for the nominal and real wage rate *w* (upper figure). According to (23), two representations are available for wages: through employed labour that is taken to be exogenous and wage rate dynamics (lower left figure), or through GDP and fixed distribution of wages (lower right figure).

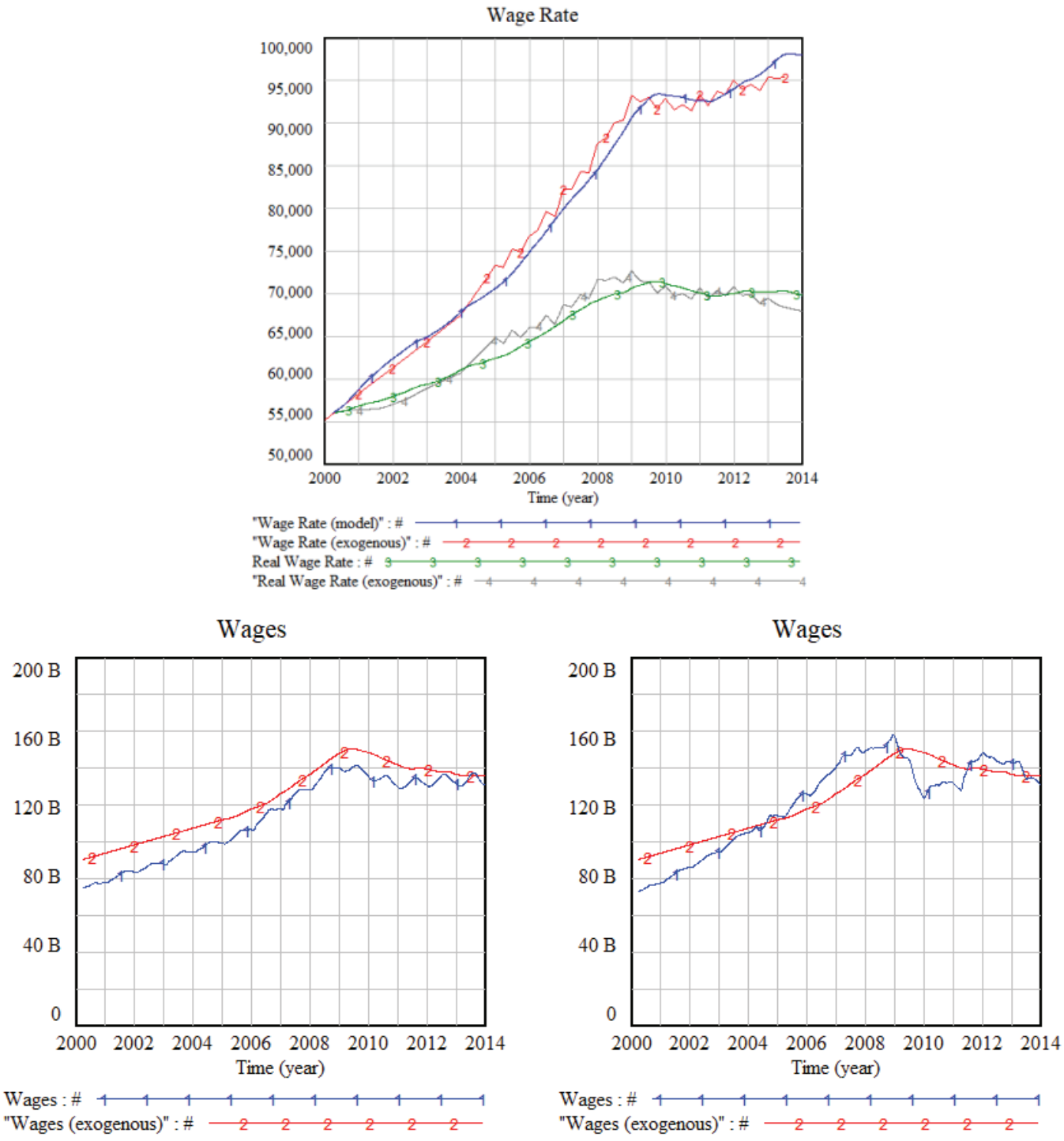
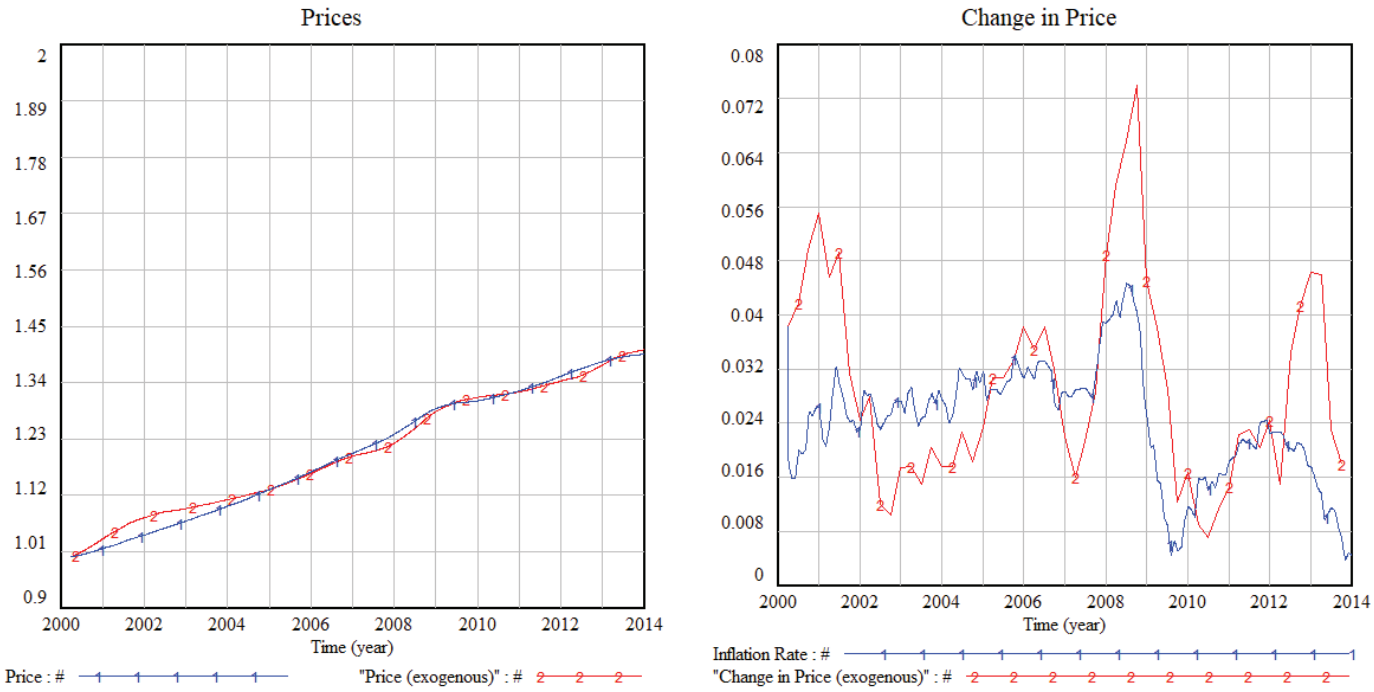


Figure 18. Simulated (modelled, endogenous) time series and historical (exogenous) time series for prices P (left figure) and for the inflation rate (change in price) π (right figure).



not tend to decrease easily, it is hard to expect that wages will exhibit such variability as obtained by the simulation.

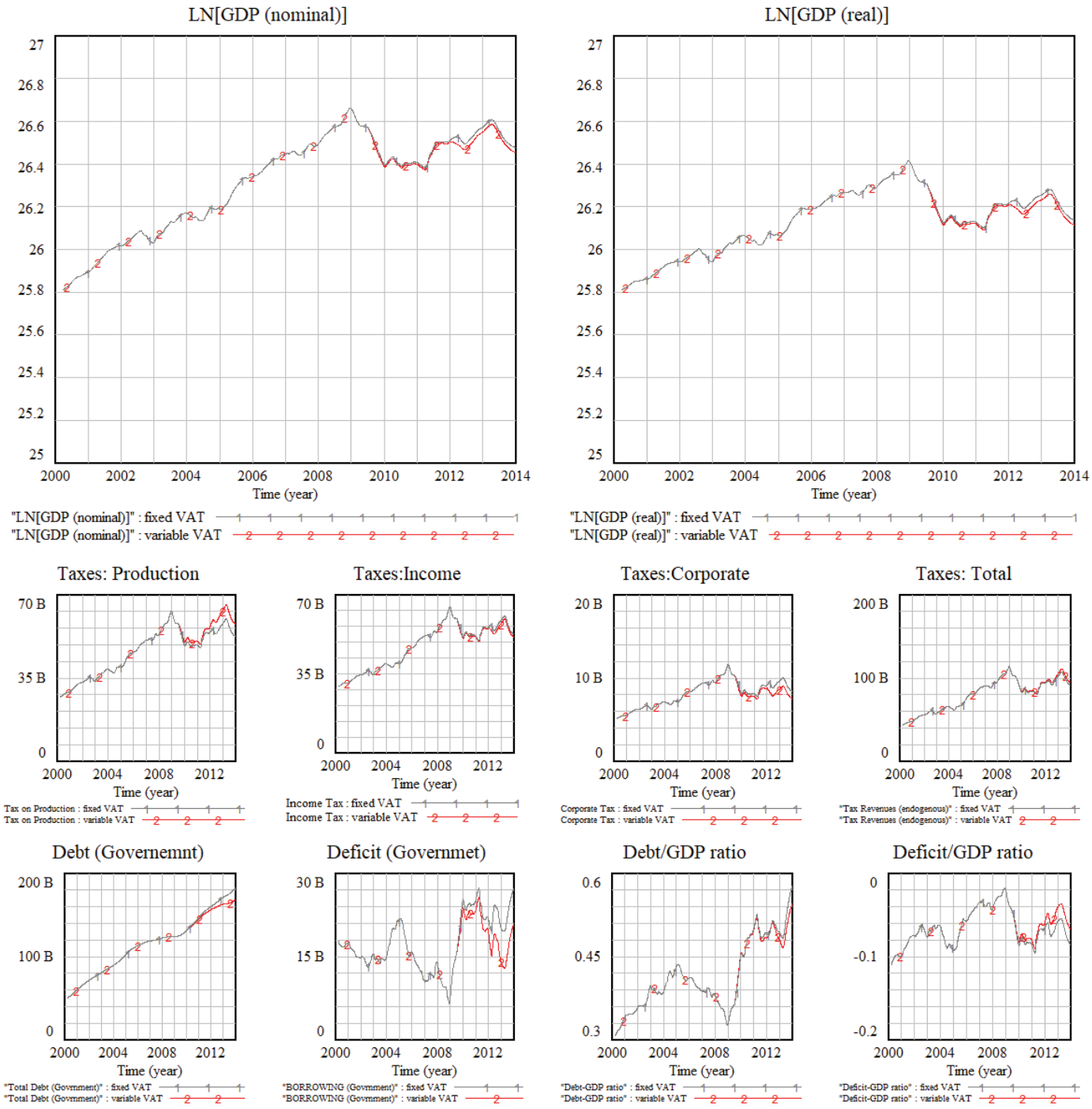
Prices and the inflation rate are shown in Figure 18. We can observe that our simulation provides an almost perfect fit in the case of prices. However, although our simulation of inflation does follow the trend in historical data very well, it cannot reproduce some significant spikes in inflation. For example, the simulation undervalues a spike in the second half of 2008 that was completely caused by a rise in global oil prices or inflation caused by administrative price hikes in 2012 and 2013. As our model does not and cannot account for all possible causes of a price increase (global price shocks or political decisions), we do not expect to get a perfect fit for inflation, but only a good approximation for the trend.

3.2. Economic policy scenarios

To test a possible application of our model to simulate effects of economic policy actions, we examined an actual discretionary fiscal policy measure that was introduced in Croatia. Before the Great Recession, Croatian value added tax rate was set at 22%, but in the third quarter of 2009 it was hiked to 23% and then again in the first quarter of 2012 to 25%. Using model, we examined two scenarios, as presented by Figure 19. First, the hypothetical scenario in which the VAT rate remained at the historical 22% (scenario 1 or "*fixed VAT*"). Second, the scenario of the actual fiscal intervention in which VAT rate was gradually increased to 25% (scenario 2 or "*variable VAT*").

Our results imply that an increase in the VAT rate raises tax revenues from this specific tax, but at the same time, it drives down revenues from income tax and especially from corporate tax, because a VAT rate hike causes an increase in consumer prices. This means consumers can afford fewer products with the same income level, which causes the contraction of aggregate demand. Producers respond to the drop in aggregate demand by decreasing production. Lower production translates into lower profit and lower corporate tax revenues for the Government. In addition, producers need to lay off some workers due to a cut in production, which adversely affects the personal income tax revenues.

Figure 19. Comparison of two scenarios: (1) hypothetical, "fixed VAT" scenario (grey line marked with "1") and (2) "variable VAT" scenario that actually occurred (red line marked with "2"). For comparison we have also plotted nominal and real GDP, production, income, corporate, and total taxes, and debt, deficit, debt/GDP ratio, and deficit/GDP ratio of the general government.



Nominal and real GDP both decrease because of VAT rate hike, due to a fall in aggregate demand caused by rising consumer prices, and then further due to the second-round increase in unemployment and related reduction of disposable income, which further suppresses aggregate demand. Regarding aggregate fiscal indicators, total tax revenues slightly increase, as VAT takes the biggest share of total tax revenues. As a result, government deficit and debt decrease in absolute terms, and relative fiscal indicators (debt/GDP and the deficit/GDP) mildly decrease because the fall in GDP is not large enough to offset the decrease in public debt and deficit, at least not when exogenous data up to 2012 are considered.

4. Discussion

Building on the previous and only theoretical work of Yamaguchi (2013), in this paper we presented for the first time the practical use of the national system dynamics model, calibrated for the case of the Croatian economy. Our contribution is in the structural adaptation of the model to the Croatian economy (mainly how the consolidated general government revenues / expenditures, transactions / liabilities and debt are specifically organized, as well as how the central bank assets / liabilities and balance of payments are explicitly structured) and the latter contribution is the calibration of the model to the actual historical time series of the Croatian economy.

The model is holistic in the sense that the whole is more than the sum because the parts of the model are interrelated and interdependent, and the model has plenty of feedback loops. The model is also dynamic and nonlinear due to numerous cash flows described by nonlinear differential equations that are solved by numerical integration in time, spanning from 2000 to 2014, using the Euler method.

The following time series have been treated exogenously in the model: money multiplier (needed to model the money supply endogenously), balance of payments (export/import, foreign direct investment, income from abroad), and labour market (population/employment) dynamics. We see this current version of the model as a proof of concept showing that the simulated data fit the historical data fairly well meaning that, by capturing the dynamics of the main economic variables in a satisfactory way, the model is validated.

The main limitation regarding the assessment of the future path (short-term and long-term) of key macroeconomic variables is the partial openness of the model and the use of several exogenous variables. In the future versions of the model, we plan to endogenize labour market dynamics and money multiplication. Endogenizing the remaining external sector would require development and calibration of a separate model of the foreign sector (e.g. European Union as Croatia's biggest trading partner).

For now, to carry out a one-quarter-ahead forecast by extending the numerical time integration for endogenously modelled variables, a naïve forecasting approach for the exogenous variables can be employed, using the last known value of the previous quarter. This approach could be significantly improved by using econometrically obtained forecasts of exogenous variables.

5. Conclusion

This paper is focused on the modelling of the national economic system, using the system dynamics approach and the practical application of the model calibrated on the real historical data. As this study is based on many system dynamics information feedbacks, it can provide holistic insight into the effects of the economic policy actions. To illustrate this feature of the model, we have demonstrated an application of the model to the analysis of fiscal policy intervention. Our results imply that an increase in the VAT rate raises tax revenues, but at the same time, decreases nominal and real GDP due to a fall in aggregate demand caused by consumer prices inflation, and additionally, by rising unemployment which aggravates disposable income and thereby further erodes aggregate demand.

We have also identified the advantages and possible further practical applications of the model. We assume that the future versions of the improved model could be used for: (1) forecasting and nowcasting paths of GDP, investment, consumption, government expenditure, inventory, interest rates, inflation, fiscal deficit, public debt, etc.; (2) calibration of other similar South East European economies (such as Bosnia and Herzegovina, Serbia, Slovenia, Macedonia, etc.)[1]; (3) programming project frameworks of EU funds for sectors with largest investment or financial gaps and analysis of their multiplication potentials; (4) scientific research, publications, and commercial projects including (a) stress tests on different economic sectors, spill-over effects estimation, non-performing loans forecasting, estimation of linkages between monetary and real economy; (b) research on multiplication effects on a sectoral basis (agriculture, construction, industry, services, public, etc.), where an added value would be to include dynamics in the analysis of multiplication potentials; (c) estimating the size of shadow economy.

Endnotes

1 For the copy of the model please contact the first author: https://www.linkedin.com/in/ssovilj/

Acknowledgements

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Appendix

Table 1. Names of the variables and constants with belonging symbols and values.

Name	Symbol	Value
Potential GDP	$Y_{potential}$	-
Full production GDP	Y_{full}	-
Factor of Technological Change	A	-
Capital (property, plant, and equipment)	K	-
Employed labour force	L	-
Total labour force	LF	-
Exponent on capital	α	0.33
Exponent on labour	β	0.67
Technological change	κ	0.015
Initial GDP	Y_0	190B (in 2000)
Initial capital (property, plant, and equipment)	K_0	250B (in 2000)
Initial employed labour	L_0	1.342M (in 2000)
Initial total labour force	LF_0	1.7M (in 2000)
Forecasting adjustment time	-	0.25 years
Desired production	Y^D	-
Inventory	I_{nv}	-
Desired inventory	I_{nv}^*	-
Normal inventory coverage	-	0.50
Time to adjust inventory	-	5 years
Aggregate demand	AD	-
Consumption	C	-
Investment	I	-
Government expenditure	G	-
Export	X	-
Import	M	-
Basic consumption	C_0	20B
Marginal propensity to consume	c	0.65
Disposable income	Y_d	-
Income (GDP)	Y	-
Income tax rate (social contributions included)	t_{income}	0.40
Tax on production (value added tax)	$t_{production}$	0.22 (or variable)
Corporate tax	$t_{corporate}$	0.20
Tax revenues	T	-
Lump-sum taxes (e.g. property taxes)	T_0	-
Government transfers (e.g. subsidies and social benefits)	T_r	-
(Nominal) interest rate	i	-

Desired interest rate	i^*	-
(Real) interest rate	r	-
Premium rate spread	-	0.025
Desired capital	K^*	-
Desired labour	L^*	-
Labour supply	L^S	-
Depreciation rate	δ	0.03
Investment base	I_0	500B
Interest sensitivity	α_I	0.1
Growth rate	g	-
Initial government expenditure	G_0	33B (in 2000)
Primary balance ratio	β_{PB}	0.7
Money supply (nominal)	M^S	-
Money demand (nominal)	M^D	-
Money velocity	V	0.52
Inflation rate (change in price)	π	-
Price level	P	-
Desired price level	P^*	-
Weight ratio for inventory and GDP gap	ω	0.5
Delay time (price adjustment)	-	5 years
Delay time (interest adjustment)	-	0.25 years
Income fraction for transaction	a	0.52
Interest sensitivity of money demand	b	1250B
Ratio elasticity (effect on interest rate)	e	1
Money demand (real)	m_d	-
Money supply (real)	m_s	-
Foreign direct investment	I_{FDI}	-
Domestic direct investment	I_{DDI}	-
Wage rate	w	-
Wages	W	-
Distribution ratio of wages	-	0.45

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DOES TOTAL FACTOR PRODUCTIVITY GROWTH AMELIORATE SOCIO-ECONOMIC STANCE? NEW FINDINGS FROM CENTRAL AND EASTERN EUROPE

Emin Efecan AKTAŞ

Abstract

National income calculations may not include knowledge that directly concerns the socioeconomic stance in an economy. Knowledge plays a significant role in promoting the economic growth of a country; however, its socio-economic role has received little attention in the literature. Total factor productivity, which is the main source of long-term economic prosperity, expresses the increase in productivity in all production factors. This paper attempts to quantify the effects of total factor productivity growth on economic prosperity. The analysis is conducted for the 2007-2020 period and 18 Central Eastern Europe countries. The "Legatum Prosperity Index" is utilized in the econometric analysis, in line with the purpose of the study. Results of the study with panel ordinary least squares, panel fixed-effects, panel random effects, panel-corrected standard errors (robustness check), and system-generalized method of moments (robustness check) confirm that total factor productivity growth positively correlated with economic prosperity.

Keywords: *total factor productivity, economic growth, economic prosperity, and panel data*

JEL classification: *C23, D24, I31, O47*

1. Introduction

Identifying the drivers and dynamics of economic growth has been a common trend among economists for many years. The social, technical, and institutional forces that increase productivity and increase economic growth have been discussed first philosophically and then mathematically and have recently been examined empirically. Initially, the dynamics of growth have been explained based on the accumulation of basic production factors such as labor and capital. Later, factors such as technology, human capital, governance, and social capital have been added to the growth literature. However, even if all these factors are tackled together, they are not considered sufficient to explain the expansion or prosperity of an economy anymore. That is, the amount of factors is insufficient to expound economic growth. It is impossible to explain how much output is produced per input with the indicator(s) of economic growth (Albeaik et al. 2017). This difference, which occurs when the increase in output is different from the contribution of labor and capital, is explained based on total factor productivity (TFP). Productivity is expressed as the ratio between

Emin Efecan AKTAŞ, Ph.D.
Assistant Professor
Vocational School of Social Sciences,
Kirsehir Ahi Evran University
Address: Sht. Necdet Yagiz Ave., No: 143,
Kirsehir Ahi Evran University, Bagbasi Campus,
40100, Kirsehir
Türkiye
E-mail: emin.aktas@ahievran.edu.tr
ORCID: 0000-0001-7751-3275

the input and output volume. It is considered a key source of economic growth and competitiveness and is, therefore, the basis for many international comparisons or country performance evaluations. (Krugman 1994). The relationship between productivity and growth has become a popular subject of economic research, especially in the long term from the 1950s to the present (Nordhaus 2005, p. 6-7). Productivity impacts macro variables such as countries' competitiveness and employment level. It is accepted that changes in productivity affect economic and social events such as economic development, the standard of living, the balance of payments, and control of inflation (Xu and Lybbert 2017, p. 2).

A wide variety of concepts has been used to evaluate the level of welfare from the past to the present. While the welfare level, which determines the development of a country, was evaluated as economic growth in the 19th century, it began to be measured by social welfare at the beginning of the 20th century and the quality of life at the end of the 20th century (Bate 2009, p. 1). It is argued that these indicators alone would not suffice to discern a country's development and that environmental, social, cultural, and political indicators, in addition to this indicator, have a significant impact (Markou et al. 2015, p. 1-2). It is possible to observe that the socio-economic stance of a country does not increase at the same pace and even decreases in some countries, while welfare is growing on a global basis. This situation has brought with it discussions about whether it is realistic to calculate economic prosperity level over macroeconomic variables such as gross domestic product (GDP) or gross national income (GNP). In the traditional sense, the concept of welfare, which expresses the quality of life of individuals and societies, emphasizes economic growth and material well-being (Fritz and Koch 2016, p. 41). The emergence of several needs with the changing world order has brought along discussions that welfare cannot be measured only by GDP and GNI, and that welfare should be measured in socio-economic terms (Bate 2009, p. 1). Many previous studies have stated that only the economic effects of socio-economic stance are measured and emphasized that many indicators such as social, geographical, human, institutional quality, education, and health should be added to these measurements. In this respect, several theoretical and empirical analyses have been realized. (Simon 1973; Easterlin 1974; Weitzman 1976; Elias 1992; Young 1995; Iwata et al. 2003; Fogel 2004; Oulton 2004; Danquah 2006; Idea 2008; Stevenson and Wolfers 2008; Stiglitz et al. 2009; Oulton 2012a; Oulton 2012b). It is anticipated that national income methods, which are used to calculate the socio-economic stance of countries, cannot fully represent economic prosperity. Therefore, the Legatum Prosperity Index is used to represent the socio-economic stance in line with the purpose of the study. The motivation of the study is to investigate whether total factor productivity growth can contribute to the socio-economic stance, which is defined as prosperity in 18 Central and Eastern Europe (CEE) countries or not. The following two hypotheses were tested in the study.

H_1: Prosperity is a multidimensional indicator that includes many economic, social, and societal dynamics and components in a given period in a country/economy, and economic growth alone cannot explain the socio-economic stance regarding prosperity.

H_2: Total factor productivity and economic prosperity are positively related.

Since the variables related to economic growth, such as GDP and GNP, are no longer sufficient to measure real economic performance, the Legatum Prosperity Index constitutes the research center of the analysis. Several explanatory variables are also included in the analysis. With this aspect, it is assumed that the study would contribute to the literature on two axes: i) Previous studies mostly focus on analyses such as TFP and economic growth or TFP and human/physical capital/governance quality, etc. This study uses an indicator of prosperity. ii) Basic policy proposals that can be evaluated in terms of countries with different economic, social, and political conditions have been remarked on. Estonia, Latvia, Lithuania, Czechia, Slovakia, Poland, Hungary, Slovenia, Romania, Bulgaria, Croatia, Russia, Belarus, Ukraine, Moldova, North Macedonia, Bosnia Herzegovina, and Serbia are subjected to the analysis. Most of these countries are newly industrialized and developing countries and are selected due to their future prosperity potential. The rest of the study consists of conceptual and theoretical framework, empirical literature review, data, methods, results, discussion, and recommendations.

2. Conceptual and Theoretical Framework

2.1. The concept of prosperity

Welfare can be expressed in many ways, such as tranquillity, spaciousness, comfort, and life quality. Welfare economics, which is a branch of the economy that uses microeconomic techniques to determine macroeconomic resource distribution efficiency and income distribution together, has placed the concept of

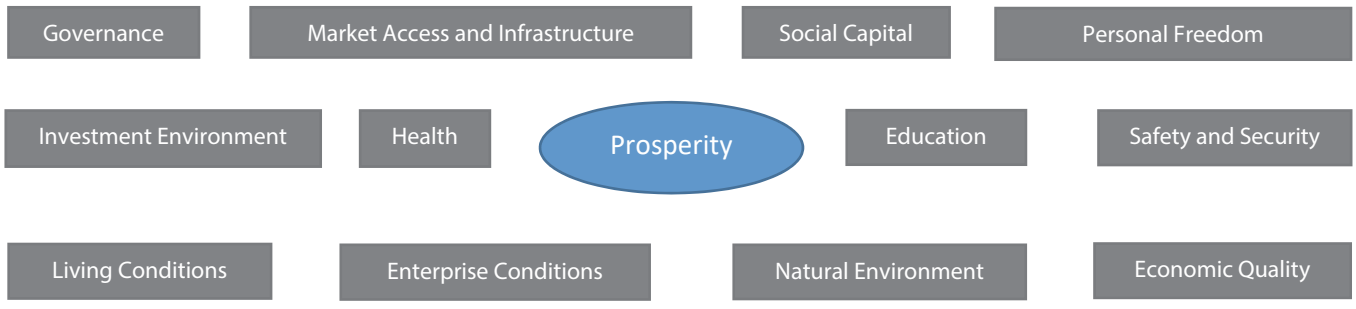
prosperity at the center of welfare debates for a while. The prosperity term which implies the overall welfare and access level of individuals or societies, not only includes wealth and employment but also contains concepts such as environment status, physical and mental health, education, entertainment, spare time, social belonging, freedom, human rights, and happiness. Prosperity is measured through an index. The Legatum Prosperity Index is a multidimensional index developed by the Legatum Institute in 2007. The Legatum Institute identifies prosperity as both well-being and wealth and records that the most prosperous nations in the world are not assuredly those with a high GDP, but those with healthy, delighted, and free citizens.

The Institute viewed prosperity as human development and argued that a nation's prosperity could only be achieved with effective institutions, an open economy, and empowered people who are healthy, educated, and secure. For this purpose, the institute created the prosperity index and succeeded in obtaining a very rich dataset representing more than 99% of the world's population (LPI 2020a, p. 5-8). With the regulations and improvements made in 2019, the Institute redefined prosperity and improved the existing dataset using 294 different sub-components by increasing 9 basic indicators to 12 (LPI 2019, p. 36-39). Currently, the prosperity index is calculated with 300 sub-components. The overall index score is calculated by weighting the 12 indicators equally (Figure 1), assuming that each criterion has equal importance for prosperity. The overall score for each country is determined by taking a simple average of 12 indicators (LPI 2020b, p. 84).

2.2. The theoretical background of total factor productivity

Although the differences in natural resources and capital per capita are shown as the main reasons for the differences in the growth rates of the countries, the effect of these factors is insufficient to explain the differences. The main factor explaining the growth rates and income differences between countries is the total factor productivity differences. TFP creates this difference by directly and indirectly affecting labor productivity (Ghosh and Kraay 2000, p. 13-14; Prescott 1998, p. 529). Total factor productivity is one of the basic elements of growth in national economies. In this context, it is among the major notions that explain the differences in the development levels of countries. TFP not only directly figures the effect of classical production factors such as labor force, capital, and technology on economic growth but also ensures an opportunity to evaluate the current situation and course of growth. TFP is obtained by dividing the total output by the inputs. Thus, it is possible to appoint the share and significance of the inputs in the production process. In this respect, it can be pronounced that high factor productivity means greater producing power (Murray 2016, p. 113; Khadimee 2016, p. 621). The ratio of output to input is the simplest way to calculate TFP. An illustration of such a scenario is shown. Assume that in an economy with two factors of production, labor, and capital, the output is depicted by Y and the input is symbolized by capital (K) and labor (L). TFP can be determined by calculating the proportion of total output to total labor and capital. If wages, the price of labor, are denoted as "*w*" and the price of capital, interest, as "*r*":

Figure 1. Sub-components of the Legatum Prosperity Index



Source: LPI 2020a.

$$TFP = Y \,/\, (w.L + r.K) \tag{1}$$

Suppose we would like to calculate TFP between the two firms. The average monthly wage at factory X, where there is only one employee, was $2000 per month. The monthly rent for the factory's two production machines is $10000. The average wage was $1250 per month at factory T with four employees. The rent for one production machine was $7500 per month. Both companies manufactured 15000 units. These two factories' total factor productivity can be aligned as follows:

$$TFP_X = 15000/(2000 * 1 + 10000 * 2) = 0.68$$
$$TFP_T = 15000/(1250 * 4 + 7500 * 1) = 1.2$$

These findings indicate that factory T has a more efficient production structure than factory X. TFP not only augments the amount of output but also enhances labor and capital productivity, the impact of elasticity, rivalry, and resource usage efficiency.

Studies on TFP are models for obtaining more output with the existing production factors in the economy. In this sense, it can be stated that the first studies in this field are based on the growth model developed by Solow (1956). Later, researchers such as Barro (1991), Elias (1992), Young (1995), Senhadji (1999), and Iwata (2003) reconsidered the concept. According to Solow (1956), technology is considered exogenous under perfectly competitive market conditions. Technology and output growth are posited as productivity growth. The Solow model, which is called the neoclassical growth model, has been developed by adding human capital to labor and capital. The theory of neoclassical growth is based on an economic development model that is derived from an external source such as physical capital, labor, and technological change. The model employs the production function, which either unveils the relationship between input and output, to quantify the economic growth rate, with the presumption that the growth rate is detected exogenously in the production function. As a consequence, according to Neo-Classical theory, the only factor that ensures economic growth is the Solow residual or technological change that exists by chance. Economic growth can also be expressed by adding the change in components (Solow residual) that cannot be explained by factor inputs (capital and labor). (Danquah 2006, p. 19; Idea 2008, p. 38-39). According to Solow (1956), the Solow residual can be formulated with the Cobb-Douglas (1928) production function (Solow 1956, p. 58):

$$Y = F(K, A.L) \tag{2}$$

K connotes capital. A refers to technology or knowledge. Multiplying A by labor force L means an effective labor force.

$$Y = K^{\propto}(A.L)^{1-\propto}, \qquad 0 <\propto< 1 \tag{3}$$

$$Y = BK^{\propto}L^{1-\propto} \qquad B = A^{1-\propto} \tag{4}$$

$$\frac{\dot{Y}}{Y} =\propto \frac{\dot{K}}{K} + (1-\propto)\frac{\dot{L}}{L} + \frac{\dot{B}}{B} \tag{5}$$

The above equation $\propto$ and *1*-$\propto$ parameters represent the capital and labor share in output under perfect competition conditions. The term B is expressed as total factor productivity. If equations (4) and (5) are to be shown as the growth rate:

$$g_y = g_{TFP} +\propto g_K + 1-\propto g_L \tag{6}$$

Accordingly, the growth rate (g_y) in an economy consists of the sum of the total factor productivity (g_{TFP}), the capital growth rate (g_K) weighted by the share of capital in the output, and the labor growth rate (g_L) weighted by the share of labor in output. Equation, which is characterized as the growth equation, can also be formulated as in (7).

$$g_{TFP} = g_y - \propto g_K - (1-\propto)g_L \tag{7}$$

According to this equation, the TFP growth rate is equal to the difference between the output growth rate and the labor and capital growth rates. The growth analysis can also be redefined with the output growth rate per employee:

$$g_{TFP} = g_y - \propto g_K - g_L +\propto g_L \tag{8}$$

$$g_{TFP} = (g_y - g_L) -\propto g_K +\propto g_L \tag{9}$$

$$g_{TFP} = (g_y - g_L) -\propto (g_K - g_L) \tag{10}$$

The factor shares of the Cobb-Douglas production function are constant over time and correlate with the derivations of the production function. The elasticity of output relative to labor is equal to the labor share when the production function showcases constant returns to scale at K and L. Similarly, under perfectly competitive conditions and where the production function betrays constant returns to scale at K and L, the elasticity of output relative to capital is equal to the capital share. When we subtract the labor growth rate (g_L) from equation (10), we get equation (11).

$$g_{TFP} = g_y - \propto g_K \tag{11}$$

According to equation (11), the TFP growth rate is equal to the difference between the output growth

rate per employee (g_y) and the capital growth rate per employee (g_K). In the Solow model, the growth rate of capital per worker and output per worker is equal to the rate of technological progress and can be formulated as follows:

$$g_y = g_K = \theta \qquad g_{TFP} = (1-\propto)\theta \tag{12}$$

According to equation (12), the rate of increase in TFP is equal to the product of labor share in output (1-∝) and the rate of increase in technology (θ) (Baier et al. 2006, p. 27-28). Here, the total factor productivity can be called a technological development that increases the efficiency of labor. In the Solow model, there is an essential assumption that technological development is exogenous. Additionally, it is argued that the source of sustainable growth per capita is technological development. Because technological development eliminates the decrease in the marginal productivity of capital, and eventually, the growth rate of countries becomes equal to the rate of technological development (Ghosh and Kraay 2000, p. 2-3).

3. Empirical Literature Review

Many studies deal with the relationship between total factor productivity and economic performance or economic effects of TFP for various countries or country groups. First, studies that analyze CEE and/or EU countries are discussed. Benkovskis et al. (2012) state that TFP plays a key role in long-term growth for the period 1995-2009 and 10 CEE countries. The contribution of technological change at the industry level to the overall growth performance of an economy has been analyzed. A model open to terms of trade shocks is constructed with the Solow residual and fixed income-to-scale approach, and the characteristics of open economies have been investigated. Beugelsdijk et al. (2018), using the development accounting technique, confirm that large and persistent differences in economic development in 257 European Union sub-national regions are due to growth in total factor productivity. The findings show that TFP differences vary even within countries and that the interregional spread of technology and efficient production implementations is limited. Levenko et al. (2019) have determined the relationship between total factor productivity and economic growth according to the crisis years for 18 CEE countries from 1996 to 2016. It has been detected that while total factor productivity increased economic growth before the crisis, there were significant differences between countries after the crisis. Borović et al. (2020) query the impact of economic freedom on total factor productivity for the period 2000-2018 and 10 CEE countries. The study proves that a high level of economic freedom, defined as an indicator of the quality of institutions, with a fixed effect panel, leads to a higher level of total factor productivity.

Other studies were listed as follows. Nehru and Dbareshwar (1994) have found a nonlinear and positive relationship between TFP growth and national income growth in 83 countries between the years 1960-1987, using regression analysis. It is concluded that rapid growth is related to factor accumulation rather than TFP growth. Senhadji (1999) investigated TFP differences in 88 countries for the period 1960-1994 using Phillips-Ouliaris and Shin's cointegration tests. The results reveal that TFP is effective in GDP growth. While TFP is low in African and Latin American countries, there is a better performance in Asian countries, especially in China. Easterly and Levine (2001) conducted a pioneering study on the economic effects of total factor productivity. It is stated that most of the income and growth differences between countries are due to total factor productivity rather than factor accumulation, and that income differs eventually. Economic activity is concentrated at high rates where the production factors flow to the richest areas, and long-term economic growth rates and economic policies are closely related. It is remarked that TFP growth does not yet make a clear distinction between different theoretical understandings.

Miller and Upadhyay (2002) inspected the convergence of real GDP per worker and TFP in 83 developed and developing countries from 1960 to 1989. The results of the beta and sigma convergence tests indicate that convergence is higher in underdeveloped and emerging economies than in developed economies. Bosworth and Collins (2003) have situated that the appropriate application and interpretation of growth regressions are valuable tools to better understand growth experiences across countries. The panel regression analysis has been performed based on 84 countries representing 84% of the world population from 1960 to 2000. It is claimed that capital accumulation is more effective in growth for all countries. It is exposed that 0.9% of the economic growth is due to TFP increases. Baier et al. (2006) conducted panel data analysis for 145 countries using variation tests from 1960 to 2000 period. A positive relationship has been found between TFP and economic growth. It is also determined that 14% of the national income is related to TFP growth in all countries. De La Escosura and Rosés (2009) have investigated the sources of long-term growth in Spain for the period 1850-2000 using a Jorgenson-type growth analysis. It has been detected that the increase in economic growth rates

is closely related to the increase in TFP. De Vries et al. (2012) have enounced that the increase in labor productivity and total factor productivity contribute to growth in China, India, and Russia because of the panel data analysis from 1980 to 2010. Such a result for Brazil has not been detected. Yang and Zhao (2018) investigated the effects of total factor productivity, physical capital, human capital, energy consumption, and environmental pollution on economic growth in China between 1981 and 2012. The main driver of China's current economic growth is an investment in physical capital. It is emphasized that total factor productivity growth is the main driver of sustainable growth in China. It has also been remarked that for sustainable economic growth in China, TFP-oriented growth is needed instead of physical capital and energy consumption. By extension of these previous literature examples, the study gauges the economic prosperity effects of total factor productivity growth in CEE countries.

4. Data

The dependent variable of the model is the "Legatum Prosperity Index" (epi) The independent variable is the growth rate of total factor productivity $(rtfp_{j,t}^{na})$.

The relative total factor productivity, which is compiled from the Penn World Table (PWT) 9.0, is used for the analysis. The total factor productivity growth rates (relative) are attained mediately by Feenstra et al. (2015) as follows:

$$\frac{rtfp_{jt}^{na}}{rtfp_{jt-1}^{na}} = \frac{rgdp_{jt}^{na}}{rgdp_{jt-1}^{na}} / Q_{jt,t-1} \tag{13}$$

$$Q_{jt,t-1} = \frac{1}{2\left(labsh_{jt} + labsh_{jt-1}\right)\left(\frac{emp_{jt}}{emp_{jt-1}}\frac{hc_{jt}}{hc_{jt-1}}\right)} + \left[1 - \frac{1}{2}\left(labsh_{jt} + labsh_{jt-1}\right)\right]\left(\frac{rk_{jt}^{na}}{rk_{jt-1}^{na}}\right) \tag{14}$$

This function is used for comparing productivity between countries *j* and *t* at a given time.

$Q_{jt,t-1}$ = *Törnqvist quantity index of factor inputs* Q^T

$rtfp^{na}$ = *TFP at constant national prices* (2017=1)

$rgdp^{na}$ = *Real gdp at constant national prices*

rk^{na} = *Capital services at constant* 2017 *national prices* (2017=1)

emp = Number of persons employed (in millions)

Table 1. The salient features of the data

Variable	Source	Definition
epi	*"Legatum Prosperity Index"*	The highest prosperity: 10, and the lowest prosperity: 0
rtfp	*Penn World Table* (9.0)	The growth rate of total factor productivity
tfp	*The Conference Board Total Economy Database*	The growth rate of total factor productivity (robustness check)
gfcf	*World Bank Open Data*	Measurement of gross net investment (earnings minus disposals) in fixed capital assets by government, households, and enterprises within the domestic economy.
open	*World Bank Open Data*	The sum of exports and imports of goods and services measured (% of GDP)
hc	*Penn World Table (9.0)*	Human capital index, based on years of schooling and returns to education
labor	*The Conference Board Total Economy Database*	Share of total labor in GDP
capital	*The Conference Board Total Economy Database*	Share of total capital in GDP
ggfce	*World Bank Open Data*	government current spending for purchases of goods and services and national defense and security spending, excluding government military spending, which is a part of government capital formation

Notes: Please note that all variables are used in the natural logarithmic form. (ln) presents the natural logarithm form of the variables and is prefixed with each variable to represent the variables in the logarithmic form. All variables except (*rtfp*) are from 2007 to 2020, while (*rtfp*) is from 2007 to 2019.

Source: Own edited.

Table 2. Summary statistics of the data

	Observation	Mean	Sta. Dev.	Minimum	Maximum
epi	252	52.38678	8.90958	39.44097	73.43861
rtfp	238	0.634909	0.2315521	0.3011301	1.282417
tfp	252	0.1865961	2.624995	0.328403	7.232754
gfcf	252	23.84451	6.113728	12.4456	35.1069
open	252	62.58794	39.97126	20.72252	210.4002
hc	252	2.407043	0.49057	1.674091	3.765123
labor	252	43.5253	8.217675	25.24954	57.78493
capital	252	56.4747	8.217675	42.21507	74.75046
ggfce	252	10.26874	3.132434	4.403315	18.17166

Source: Own edited using Stata 14.2 calculations.

hc = Human capital index,based on years of schooling and returns to education

labsh = Share of labour compensation in GDP at current national prices

j = country, t = year, na = constant national prices

For the robustness check, the logarithm of the growth of total factor productivity data for each country and year compiled from "The Conference Board Total Economy Database" is used in the analysis. All variables used in the model are presented in Table 1. Control variables have been compiled following the empirical literature among the indicators that are excluded in the Legatum Institute's 300 sub-components. Table 2 represents the summary statistics of the data.

5. Methods

Before the analysis of the basic linear logarithmic model, the research method is organized as cross-sectional dependence and unit root test. The fact that the cross-section units that comprise the panel are independent of one another is critical in terms of analysis results. Cross-section independence assumes that any shock to any panel unit affects all countries and that any macroeconomic shock that appears in any country has no impact on the other countries in the panel. It would be more plausible that such economic shock inside one country may have a divergent impact on other countries. Because the results of the analysis would be biased and inconsistent if the cross-sectional dependence is not presumed, it is crucial to verify whether there is a dependency between the cross-sections before initiating the analysis. Breusch and Pagan Lagrange Multiplier (1980) LM and Pesaran Cross-section Dependence Lagrange Multiplier (2004) CD_{LM} tests are used for the analysis of cross-sectional dependence.

$$\Delta Y_{i,t} = \alpha_i + \delta_i Y_{i,t-1} + \sum_{j=1}^{p_i} Y_{ij} \Delta Y_{i,t-j} + \theta_i \bar{Y}_{t-1} + \sum_{j=0}^{p_i} \vartheta_{ij} \Delta \bar{Y}_{i,t-j} + u_{it} \quad (15)$$

$$t = 1, \ldots., T \; i, j = 1, \ldots. N$$

Here, $\Delta Y_{i,t}$ represents the critical values. Y_{ij} and ϑ_{ij} demonstrate observable values in units of a cross-section. $Y_{i,t\text{-}1}$ and $\Delta Y_{i,t\text{-}1}$ show the coefficients with no constant. $\bar{Y}_{i,t\text{-}1}$ presents the coefficients with constant. $\Delta \bar{Y}_{i,t\text{-}1}$ displays the coefficients with constant and trend. The simple correlation coefficients gathered adopting the model's estimated residuals are tested to view if they are equal to zero. The model that incorporates the lagged values of $\Delta \bar{Y}_t$ and $\Delta \bar{Y}_{i,t}$ is used to obtain the autocorrelation in error terms for each cross-section unit. The following hypotheses were tested to detect whether there is a relationship between the cross-sections of units:

$$H_0: p_{ij} = cor(u_{it}, u_{jt}) = 0 \quad i \neq j$$

$$There\ is\ no\ dependency\ between\ units.$$

$$H_\alpha: cor(u_{it}, u_{jt}) \neq 0 \quad i \neq j$$

$$There\ is\ dependency\ between\ units.$$

When N and T progress to infinity, the test statistic is computed as shown below.

$$CD_{LM} = \left(\frac{1}{N(N-1)}\right)^{\frac{1}{2}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} (T\hat{p}_{ij}^2\text{-}1) \quad (16)$$

Unit root testing is used to assess whether or not the series is stationary after cross-sectional dependency. The Augmented Dickey-Fuller (CADF) process (Pesaran 2007) is one of the second-generation panel unit root tests. In this test, a strong upshot can be acquired both for N goes to infinity and for scenarios where T is higher than N and N is larger than T.

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + \delta_{i,t} + \sum_{j=1}^{p_j} \emptyset_{i,j} \Delta Y_{i,t-j} + u_{i,t} \quad (17)$$

The CADF test's equation is symbolized in equation (17). As N approaches infinity, the stationary sections or not are proved by forecasting the equation with the least squares.

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + \sum_{j=1}^{p_j} c_{i,j} \Delta Y_{i,t-j} + d_i t + h_i \bar{y}_{t-1} + \sum_{j=0}^{p_i} \eta_{i,j} \Delta \bar{y}_{i,t-j} + \varepsilon_{i,t} \quad (18)$$

The CADF test's null and alternative assumptions are as follows:

$$H_0^i: \beta_i = 0;\ H_A^i: \beta_i < 0$$

In equation (19), the $\overline{\text{CADF}}$ statistics adjusted for case $N > T$ can be seen. This statistic is renowned as the CIPS (cross-sectionally augmented panel unit root test) statistic, and it doesn't compute significant results if $T > N$.

$$\overline{CADF} = CIPS = \sum_{i=1}^{N} \frac{CADF_i}{N} \quad (19)$$

The linear panel static model in equation (20) has been set up for estimating the nexus between economic prosperity and total factor productivity growth by adding the other control variables.

$$lnepi_{j,t} = \alpha_0 + \alpha_1 lnrtfp_{j,t} + lngfcf_{j,t} + lnopen_{j,t} + lnhc_{j,t} + lnlabor_{j,t} + lncapital + lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (20)$$

The econometric analysis is based on data from 18 countries. Static and dynamic panel data models have been used in statistical analysis with the help of Stata 14.2. Panel data regressions have some advantages owing to the data quality, using cross-sectional analysis, and time series together. Panel regressions were created with the help of static and dynamic models. Equation (20) represents a static panel linear model. To eliminate the endogeneity problem in a static panel model, the variables have been re-estimated with the help of a dynamic model. In dynamic models, the lagged value of the dependent variable is included in the model as an independent variable. For this reason, known estimators cannot be used to estimate these models (Bond 2002, p. 1-2; Verbeek 2017, p. 146; Akay 2018, p. 115). For dynamic models, the System Generalized Method of Moments estimator is typically used. Contrary to the first difference method, the difference from the prior period is not accounted for if the System Generalized Method of Moments (GMM) is conducted. The analysis is based on the combination of the difference equation and level equations. Instead, the average of all potential future values of a variable is subdivided to identify the difference. As a result, the System GMM allows the creation of estimates that are significantly authentic when the variables are undergoing a random walk (Breitung 1997, p. 9; Bond 2002, p. 5-6; Sattarhoff 2010, p. 4; Akay 2018, p. 110-12). Additionally, the System GMM estimator has more accurate and effective forecasting in small samples (Hayakawa 2007, p. 35; Soto 2009, p. 13-14; Roodman 2009, p. 124-125). To obtain more consistent results, the dynamic relationship between the variables has been tested with the help of equations (21) and (22).

$$lnepi_{j,t} = \beta_0 + \beta_1 lnepi_{jt-1} + \beta_2 lnrtfp_{j,t} + \beta_3 lngfcf_{j,t} + \beta_4 lnopen_{j,t} + \beta_5 lnhc_{j,t} + \beta_6 lnlabor_{j,t} + \beta_7 lncapital_{j,t} + \beta_8 lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (21)$$

$$lnepi_{j,t} = \beta_0 + \beta_1 lnepi_{jt-1} + \beta_2 lntfp_{j,t} + \beta_3 lngfcf_{j,t} + \beta_4 lnopen_{j,t} + \beta_5 lnhc_{j,t} + \beta_6 lnlabor_{j,t} + \beta_7 lncapital_{j,t} + \beta_8 lnggfce_{j,t} + \mu_j + \lambda_t + \varepsilon_{j,t} \quad (22)$$

6. Results

The presence of cross-sectional dependence implies a significant connection between model errors. The null hypothesis of the tests denotes the absence of cross-sectional dependence. The alternative hypothesis for the tests indicates cross-sectional dependence. The probability values were less than 1%. There is a cross-sectional dependence between the series.

It also ascertained the extent to which the series is stationary to avoid complications caused by

a cross-sectional dependency. Deceptive regression issues in non-stationary series models may arise (Gujarati and Porter 2012, p. 748). As a result, Pesaran (2006)'s Cross-sectionally Augmented Dickey-Fuller ($CADF$) unit root test is used for stationarity analysis. If the $CADF$ critical value exceeds the $CADF$ statistic, the null hypothesis is invalidated, and the series is defined to be stationary. The results demonstrate that the series becomes stationary when the first difference is taken, implying that the null hypothesis is dismissed.

In the analysis, panel ordinary least squares (OLS), panel fixed effects (FE), and panel random effects (RE) methods are realized. The panel-corrected standard error (PCSE) method is also conducted to obtain more consistent results. This method performs estimation by considering constraints such as cross-section dependence and heteroscedasticity. A high R^2 indicates that the regression model is well-fitting. A perfect model is formed when all points are on the regression line. Since the sum of squares of the residuals will be zero when all points are on the line, R^2 will also be equal to 1 and take the highest possible value. Each independent variable introduced into the regression models is projected to raise the explanation rate of alterations to the dependent variable, i.e., the coefficient of determination. For this reason, the coefficients of determination are adjusted for the comparison of models with the different numbers of independent variables and the selection of the appropriate model. In reality, however, more than one dependent variable influences the dependent variable. When we use R^2 as the fit indices, the better the fit, the lower the

Table 3. Results of cross-sectional dependence test

Variables	LM Test Results		CD_{LM} Test Results	
	Statistic	p-value	Statistic	p-value
lnepi	444.07	0.000	28.49	0.000
lnrtfp	310.74	0.000	6.78	0.000
lntfp	216.53	0.000	4.71	0.000
lngfcf	195.47	0.000	11.32	0.000
lnopen	108.09	0.000	5.47	0.000
lnhc	578.82	0.000	9.11	0.000
lnlabor	391.66	0.000	5.46	0.000
lncapital	273.37	0.000	6.42	0.000
lnggfce	101.28	0.000	1.49	0.000

Source: Own edited using Stata 14.2 calculations.

Table 4. Results of CADF unit root test

Variables	Level	First Difference	Result
lnepi	-3.280	-4.036**	I_1
lnrtfp	-1.294	-1.943**	I_1
lntfp	-0.434	-2.527**	I_1
lngfcf	-0.032	-1.637**	I_1
lnopen	-2.384	-4.307**	I_1
lnhc	-3.791	-3.911**	I_1
lnlabor	-5.208	-7.045**	I_1
lncapital	-1.935	-2.889**	I_1
lnggfce	-2.257	-4.629**	I_1

Notes: ** represents the null hypothesis rejection at 5%. The 5% critical value for the constant model is -2.163, while the value for the constant and trend model is -3.091.

Source: Own edited using Stata 14.2 calculations.

total square of the residuals. However, as the number of independent variables increased, the denominator would continue to decrease. Thus, R^2 would not decrease, and the more variables included in the model, the better the fit. To reduce model complexity and generate intelligible, interpretable models, variables that have little or no effect on the target variable are excluded from the model. For this reason, adjusted R^2 is used. Adjusted R^2 is distinct from R^2 that, it hinders superfluous arguments. Adjusted R^2 is a useful metric because it re-measures model fit because of duplicated variables. The adjusted R^2 findings of all models depict that the variables included in the model have high explanatory power.

Tables 5 and 6 present the estimation findings of the linear logarithmic model in Equation (20). As can result from the tables, the growth of total factor productivity affects (*lnrtfp* and *lntfp*) economic prosperity positively. These findings are in line with the prior studies of Nehru and Dbareshwar (1994), Senhadji (1999), Easterly and Levine (2001), Bosworth and Collins (2003), Baier et al. (2006), De La Escosura and Rosés (2009), Benkovskis et al. (2012), De Vries et al. (2012), Beugelsdijk et al. (2018), Yang and Zhao (2018), and Levenko et al. (2019). The result of this study suggests that economic prosperity is highly correlated with the total factor productivity accompanied by economic growth and/or development. Besides, *lngfcf*, *lnopen*, *lnhci*, *lnlabor*, and *lncapital* have positive coefficients. In contrast, *lnggfce* has negative coefficients. In brief, openness, human capital, the share of labor and capital in GDP, and gross fixed capital formation enhance economic prosperity, while general government final consumption expenditure negatively affects economic prosperity. Since the panel least squares, fixed effects and random effects analysis results differ in the size of the coefficients, it is attempted to determine which method is more convenient by applying the Hausman test. The Hausman test shares that according to the probability values of test results, fixed-effects findings are more appropriately realized with two total factor productivity indicators *lnrtfp* and

Table 5. Results of panel OLS, FE, RE, and CSE tests

Variables Dep. Var: ***lnepi***	OLS	FE	RE	PCSE	
				FE	RE
lnrtfp	0.152174*** (0.03295)	0.003293** (0.058392)	0.198439*** (0.087392)	0.038204*** (0.030837)	0.105034** (0.058392)
lngfcf	0.242950*** (0.018390)	0.001051*** (0.004824)	0.048251* (0.104821)	0.274020*** (0.028491)	0.004923** (0.048293)
lnopen	0.187391** (0.158293)	0.035920*** (0.238025)	0.000184*** (0.001517)	0.590231** (0.004821)	0.058293** (0.039045)
lnhc	0.002719*** (0.058293)	0.006349*** (0.038951)	0.138094*** (0.005281)	0.058341*** (0.046391)	0.289201*** (0.003782)
lnlabor	0.382941*** (0.032859)	0.022072*** (0.017403)	0.047210** (0.002048)	0.603481*** (0.047038)	0.039201*** (0.056382)
lncapital	0.232451*** (0.073619)	0.382056*** (0.004932)	0.186302*** (0.079302)	0.490281*** (0.393021)	0.047329*** (0.006035)
lnggfce	-0.057314*** (0.034392)	-0.039201*** (0.027391)	-0.011390*** (0.004839)	-0.083026*** (0.047291)	-0.054634 (0.186043)
Ad. R^2	0.68	0.74	0.69	0.72	0.67
F statistic	13.47291 (0.0000)	41.04528 (0.0000)	18.94621 (0.0000)		
Breusch-Pagan LM	97.28349 (0.0000)	62.68241 (0.0122)	78.59352 (0.0000)		
Hausman Test			(0.0000)		

Notes: Values in parentheses represent standard errors and values before parentheses represent coefficients. ***,**,* indicate 1%, 5%, and 10% significance levels, respectively. Hausman and Breusch-Pagan's values demonstrate the probability values of the tests.

Source: Own edited using Stata 14.2 calculations.

lntfp. Breusch-Pagan test results indicate the cross-section in fixed-effects, random-effects, and ordinary least squares. As the cross-sectional dependence between the units has been ascertained, first-order differences of the variables have been applied to the estimations, and the variables have become stationary when the first-order differences have been handled. Even so, because of the heteroscedasticity issue in OLS, FE, and RE, these outcomes may be biased and incoherent. Therefore, the panel-corrected standard error method is adopted as a robustness check. The findings of PCSE still partake in similar aspects of the nexus.

The derivative of one variable concerning another in a function that becomes linear by undergoing a logarithmic transformation denotes the elasticity. Therefore, the logarithmic form of the variables helps make the elasticity interpretation of the slope coefficients. According to the panel-corrected standard error fixed-effect results in Table 5, the elasticities of the economic prosperity *lnepi* concerning the growth of total factor productivity *lnrtfp* is 0.03. The elasticities are for the other variables as follows: gross fixed capital formation *lngfcf* is 0.27, the openness *lnopen* is 0.59, the human capital *lnhc* is 0.05, the share of labor and capital in GDP are 0.60, 0.49, and the general government final consumption expenditure *lnggfce* is -0.08. In other sayings, if the total factor productivity growth increases by 1%, economic prosperity increases by approximately 0.03%. Similarly, if the gross fixed capital formation, the openness, the human capital, the share of labor and capital in GDP scaled up 1%, the economic prosperity in CEE countries increased by about 0.27%, 0.59%, 0.05%, 0.60%, and 0.49%, respectively. On the other hand, if the general government's final consumption expenditure goes up 1%, economic prosperity declines 0.08%. According to Table 6, these ratios are for all variables as: 0.004% for

Table 6. Results of panel OLS, FE, RE, and CSE tests (robustness check)

Variables Dep. Var: ***lnepi***	OLS	FE	RE	PCSE	
				FE	RE
lntfp	0.004603*** (0.003027)	0.0018402*** (0.018401)	0.004820** (0.018057)	0.004072*** (0.104937)	0.059237** (0.003902)
lngfcf	0.048037*** (0.038021)	0.048301*** (0.048042)	0.049301*** (0.059042)	0.004829*** (0.012704)	0.005902*** (0.206738)
lnopen	0.340371** (0.083023)	0.026052*** (0.004037)	0.183021*** (0.009482)	0.073032*** (0.053082)	0.047328** (0.059043)
lnhc	0.069302*** (0.000837)	0.004839*** (0.04902)	0.004629** (0.007037)	0.320854*** (0.004037)	0.303728*** (0.007852)
lnlabor	0.004728* (0.003729)	0.017035*** (0.047291)	0.043092*** (0.004932)	0.058391*** (0.007047)	0.004502*** (0.076083)
lncapital	(0.028104)*** (0.003729)	0.003058*** (0.005041)	0.080472*** 0.004782	0.048301*** (0.004839)	0.004527** (0.004532)
lnggfce	-0.036281* (0.047390)	-0.058201*** (0.049253)	-0.053904*** (0.009831)	-0.005930*** (0.003092)	-0.048291* (0.007810)
Constant	3.04721*** (0.000)	3.00572*** (0.0000)	4.05832*** (0.0000)	9.40417*** (0.0000)	4.04829*** (0.0000)
Ad. R^2	0.69	0.71	0.72	0.66	0.70
F statistic	16.04627 (0.0000)	34.04619 (0.0000)	18.57390 (0.0000)		
Breusch-Pagan LM	83.46021 (0.0000)	35.06291 (0.0048)	47.04529 (0.0000)		
Hausman Test			(0.0000)		

Notes: Values in parentheses represent standard errors and values before parentheses represent coefficients. ***,**,* indicate 1%, 5%, and 10% significance levels, respectively. Hausman and Breusch-Pagan's values demonstrate the probability values of the tests.

Source: Own edited using Stata 14.2 calculations.

total factor productivity growth *lntfp*, 0.004% for gross fixed capital formation, 0.07% for openness, 0.32% for human capital 0.05%, and 0.04% for the share of labor and capital in GDP, respectively. Table 6 pictures that the general government's final consumption decreases economic prosperity 0.005%.

The results of the diagnostic tests performed for the confidence of the forecasts are given in Table 7. Under the null hypothesis of no autocorrelation, the Arellano Bond autocorrelation AR(2) analysis has confirmed that there is no second-order autocorrelation among the first-differenced residuals. The null hypothesis (the validity of over-identifying constraints) is not verified by the Sargan test. The coefficients of the variables are strongly significant according to both the test results. The System GMM results indicate that economic prosperity is positively correlated with the total factor productivity growth *lnrtfp* and *lntfp*. A one-unit increase in *lnrtfp* and *lntfp* results in a completely different relative growth in *lnepi* for each country. According to the results of the previous period, the economic prosperity index *lnepi(-1)* is also positively associated with the prosperity *lnepi* and increases well-being in these countries. *lngfcf*, *lnopen*, *lnhc*, *lnlabor*, *and lncapital* indicators are positively correlated with the *lnepi*. All the estimation results of these variables have significant values at the 1% level. The general government final consumption expenditure indicator *lnggfce* is negatively related to economic prosperity *lnepi*.

Tables 5, 6, and 7 briefly show that increases in total factor productivity growth ease the social and economic conditions in CEE countries, as proven by prior studies. In other words, the effect of total factor productivity growth on economic prosperity is more effective when the indicators are included in the calculations that evaluate real economic performance such as education, health, human capital, expenditures, labor, and physical capital. Prior studies of Nehru and Dbareshwar (1994), Senhadji (1999), Easterly and Levine (2001), Bosworth and Collins (2003), Baier et al. (2006), De La Escosura and Rosés (2009), Benkovskis

Table 7. Results of dynamic panel test (robustness check)

Variables	System GMM Model-1 Dependents Var: ***lnepi***		Variables	System GMM Model-2 Dependents Var: ***lnepi***	
	Coe. (sta. err.)	P- Values		Coe. (sta. err.)	P- Values
lnepi(-1)	0.017304 (0.0008)	(0.000)	***lnepi(-1)***	0.027493 (0.0105)	(0.000)
lnrtfp	0.003062 (0.0027)	(0.000)	***lntfp***	0.038047 (0.0012)	(0.000)
lngfcf	0.001058 (0.0023)	(0.000)	***lngfcf***	0.008395 (0.0048)	(0.000)
lnopen	0.003840 (0.00098)	(0.000)	***lnopen***	0.002850 (0.0063)	(0.000)
lnhc	0.017403 (0.0054)	(0.000)	***lnhc***	0.000149 (0.0027)	(0.000)
lnlabor	0.000839 (0.0003)	(0.000)	***lnlabor***	0.028045 (0.0093)	(0.000)
lncapital	0.003047 (0.0077)	(0.000)	***lncapital***	0.007037 (0.0186)	(0.000)
lnggfce	-0.004027 (0.0034)	(0.000)	***lnggfce***	-0.002854 (0.0044)	(0.000)
Observations	238			252	
	Diagnostic Tests				
Sargan	12.385 (0.1047)			24.056 (0.0284)	
AR(2)	-1.503 (0.0048)			-2.048 (0.1408)	

Note: System GMM Model 1 reflects the results of Equation (21). System GMM Model 2 reflects the results of Equation (22). Two-step GMM estimator results are shown. *lnepi(-1)* is considered a lag variable.

Source: Own edited using Stata 14.2 calculations.

et al. (2012), De Vries et al. (2012), Beugelsdijk et al. (2018), Yang and Zhao (2018), and Levenko et al. (2019) share similar results.

As such, the increase in TFP, the study's findings, and its relationship to the Legatum Prosperity Index are critical because; i) TFP is a measure of how efficiently companies, sectors, or countries allocate their resources on a macro scale. ii) Because TFP is a marker of how much resources are scattered, it also serves to highlight socioeconomic distinctions among nations, particularly income distribution, inequality, and poverty. iii) TFP is notable in terms of country, sector, and company competitiveness. In a sector with a high TFP, for example, the amount of final output produced with unit labor may be greater, or it may manufacture more with the same amount of capital. Therefore, a direct positive effect on the competitiveness of that company or sector would be provided. This strengthens not only output or economic growth but also labor and capital productivity and/or elasticity. Furthermore, there would be an ease in macroeconomic indicators such as (trade) openness, stable, equilibrating, and long-term capital flows, increasing investment, and human capital growth resulting from rising labor/capital quality and productivity. As a result, socioeconomic stance would invigorate. iv) In a market, resources are channeled toward sectors with high TFP. The higher the TFP, the more competitive countries, sectors, or companies are. Therefore, the higher the TFP, the greater the economy's resource usage efficiency.

7. Conclusions and Discussion

The impact of the increase in total factor productivity on economic prosperity in 18 CEE economies has been realized by panel data analysis. Previous studies associate TFP with indicators such as economic growth, labor, use of physical capital, deepening, and governance. This paper analyzes the increase in total factor productivity with the Legatum Prosperity Index, which includes many sub-components such as human well-being, quality of life, education, health, wealth, and growth. The total factor productivity growth indicator was been obtained from Penn World Table 9.0. The other total factor productivity growth rate compiled by The Conference Board Total Economy Database was also used for a robustness check. The findings show that TFP growth has positive and significant effects on economic prosperity in the 2007-2020 period. CEE countries are seen as potentially making significant economic progress in the current and future periods. Benkovskis et al. (2012), Beugelsdijk et al. (2018), and Levenko et al. (2019) argue that high investment in GDP in CEE countries is due to capital deepening and TFP growth. These three analyses that research CEE countries consider total factor productivity growth in terms of technological progress, regional progress, and industrial progress that takes into account different production technologies in detail. The studies performed analysis by developing the constant returns Cobb-Douglas production function to scale, which has been brought up in the theoretical part, to quantify the increment in TFP. This and its derivative functions presume the share of capital and labor force as constant. It is postulated in this case that the parameter values obtained for developed countries apply to all countries. As an offshoot of this assumption, it is accepted that the technological parameters are identical for whole countries, just like in the Solow exogenous growth model. The analysis in this study has been formed by following the total factor productivity growth in the study by Feenstra et al. (2015). Feenstra et al. (2015) used modeling that calculates capital and labor share separately for each country and each period. This is the first distinction and/or contribution of this study to previous research. If an international comparison is to be realized, it would be more factual to surmise that the TFP growth that is likely to change owing to the subjective capital and labor share circumstances, such as in CEE countries, is due to the various parameter preferences. The second contribution is as follows: It is specified that the capital stock increased rapidly in all Central and Eastern European countries during the crisis years, but the rate of use of capital stock decreased significantly. Instead of the standard growth analysis, the use of a more consistent and comprehensive socio-economic indicator and the analysis of whether the increase in total factor productivity creates economic prosperity expands the contribution to the literature.

Although the global financial crisis periods have harmed the CEE economies, considering that the analysis period coincided with the monetary expansion period in the world economy, economic prosperity may be positively affected by total factor productivity growth in this period. The panel-corrected standard error analysis findings confirm that the share of labor and capital in GDP makes the largest contribution to economic prosperity in CEE countries. Considering that the total factor productivity is an element that increases labor productivity and the labor productivity is determined by factors such as health, education, skills, and knowledge, the policies to improve these issues may have positive effects on economic prosperity in CEE countries. Moreover, considering that productivity increase is a factor that pushes the

physical capital stock up, it is of great importance to allocate more resources to research and development activities that enable the increase in knowledge and the emergence of inventions, and the development of education policies that would increase the quality of labor. The productivity increase due to a more qualified labor force and increased inventions can enhance the human capital stock by increasing the amount of physical capital and its efficiency, and the prosperity/wealth gap between CEE and developed countries can be closed. The analysis findings display that the human capital variable also has a positive effect on economic prosperity. The effect of macroeconomic indicators on economic prosperity should not be ignored. Openness and capital formation have positive effects on economic prosperity according to the results. If openness allows technology transfer, capital will be positively affected and productivity will be achieved. The developed financial structure that accompanies openness and keeping up with the global financial system would contribute to capital formation by providing financial resources for technological improvements that may increase TFP. According to the results of the analysis, the expenditure variable is negatively correlated with economic prosperity. Creating a strong awareness that price stability is a prerequisite of economic prosperity, and similarly, the realization of public spending policies with this awareness may decline the oppression of fiscal and monetary policy tools in these countries. These matters may help policymakers eliminate the negative effects of expenditures on economic prosperity. Although TFP is an essential condition for the prosperity increase in countries, the nexus should be promoted by macroeconomic variables for TFP-based prosperity increase.

It is meditated that the beginning of the Legatum Prosperity Index from 2007 constitutes the major limitation of the study. This index is calculated using data compiled from many social, economic, and institutional databases. To eliminate this issue, dynamic panel analysis has also been operated as a robustness check. The research area should be improved with other indicators as well. Nonlinear models may also be operated. It is envisioned that the analyses to be carried out for different econometric methods and country groups would strengthen the contribution to the research field. Given that fixed capital investments, human capital investments, export, import, and foreign trade volume, foreign direct investments, and capital and labor productivity all donate to an upward trend in total factor productivity, sectoral comparison analyses can help advance the research area. Short and long-term policy implications may be undergone by pinpointing the sources of the increase in total factor productivity, both for the CEE economies as a whole and for the low-productivity sectors classified by sectoral comparison. To boost total factor productivity, it may be convenient to policies on intensifying foreign trade volume, imports, and labor productivity, and then implement strategies to uplift fixed capital investments, human capital investments, exports, and foreign direct investments. While applying these, it would be beneficial to control the money supply increase and eliminate the negative effect on TFP increases. To sustain the increase in total factor productivity over the long term, similar policies should be constructed that prioritize the rise in capital productivity. Because of the increase in total factor productivity achieved in both the CEE economies in general and in low-productivity sectors, economic development would be accelerated, and the substructure required for improved prosperity would be established.

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THE DISTRIBUTIONAL IMPACT OF SOCIAL SPENDING ON IN-KIND AND CASH CHILD TRANSFERS IN CROATIA

Martina Pezer, Nora Mustać, Chrysa Leventi

Abstract

Social spending in Croatia is mainly based on social protection, public healthcare and education policies. There are two forms of investing in children through the social spending provided by central and local governments: cash and in-kind transfers. This paper describes the impacts of such social spending on households with children in Croatia and its capital, Zagreb. Making use of a microsimulation model, the income distribution of cash and in-kind transfers and their impacts on poverty and inequality are assessed. Compared to cash transfers, in-kind transfers, including local government subsidies, are relatively evenly distributed, income independent, and thus roughly equally important for the entire population. Their value greatly exceeds that of monetary transfers. Results demonstrate the progressive effect of transfers in kind on income distribution by reducing income inequality and poverty. This research seeks to emphasise the importance of using augmented income in the analysis of income inequality and poverty, instead of solely monetary disposable income.

Keywords: *income distribution, in-kind transfers, microsimulation, child poverty, income inequality*

JEL classification: *D31, H51, H52, I30*

1. Introduction

Children can be characterised as a public good because of the positive effects that the state obtains in the long run by investing in them. It is also well-established that, child poverty and lack of equal opportunities have a strong impact on economic development. Therefore, investing in children is equivalent to investing in future human capital, and research contributing to a better understanding of the impact of social spending on children is vital.

There are two forms of public spending and investment in children or households with children – cash and in-kind transfers (Slesnick 1996). Cash transfers are usually provided to parents as child benefits (allowances) or tax reliefs. While transfers in kind directly impact children who use them, cash transfers can end up being spent by

Martina Pezer, PhD (corresponding author)
Research Associate
Institute of Public Finance
Smičiklasova 21
10000 Zagreb, Croatia
E-mail: martina.pezer@ijf.hr
ORCID: 0000-0003-3291-220X

Nora Mustać, PhD
Postdoctoral researcher
Institute of Public Finance, Croatia
E-mail: nmustac02@gmail.com
ORCID: 0000-0001-8044-2199

Chrysa Leventi, PhD
European Commission, Joint Research Centre
Spain
E-mail: Chrysa.LEVENTI@ec.europa.eu
ORCID: 0000-0002-1756-9207

parents who receive those transfers on non-child related causes (Currie and Gahvari 2007). In some countries, in-kind transfers such as health care or education are provided by the government, as in Europe, and financed by general taxation, while in other countries, e.g., in USA, such services may need to be purchased out of households' disposable income (Figari, Paulus, and Sutherland 2011).

Social transfers, both in cash and in kind tend to decrease income inequality (Förster and Verbist 2012). In Croatia, relevant research confirms that taxes and social spending reduce inequality. The 15% share of GDP spent on healthcare, and the 11% on the education system in 2019 in Croatia indicate the large share of GDP spent on in-kind transfers (Eurostat 2022a). However, indirect taxes tend to impede the social system in the task of reducing poverty in the case of households with children (Inchauste and Rubil 2017). Using 2018 data, Nguyen and Rubil (2021) confirm that the Croatian fiscal system contributes to the reduction of inequality while it tends to increase poverty. In general, research suggests that indirect taxes usually have a regressive effect (i.e., increase inequality), and transfers in kind a progressive effect (i.e., decrease inequality), (Verbist and Förster 2019; Christl et al. 2020; Inchauste and Rubil 2017).

In this paper, we look at the distribution of cash and in-kind transfers provided by the central and a local government unit (Zagreb) for households with children and assess their impact on poverty and income inequality. The main tool for the analysis is the Croatian microsimulation model miCROmod (Urban et al. 2022), a spin-off of the EU-wide microsimulation model EUROMOD (Sutherland and Figari 2013). We put the focus on in-kind transfers provided by the central government – education and healthcare systems. As distinct from previous research (e.g., Nguyen and Rubil 2021; Pezer, Urban, and Leventi 2022), this analysis combines local and central government cash and in-kind transfers, focusing on households with children. Furthermore, the methodological approach to the simulation of in-kind transfers provides more precise results and is based on new data sources. An additional contribution of this paper is that we have incorporated central government in-kind transfers to miCROmod.

After the introductory section, the second section describes the related literature on government spending on health care, education and social protection, or cash and in-kind transfers. The third section describes the data, methodology and policies in question. The fourth section presents the results of this work, and the final section concludes.

2. Related Literature

The socioeconomic status of children has an important role in their future outcomes. Children born and raised in low-income families have fewer opportunities to be educated and to find a job, and their health is poorer (Musić Milanović et al. 2020; Currie 2009). Family policies, governmental support and interventions tend to decrease child poverty. But the central factors in reducing child poverty are parental employment, sufficient incomes and gender equality (Nygård et al. 2019). Further, in promoting equal opportunities and fighting against social exclusion, access to childcare is a key determinant that prevents children from being socially disadvantaged. Investing in education and health care contributes to more equal opportunities for children, as there is ample evidence that social background plays a crucial role in pre-primary and tertiary education participation (Verbist and Förster 2019). In-kind transfers like education and health services, housing, transportation subsidies or school meals, are worth significantly more for low-income households. But some research findings indicate that poorer parents, if they have a choice, prefer cash instead of in-kind transfers due to a lack of awareness (Currie and Gahvari 2007). However, health systems and educational systems, vary widely among countries, as well as between Europe as a whole and the USA. Great controversies are waged about whether the healthcare system needs to be private or public (Currie and Gahvari 2007).

Research indicates there is lower income inequality after in-kind transfers are included in the analysis (Evandrou et al. 1993). Thus, it is important to use full income instead of solely monetary disposable income in the analysis of income inequality and poverty since household income does not consist only of money transfers but of in-kind transfers as well (Rosen and Gayer 2010). It is important to focus on the distributional effects of generous in-kind public transfers, especially education and health care (Koutsampelas and Tsakloglou 2013). But, we cannot know whether transfers in money are valued as much as in-kind; in addition, in-kind transfers entail higher administrative costs (Rosen and Gayer 2010).

Using data for Greece in the mid-2000s, Koutsampelas and Tsakloglou (2013) show that income inequality declines sharply when the distribution includes both cash and non-cash incomes because younger and older individuals below the poverty line use in-kind services more. Christl et al. (2020) report that indirect taxes in Austria have a regressive effect, while in-kind transfers seem to have a

progressive effect. The authors include two kinds of redistribution – between different income groups and between generations. Their results indicate that indirect taxation tends to shift a household with a marginal income downwards, while in-kind transfers shift it upwards.

In Germany, to reduce the risk of poverty for families with children, child benefits should be reformed, especially for children in single-parent families who face a relatively high poverty risk (Hufkens et al. 2019). The results of Nygård et al. (2019) based on an aggregate social spending analysis of 22 European countries show that spending on transfers in kind is more efficient in restraining child poverty than spending on cash transfers. Furthermore, the efficiency of public spending on households with children declined over the period 2006-2015. Förster and Verbist (2012) found that the inclusion of in-kind transfers in the analysis reduces child poverty by one quarter, whereas poverty among children enrolled in childcare is more than halved.

Forms of family support provided through government transfers in Croatia are various: the child benefit, tax allowance for dependent children, benefits for newborns, maternity and parental leave, but also social assistance and housing benefits whose amounts and entitlement depend on the presence of children in the family. Other cash and in-kind transfers include a variety of benefits provided at the local government level, such as extended stay at school and school meals, as well as education and health care provided by the central government.

Nguyen and Rubil (2021) conclude that, based on 2018 data, the fiscal system in Croatia reduces inequalities but increases poverty: only direct transfers (disability pensions and benefits, child benefits and guaranteed minimum benefit) reduce poverty, especially for households with three or more children. Previous comparative research on child poverty indicates that Croatian cash transfers to families are less potent than in some European countries (Pezer 2022). Pezer, Urban, and Leventi (2022) demonstrate how the inclusion of subsidies provided by local governments for kindergarten and transport greatly contributes to poverty reduction. Thus, it is expected that the extension of this research to include the highly valuable central government in-kind transfers, education and health care, will shed more light on the redistributive effects of the Croatian tax and benefit system for families with children.

3. Methodology and Policies in Question

The lack of data containing information about the in-kind transfer distribution, spending, users and other necessary information for analysis causes several methodological challenges in the relevant research. However, the use of tax-benefit microsimulation models such as EUROMOD, which allows for the inclusion of in-kind transfers when analysing changes in the income distribution, is a valuable tool for this sort of analysis (Christl et al. 2020; Paulus, Sutherland, and Tsakloglou 2010).

There are different approaches in the analysis of the in-kind transfers. The straightforward approach of assigning the transfer to an individual is used when the value of the provided transfer can be measured, most often in the case of education, childcare and social (subsidised) accommodation. Different approaches are used when the value and intensity of in-kind transfers are not visible. For example, individuals are grouped depending on common characteristics such as age or gender. The value is then determined by the cost of producing services for the same group receiving the same amount of transfers, although within that group there are individuals who do not use the service but know they have access to it, such as health services or care for the elderly and disabled (Tonkin et al. 2014; Koutsampelas and Tsakloglou 2013; Paulus, Sutherland, and Tsakloglou 2010; Inchauste and Rubil 2017).

Across OECD countries, public expenditure for in-kind transfers accounts for approximately 13% of GDP, but with important cross-country differences (Verbist and Förster 2019). In Croatia, spending on health care and education has increased since 2014 (Nguyen and Rubil 2021). The country's public education and healthcare expenditure account for 11% and 15%, respectively, while social protection, education and health care together account for 56% of total government expenditure (Table 1).

According to Table 1, expenditure for social protection in Croatia, primarily made in the form of cash transfers, amounts to 30% of total government expenditures. Most social protection is made up of public pensions. Health care and education total 26% of government expenditure, most of which are in-kind transfers. As can be seen from the previously presented data, in-kind transfers are a significant part of total government expenditure. Hence, one can assume they may also have a substantial role in reducing inequality and poverty.

Table 1. General government expenditure in Croatia, 2019

	In billion euros	In % of total
General public services	2.9	11
Defence	0.6	2
Public order and safety	1.2	5
Economic affairs	4.3	17
Environmental protection	0.6	2
Housing and community amenities	0.7	3
Health care	3.9	15
Recreation, culture and religion	0.8	3
Education	2.8	11
Social protection	7.7	30
Total	25.6	100

Source: Eurostat (2022a).

3.1. Public policies in question

Table 2 describes the public policies in question in this research. Central government cash transfers include the child benefit, maternity and parental leave benefits, the newborn grant, the guaranteed minimum benefit and the tax allowance for dependent children (unless otherwise stated). Central government in-kind transfers include health care and education. Local government cash transfers of the City of Zagreb (Croatian capital) are also simulated and include the housing benefit and the newborn grant. Local government subsidies of the City of Zagreb include the city transport and the kindergarten subsidy. [1]

Table 2. Description of benefits, 2021

Name of benefit	Description
Guaranteed minimum benefit (*zajamčena minimalna naknada*)	A cash benefit provided by the central government if the person has no (or insufficient) income to cover basic living needs. The amount depends on the income of recipients and the size and type of a household (e.g., up to HRK 1,600/EUR 212 monthly for parents with two children). The benefit was reformed in 2022.
Child benefit (*doplatak za djecu)*	A means-tested cash benefit received by households with children. The benefit amount depends on the household's income, number of children, disability etc. Basic benefit amount ranges from HRK 200 (EUR 27) to HRK 300 (EUR 40) monthly. Supplements for the third and the fourth child equal HRK 500 (EUR 66) monthly are also available.
Tax allowance for dependent children (*porezni odbitak za uzdržavanu djecu*)	A personal income tax allowance that progressively increases with each subsequent child.
Maternity and parental leave benefits (*naknada za rodiljni i roditeljski dopust)*	An income-replacement social benefit for employed and self-employed parents. The benefit amount depends on income received in the period before the maternity (parental) leave.
Maternity and parental allowance (*naknade za rodiljnu i roditeljsku brigu i poštedu od rada*)	Available to parents of a newborn child who are temporary workers, workers in agriculture, unemployed persons or inactive persons. Monthly benefit amount is HRK 2,328 (EUR 309).
Newborn grant (*novčana potpora za novorođeno dijete*)	A lump-sum cash benefit of HRK 2,328 (EUR 309) provided at central government level.
City of Zagreb's newborn grant (*novčana pomoć za opremu novorođenog djeteta*)	The benefit increases with the number of children. It equals HRK 1,800 (EUR 239) for the first child, HRK 3,600 (EUR 478) for the second child, and HRK 54,000 (EUR 7,167) for the third and subsequent children. The benefit was reformed in 2022.
City of Zagreb's transport subsidy (*subvencija za prijevoz*)	The benefit amount depends on recipients' economic status, age, household income and similar. Maximum subsidy equals HRK 250 (EUR 33) monthly. In general, low-income pensioners, students, and the unemployed receive full subsidies, while others pay reduced fees.
City of Zagreb's kindergarten subsidy (*subvencija za vrtiće*)	A subsidised amount of the economic cost of the kindergarten. The subsidy is equal to the difference between the economic price and the fee paid by parents; the maximum amount is HRK 2,000 (EUR 265) monthly.[2]
City of Zagreb's compensation for housing costs (*naknada za troškove stanovanja*)	The benefit received by beneficiaries of the *guaranteed minimum benefit*. It covers various housing costs such as rental, electricity, utility, heating, etc. Amount is equal to half of the maximum amount of the guaranteed minimum benefit.

3.2. Data

The analysis is conducted using EU-SILC microdata, which are based on the Croatian national SILC (*Anketa o dohotku stanovništva*), collected by the Croatian Bureau of Statistics, for the year 2019, with income data for 2018. The sample consists of 7,879 households and 19,547 individuals that are a representative sample for the Croatian population, but the analysis for households with children was conducted on an urban subsample (based on EU-SILC's variable for densely populated areas - cities) of 1,738 households and 4,068 individuals. This urban subsample was chosen to reflect better the impacts of simulated policies of the City of Zagreb since the survey does not contain exact information on people's places of residence. There are differences between the urban and rural populations in education level, age structure and other characteristics of interest in this analysis. Income data have been uprated to reflect 2021 values as the simulation was based on policy rules valid in 2021. Uprating incomes is performed by using factors based on available administrative statistics. Specific uprating factors are derived for each income source, reflecting the change in their average amount between the income data reference period (2018) and the target year (2021).

3.3 Methods and Assumptions

The main tool for our analysis is the Croatian microsimulation model of taxes and benefits miCROmod (Urban et al. 2022), a spin-off of the EU-wide microsimulation model EUROMOD (Sutherland and Figari 2013). Microsimulation models simulate social insurance contributions, taxes and benefits for individuals and households, and hence, their disposable income. Such models are an excellent tool for policy evaluation and various distributional analyses (Figari, Paulus, and Sutherland 2015). miCROmod consists of two modules: arithmetical (employed in this analysis) and behavioural (Urban, Bezeredi, and Pezer 2018; Bezeredi et al. 2019). The arithmetical module, miCROmodA, simulates central government cash transfers and taxes as well as the local government cash transfers and subsidies of the Croatian capital (Zagreb) and the three next biggest cities (Split, Rijeka and Osijek). For this analysis, miCROmodA is upgraded by incorporating healthcare and education in-kind transfers provided by the central government.

The main object of our analysis is households with children, with particular emphasis on the cash and in-kind transfers parents receive on account of children in their household. Children are defined as below 18 years of age but we also include young dependent adults, as in Pezer (2022). Young dependent adults are economically dependent adults up to 25 years of age (students, unemployed, disabled and similar). The analysis is conducted for households of up to three children due to the low number of households with more children in the subsample.[3]

Calculations are performed at the household level, using equivalised incomes. The modified OECD equivalence scale is used to account for economies of scale as a better estimate of a living standard than monetary incomes (OECD 2020).[4] We assume full benefit take-up and full tax compliance. However, kindergarten enrolment data is based on survey data as well as school/university enrolment. The child-contingent payments method is applied to capture the monetary amounts parents obtain for the children in their household from the tax-benefit system (Corak, Lietz, and Sutherland 2005; Figari, Paulus, and Sutherland 2011). This is a microsimulation technique which compares benefits received and taxes paid when children are present in the household, to a hypothetical situation when children are "removed" from the household, and thus calculate the net amount of payments obtained on account of children.

To account for perceptions of in-kind transfers and subsidies, several income concepts are used:

i) post-SIC income (X) is equal to the sum of market incomes and pensions minus the social insurance contributions (SIC);
ii) Y0 is equal to X minus taxes (taking into account tax allowances) plus central government cash transfers
iii) Y1 is equal to Y0 plus local government cash transfers (disposable income)
iv) Y2 is equal to Y1 plus central government in-kind transfers
v) Y3 is equal to Y2 plus local government subsidies (augmented income)

Child poverty is calculated using Foster-Greer-Thorbecke (FGT) indices (Foster, Greer, and Thorbecke 1984): comparing poverty headcount (share of children in households with incomes below the poverty line) and poverty gap (which takes into account how far households are from the poverty line). The poverty line is fixed at 60% of the median equivalised disposable household income. However, a changing poverty line for different income concepts is also used. Concentration curves are estimated using the DASP Stata Package (Araar and Duclos 2007).

3.3.1. Simulation of central government in-kind transfers

We upgraded the miCROmodA model with two in-kind central government policies: health care and education, as these are the two most important in-kind transfers in Croatia. To do that, we match the average education costs per student to a particular household whose members are in education according to their level: primary, secondary and tertiary, and the cost of health care according to age and gender (see Table 3). The value of the transfer in kind for the user is equal to the average cost of production of that service (Paulus, Sutherland, and Tsakloglou 2010). Data for education is based on total government spending ("Financial Agency - FINA" 2022) for each stage of education (primary, secondary and tertiary) and divided by the number of students in each stage (Croatian Bureau of Statistics 2022b). These amounts are reduced by the amounts of Research and Development spending (Eurostat 2022a).[5]

The amount for healthcare spending is matched to users of that benefit (entire population) according to age and gender. Data for health care (Basic Health Insurance) is provided by the Croatian Bureau of Statistics (2022a). Health care includes in-patient care (direct provision); expenditures on medicines

Table 3. Costs of education per student, in HRK, 2019

Level of Education	Number of students	Total cost	Average cost per student
Primary	312,530	7,129,027,068	22,810.70
Secondary	146,277	3,525,747,634	24,103.23
Tertiary	145,178	4,831,555,230	33,280.22

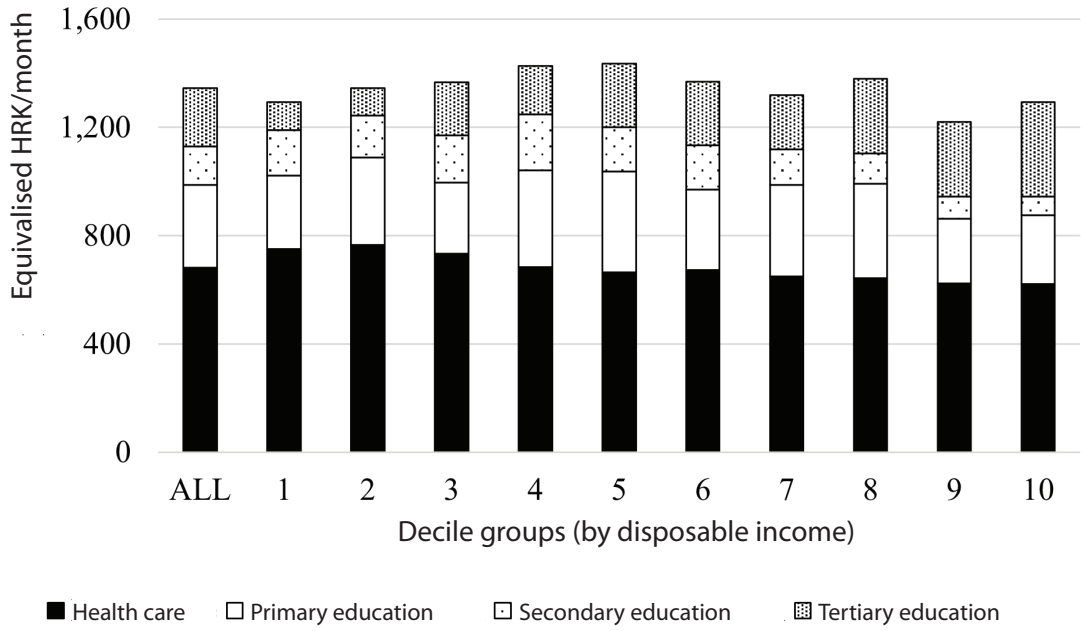
Source: Authors' calculations based on data from Eurostat (2022a, 2022b); Croatian Bureau of Statistics (2022b); Financial Agency - FINA (2022).

Table 4. Average healthcare spending by age and sex, in HRK, 2019

Age	Total	Men	Women
TOTAL	5,522	5,286	5,744
0-4	3,576	3,880	3,255
5-9	1,532	1,707	1,347
10-14	1,744	1,770	1,716
15-19	2,401	2,188	2,626
20-24	2,600	2,135	3,093
25-29	3,295	2,380	4,264
30-34	3,439	2,495	4,421
35-39	3,059	2,485	3,655
40-45	3,662	3,209	4,128
45-49	5,177	4,782	5,576
50-54	5.919	5,837	5,998
55-59	6,001	6,312	5,709
60-64	5,865	6,365	5,406
65-69	7,730	8,601	6,983
70-74	13,079	15,187	11,511
75-79	12,442	14,899	10,838
80-84	12,643	15,008	11,339
85+	18,880	21,138	17,962

Source: Authors' calculations based on data from the Croatian Bureau of Statistics (2022a) and Eurostat (2022b).

Figure 1. Distribution of average equivalised value of health care and education by household (Croatia), 2021



Source: Authors' calculations based on miCROmodA output.

Note: The figure displays the distribution of in-kind transfers across the entire sample.

prescribed to beneficiaries by primary healthcare doctors; out-patient care (direct provision); health protection financed by government ministries, and health protection financed by regional and local self-government units. The total amount spent on the healthcare system is divided into groups by age and gender according to the proportion of spending estimated for each group. Due to the unavailability of Croatian data, the proportion of spending for each group is based on the Austrian healthcare system, as presented in Christl et al. (2020).[6,7] The number of people in each five-year group of population is taken from Eurostat (2022b).

Figure 1 illustrates the distribution of the simulated in-kind transfers across the entire sample. Average equivalised values across decile groups reveal their relatively uniform overall distribution. Health care is slightly more important for the decile groups below the median. This can be attributed to pensioners with higher healthcare costs and lower disposable income than the working-age population. Tertiary education values increase with income, while secondary education values decrease due to the population structure.

4. Results

This section summarises the main findings of our analysis for households with children in the urban subsample. Basic descriptive statistics are available in Appendix Table A1. Results reveal that, on average, central government transfers are more generous, both cash and in-kind, than local government transfers. Central government support includes costly education and health care, as well as the child benefit and tax reductions due to the child tax allowance. The expansion of the analysis by the inclusion of in-kind transfers and subsidies to household incomes (measured with Y3) substantially increases median income, by 29% up from the disposable income (Y1).

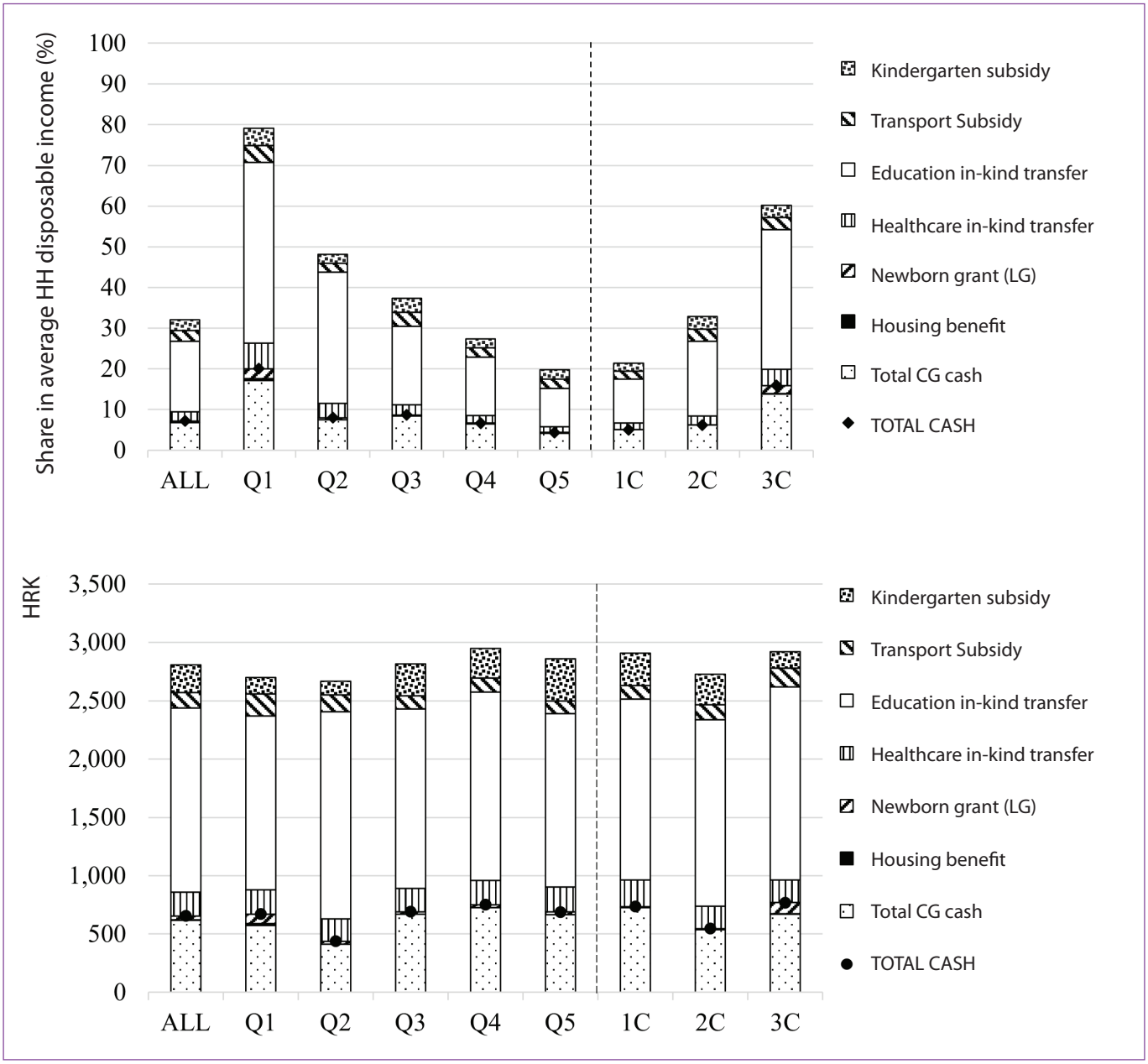
How child-contingent support varies by income quintile and type is presented in Figure 2 in relative and absolute amounts (see also Appendix Table A2). In-kind child-contingent support is, on average, in absolute terms, 229% higher than cash payments. The most dominant transfer is education, with an average share in total child-contingent support of 56%. It is followed by central government cash payments. The lowest payments, on average, are from the means-tested housing benefit. The transport subsidy is highest for the lowest quintile group due to their entitlement to greater subsidy amounts, while the kindergarten subsidy increases with income in absolute terms due to a higher number of kindergarten users in higher-income groups.

The lowest absolute support is obtained in the second quintile group as these households, on average, obtain the lowest amount of child benefit, while at the same time their incomes are not high enough

to fully utilise the child tax allowance (Urban 2014; World Bank 2014).[8] While it can be observed that the share of the central government's cash child-contingent payments to a certain extent follows the income growth (most pronounced in Q2-Q4), the addition of in-kind transfers which are not income-dependent contributes to a fairer distribution of the overall child-contingent support in relative terms, from a vertical equity perspective.

Variations of child-contingent support by the number of children in the household are also analysed. In absolute terms, per child, the differences between household types are not as pronounced, and they are mainly driven by the central government's

Figure 2. Structure of child-contingent support by income quintile groups and the number of children in household, monthly (Zagreb) 2021; as share in disposable income (upper panel), in absolute terms per child (lower panel)



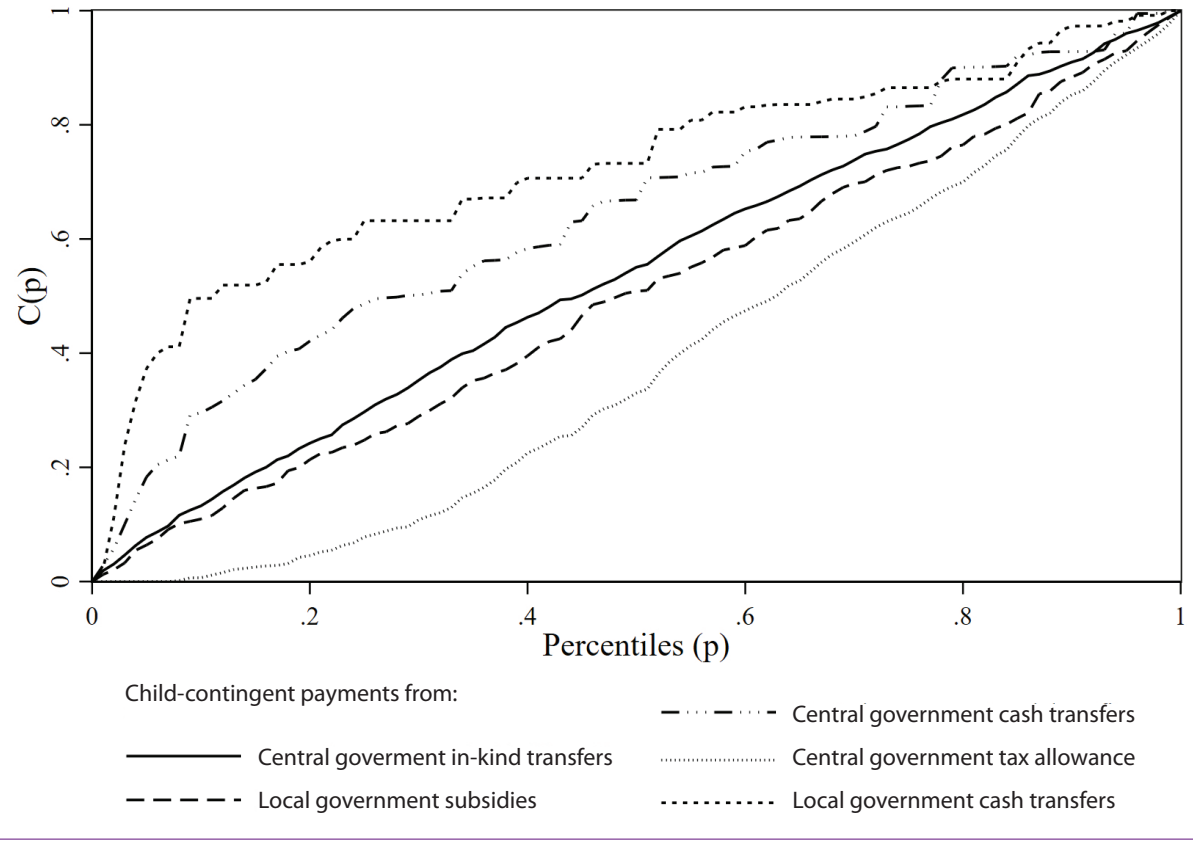
Source: Authors' calculations based on miCROmodA output.

Note: Tax reduction is included in Total CG cash. Q*n* denotes quintile groups which are formed according to post-SIC incomes of all households in the urban subsample, HH denotes household, CG denotes central government, LG denotes local government, *n*C denotes the number of children in a household (urban subsample).

policies. In relative terms, large families obtain greater support with a similar structure as smaller households.

Figure 3 depicts aggregate concentration curves for child-contingent payments from groups of tax-benefit policies that reveal which are "pro-poor" and "pro-rich". Local and central government in-kind benefits/subsidies are distributed relatively evenly across households, as their entitlement, in general, is

Figure 3. Aggregate concentration curves of child-contingent support, Zagreb, 2021



Source: Authors' calculations with DASP based on miCROmodA output.

Note: Households are ranked by their equivalised pre-child-contingent payments income; analysis was conducted for the urban subsample.

Table 5. Poverty analysis, Zagreb, 2021

Income concept	All		1 child		2 children		3 children	
	FGT(0)	FGT(1)	FGT(0)	FGT(1)	FGT(0)	FGT(1)	FGT(0)	FGT(1)
A) Poverty line: fixed, 60% median of household equivalised disposable income (Y1)								
X	19	8	16	4	10	3	31	18
Y0	14	5	11	3	6	2	26	12
Y1	13	4	11	3	6	2	26	11
Y2	2	0	2	0	1	0	3	0
Y3	1	0	2	0	0	0	0	0
B) Poverty line: moving, 60% median of household equivalised income								
Y0	14	5	11	3	6	2	26	12
Y2	7	1	7	1	2	0	15	2
Y3	6	1	7	1	2	0	12	1

Source: Authors' calculations.

not means-tested. With the lion's share of grants for newborn children, local government cash transfers are found to be pro-poor.[9] Central government cash policies are depicted separately for benefits (child benefit, guaranteed minimum benefit, newborn grant and parental benefits) and for the support obtained through tax reductions (due to the child tax allowance). The former are found to be pro-poor while the latter is by design pro-rich.

Poverty analysis is presented in Table 5. Child poverty headcount (FGT(0)) and poverty gap (FGT(1)) are compared for households with a different number of children and different income concepts. On average, households with three children are the poorest, while households with two children are the least poor. Central government transfers are estimated to be the most potent in child poverty reduction.

While keeping the poverty line fixed (Table 5, section A), it can be observed that child poverty diminishes when assessed for the augmented income (Y2 and Y3). Having in mind the high value of in-kind transfers and their uniform distribution, the addition of in-kind healthcare transfers and the education transfers significantly lowers child poverty. The value of these transfers is so high that it almost completely lifts all households out of poverty. However, a moving poverty line (Table 5, section B) reveals that with an increased poverty line half of the households remain below the poverty line compared to disposable income poverty.

In-kind transfers also contribute to income inequality reduction in Croatia as demonstrated in Table 6. If in-kind transfers are included in the analysis they decrease the Gini coefficient by 16% compared to the disposable income, which is slightly higher than the overall reduction of income inequality achieved through the tax and benefit system if disposable and post-SIC incomes are compared.

A similar magnitude of inequality reduction is confirmed with the S80/S20 ratio; accounting for in-kind transfers lowers this indicator by a non negligible 17%.

Table 6. Income inequality indicators, Zagreb, 2021

Income concept	Gini coefficient	S80/S20
Post-SIC income (X)	0.348	2.550
Disposable income (Y1)	0.306	2.145
Augmented income (Y3)	0.258	1.777

Source: Authors' calculations with DASP.

Note: Calculation for all households in the urban subsample.

5. Discussion and Conclusion

The paper analyses the impact of the Croatian tax-benefit system on households with children, with special emphasis on in-kind transfers, at both local and central government levels. The Croatian microsimulation model miCROmod is utilised and upgraded with the simulation of those transfers. The results suggest that transfers in kind have strong inequality- and poverty-reducing effects. This research emphasises the importance of using augmented income to analyse income inequality and poverty instead of solely monetary disposable income. It is important to point out that household income does not consist only of cash transfers but of in-kind transfers as well.

Our findings suggest that in Croatia, health care is almost evenly distributed among the entire population; education varies with income - tertiary education is more represented in higher-income households. Child-contingent support through in-kind transfers, including local government subsidies is also relatively evenly distributed and income independent and thus roughly equally important for the entire population. The value of in-kind transfers greatly exceeds that of monetary transfers. In general, in-kind transfers are estimated to decrease the Gini coefficient by 16% compared to disposable income inequality. Furthermore, adding in-kind healthcare and education transfers significantly lowers child poverty.

A certain amount of caution is called for when interpreting these results. The main issues, to do either with the quality and representativeness of survey data or with our simulations, are briefly discussed below. First, the unavailability of residence data does not allow for a more detailed simulation of a sub-sample of residents of Zagreb. Second, due to the lack of necessary information and the complexity of some policy rules, our simulations do not include the totality of transfers provided by the central and local governments. However, although not simulated, part of these benefits is still present in our input data, and hence used in the analysis. One of the non-simulated benefits is the parent educator benefit for parents of three (or more) children, which caused a lot of controversies and is subject to reform.[10]

A strength of this research, an advanced estimate of in-kind healthcare benefit, is also a limitation. To provide a more precise estimate compared to previous research, Austrian healthcare spending data was used. Making such data more broadly available is certainly one of the future tasks for the Croatian government, especially for the Croatian Ministry of Health. The ministry should provide research data for healthcare

spending for each population group according to age and gender.

Future research based on microsimulation may use simulated local and central government policies, in-kind and cash transfers, and also include indirect taxes. Such a comprehensive analysis would provide additional insights and reveal the full impact of the Croatian tax-benefit system. In addition, future research could involve more local units, with different fiscal capacities, to account for differences between cities and municipalities and economic disparities between different regions of the country.

Living in an era of pandemic, war and inflation is hard for every citizen of Europe and indeed of the whole world. Such global developments tend to disadvantage the most vulnerable parts of the population – children, the elderly and marginalised groups. Public finances are critical in protecting the standards of living of those populations. Croatia too is not spared from the effects of these events, which are likely to induce high risks of poverty and inequality. The latter might be exacerbated by emigration and by the demographic challenges the country is currently facing (ageing and natural decrease of the population). Unfavourable demographic conditions affect productivity, economic development, and, consequently, the state budget. Considering these challenges, additional funds would help fight child poverty and income inequality, but they are not a prerequisite. Even with current levels of funding, a long overdue child benefit reform could be implemented (Pezer 2023). Also, as shown by the Programme for International Student Assessment (PISA) and the European Health Interview Survey (EHIS), Croatia is lagging behind in terms of quality education and health care. Improvements in these fields can be expected via better management, anti-corruption strategies and digitalisation.

Our research is focused on Zagreb, the most prosperous territory of the country; but regional differences remain an issue in Croatia. Dobrotić and Matković (2023) emphasise that in addition to the formal right to receive a particular service, inter-territorial fiscal equalisation policies are essential for the resolution of the territorial fragmentation of social rights. The provision/availability of cash/in-kind transfers at a sub-national level must be addressed through structural reforms. A step forward could be the announced reform of the Croatian local governments by mergers of municipalities. If well-implemented, such a reform could enhance the availability of early childhood education and care, transport to schools and school supplies in the most disadvantaged regions of the country.

Evidence-based policy-making is essential for fighting child poverty and income inequality. Analyses of this kind point to the gaps in the distribution of transfers and can be used to better understand the fiscal and distributional implications of potential policy reforms. Subject to data availability, various local or central government initiatives, such as the recently introduced provision of free meals for every schoolchild, can also be assessed with the use of microsimulation techniques. The importance of in-kind transfers is highlighted throughout the results of this analysis. While some of those transfers are costly and their value cannot be easily perceived or counted by beneficiaries, as is often the case with in-kind transfers such as health care and education, their importance should not be neglected. Guaranteeing high quality and wide accessibility for those benefits is essential to achieve the goal of equality of opportunity for every child and citizen.

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Endnotes

1 Other Croatian cities have similar benefits to City of Zagreb, but they may differ in amounts, eligibility, conditions etc.

2 Explained in more detail in Urban et al. 2022.

3. In the urban subsample there are 1,281 childless households, 205 households with 1 child, 189 with 2 children, 51 with 3 children and 12 with 4+ children.

4. The modified OECD equivalence scale assigns the following weights to household members: 1 to the head of the household, 0.5 for every subsequent member older than 14, and 0.3 for every child up to 13 years of age.

5. The Research and Development (R&D) spending is not directly related to the benefit that the student has from the education service. The cost for R&D in Croatia averages around 1% of total government spending on higher education.

6. There are many similarities between the Austrian and Croatian healthcare systems, the most important of which are that the two systems are based on the same foundations. The healthcare system in Croatia began to develop in the 19th century within the Austro-Hungarian monarchy, and even today both systems are based on Bismarckian principles. The share of healthcare expenditures, as well as the share of expenditures for medicines, is very similar in both countries, and most importantly, the countries have similar age structures.

7. The proportion of spending by age resembles the OECD data under the System of Health Accounts (SHA) Framework available for Czechia, the Netherlands, and South Korea.

8. The recent change in the child benefit (in 2018) increased the entitlement threshold of the child benefit and improved its distribution, but the regressive tax allowance still raises some equity concerns.

9. While the grant is not means-tested, it is a pronatalist benefit. To a certain extent, lower-income households tend to have more children, and also first-time parents are usually younger, starting their careers with lower incomes. It should also be noted that equivalised incomes of households with more children are lower than those with fewer children, having the same employment income, and thus they will be in lower percentiles.

10. In 2021, the parent educator (cash for care) is the mother or father of the child (or the foster parent or similar). The youngest child must not be in the primary school education program, and the oldest child at the time of application must not be older than twenty-six years of age. The benefit was paid monthly in the amount of 65% of the average gross salary in Zagreb.

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APPENDIX

Appendix Table A1. Descriptive statistics, 2021, Zagreb, yearly amounts in HRK

Child-contingent support per capita from:	
child tax reduction	861
child benefit	208
social assistance benefits	60
health care	537
education	4,144
parental benefits	494
Total CG cash	1,623
Total CG in-kind	4,681
Total CG	**6,305**
housing benefit	7
LG grant for newborn children	88
kindergarten subsidy	621
city transport subsidy	349
Total LG cash	95
Total LG subsidies	970
Total LG	**1,065**
Total cash CG+LG	1,718
Total in-kind CG+LG	5,651
Total CG + LG	**7,369**

Median equivalised incomes (household level)	
X (post-SIC income)	70,214
Y0	70,559
Y1 (disposable income)	70,559
Y2	88,221
Y3 (augmented income)	91,296
Per capita incomes	
X (post-SIC income)	55,082
Y0	52,802
Y1 (disposable income)	52,987
Y2	63,694
Y3 (augmented income)	65,449

Appendix Table A2. Structure and amounts of child-contingent support by income quintile groups and the number of children in household, monthly, Zagreb, 2021 (per child)

A) Quintiles	ALL	Q1	Q2	Q3	Q4	Q5
			Central government (CG):			
Tax reduction	328	27	184	384	460	509
Child benefit	79	292	134	16	1	0
Social assistance	23	53	25	14	16	12
Parental benefits*	188	203	72	257	249	145
Total CG cash	618	575	415	670	726	666
Healthcare in-kind benefit	204	209	191	198	209	214
Education in-kind benefit	1,578	1,488	1,775	1,540	1,617	1,486
TOTAL CG	2,401	2,272	2,381	2,409	2,551	2,366
			Local government (LG):			
Housing benefit	3	16	0	0	0	0
Newborn grant	33	80	24	21	25	23
Total LG cash	36	96	24	21	25	23
Kindergarten subsidy	236	140	118	272	255	362
Transport subsidy	133	192	143	113	118	109
TOTAL LG	405	428	285	407	398	495
			TOTAL:			
TOTAL CASH	654	671	439	692	751	690
TOTAL CASH + IN-KIND	2,806	2,700	2,666	2,816	2,949	2,860

B) Number of children	1 child	2 children	3 children
		Central government (CG):	
Tax reduction	291	382	294
Child benefit	25	39	195
Social assistance	30	18	24
Parental benefits*	380	102	157
Total CG cash	726	540	670
Health in-kind benefit	228	192	194
Education in-kind benefit	1,551	1,597	1,656
TOTAL CG	2,505	2,329	2,520
		Local government (LG):	
Housing benefit	0	1	4
Newborn grant	9	7	95
Total LG cash	9	8	99
Kindergarten subsidy	274	263	142
Transport subsidy	119	129	160
TOTAL LG	402	399	401
		TOTAL:	
TOTAL CASH	734	548	769
TOTAL CASH + IN-KIND	2,906	2,728	2,921

Source: Authors' calculation based on miCROmod output.

Note: *includes central government's newborn grant.

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MEASURING THE NATURAL INTEREST RATE FOR THE MACEDONIAN ECONOMY: A MULTI-MODEL APPROACH

Mite Miteski, Magdalena Petrovska, Artan Sulejmani

Abstract

This paper identifies the natural interest rate for the Macedonian economy using quarterly data for 2001Q4-2019Q3. To this end, the estimation is made by using different types of models, such as the Holston, Laubach, and Williams model and the full-fledged country-specific structural MAKPAM model. The empirical results show that the natural rate of interest in the Macedonian economy has declined over time, which is similar to the findings for other countries. The decomposition of the natural rate suggests that the main driver for the decline is the slowdown of the Macedonian potential GDP growth in the period after the global economic crisis, although there are signs of its recovery at the end of the sample period. In addition, the results indicate that the monetary policy conditions in the Macedonian economy have been broadly accommodative from 2011Q4 onwards. The substantive conclusions are unchanged across the multiple models used in this study.

JEL Classification: *C32, E43, E52, O40*

Keywords: *Natural interest rate, interest rate gap, Holston, Laubach, and Williams model, MAKPAM Model*

Mite Miteski
Senior Advisor Analyst
Monetary Policy and Research Department
National Bank of the Republic of North Macedonia
Republic of North Macedonia
E-mail: miteskim@nbrm.mk
ORCID: 0000-0002-5819-3509

Magdalena Petrovska (corresponding author)
Senior Advisor
Monetary Policy and Research Department
National Bank of the Republic of North Macedonia
Blvd Kuzman Josifovski Pitu 1
1000 Skopje
Republic of North Macedonia
E-mail: petrovskam@nbrm.mk
ORCID: 0000-0001-5939-7987

Artan Sulejmani
Analyst
Monetary Policy and Research Department
National Bank of the Republic of North Macedonia
Republic of North Macedonia
e-mail: sulejmania@nbrm.mk
ORCID: 0000-0001-6011-8834

1. Introduction

Many advanced economies have had low inflation now for an extended period, while the interest rates in some have reached record low levels. Additionally, the recent global economic slowdown has brought the need to introduce unconventional policy measures and ease the monetary policy by pushing the nominal interest rate into negative territory. This decline in the nominal and real interest rates has renewed the interest in determining the natural rate of interest. The natural rate of interest was first introduced by Wicksell as, "[the real] rate of interest on loans which is neutral

in respect to commodity prices, and tends neither to raise nor to lower them" (Wicksell 1936, p. 102). A more recent definition of the natural rate of interest (or the equilibrium real rate) is the real interest rate level consistent with stable inflation, implicitly at the inflation target and with output at its equilibrium level (Hlédik and Vlček 2018).

In many advanced countries, where the short-term interest rate has become the primary policy instrument, the "equilibrium" or "natural" interest rate provides a metric for the policy stance. Therefore, the proper estimation of the natural rate of interest is crucial. So, the question arises whether the natural rate declined or does it remain at the pre-crisis levels? If the natural rate has declined, central bankers will have to keep their nominal interest rates below the pre-crisis level, otherwise, their monetary policy will be too restrictive, and conversely, if the natural rate remains at the pre-crisis level, monetary policy might be too expansionary. Additionally, the natural rate of interest is also important because the difference between the real interest rate and the natural rate – the real interest rate gap – is commonly used to measure the effects of monetary policy on the real economy. Having a short-term real rate below its natural level means, the monetary policy is stimulating the economy by creating a positive output gap, with an appropriate effect on inflation as well.

Therefore, the aim of this paper is to estimate the natural interest rate for the Macedonian economy, which would help in making more effective monetary policy decisions. For this purpose, we estimate the natural rate of interest based on several methodologies, including the Holston, Laubach, and Williams (2017) methodology and the modified Macedonian Policy Analysis Model (MAKPAM) model. In doing so, we ascertain the linkage between the natural interest rate, the potential output, and its trend growth and examine the empirical relationship between these unobserved variables. To the best of our knowledge, this is the first formal attempt to estimate the natural rate of interest for the Macedonian economy. Hence, this paper has an important contribution to enriching the empirical literature on this topic and is the first one related to the specifics of the topic, which has not been explored before in our country.

The paper is organized as follows. The second section briefly discusses the literature on the natural rate of interest, with a focus on the relevant empirical literature. The third section explains the data used and presents some brief stylized facts. The fourth section refers to the selected empirical methodology and discusses the main findings. The fifth section provides some robustness checks. Conclusions are presented in the sixth section.

2. Related literature

One of the first seminal papers in the area of natural interest rate estimation was written by Laubach and Williams (2003). Through the application of the Kalman filter in a closed economy (the USA) setup, the authors estimated the natural rate of interest, potential output, and its trend growth, further examining the empirical relationship between these estimated series. Their results indicated that the US natural interest rate experienced a significant variation in the past forty years, with this variation being in a one-for-one relation with changes in the trend growth rate. Consequently, concluding that the trend growth rate was an important determinant of changes in the natural rate with time variation in the natural rate having important implications for the design and implementation of monetary policy. Therefore, adjustment to changes in the natural rate was crucial for the achievement of long-run inflation and short-run stabilization goals.

The Laubach and Williams (2003) method was also used for the case of the Czech Republic by Hlédik and Vlček (2018), but mainly modified in two aspects. First, the natural rate of interest was linked to equilibrium GDP growth, which was adjusted for real exchange rate appreciation (to incorporate the effect of koruna appreciation). Second, a semi-structural model closed by a monetary policy rule was employed, which allowed for forward-looking model-consistent expectations and imposed a comprehensive set of restrictions, i.e., model equations, to identify the natural rate of interest. Their estimations indicated that the natural rate of interest in the Czech economy in 2017 was close to 1 percent, a level lower compared to the 2015 peak, which was mainly driven by the appreciation of the equilibrium real exchange rate despite a recovery in the real economic activity.

On the other hand, the natural interest rate of the Danish economy was estimated by Pedersen (2015) using an empirical model adopted by Berger and Kempa (2014), instead of Laubach and Williams (2003), which according to him, is inappropriate due to the idiosyncratic characteristics of the Danish economy. Hence, the natural rate of interest was inferred from movements in GDP, applying a dynamic IS-relation and a Phillips-curve adopted from the small standard dynamic macroeconomic model theory. Pedersen (2015) found evidence of very low and perhaps negative levels of the natural real rate for Denmark, arguing

on an increased probability for these levels to remain in the near future and for the monetary policy rate to end up in the lower bound again.

Mendoca (2017) used the Laubach Williams (2003) methodology to estimate the natural rate of interest of Italy and the Netherlands. In the paper, the author detected a decreasing trend in the natural interest rates, further stating that the 'Wicksellian' rate of interest in these economies had reached a negative point. According to him, there was a link between the real interest rate gap and the output gap, but the natural interest rate estimates are subject to a high degree of uncertainty.

An interesting perspective on the natural rate of interest was given by Armelius, Solberger, and Spanberg (2017). The authors, besides estimating the Swedish natural rate of interest, also analyzed the determinants of its movement. Using a version of the Laubach Williams (2003) approach, they observe a declining trend in the Swedish natural rate in the last two decades, which had reached a negative value in 2017, with this decline being mainly due to unobserved variables and unrelated to the growth of potential GDP. Notably, they documented a significant influence from the US natural rate on the Swedish counterpart, as well as a separation in the real rate (analyzing its effect on house prices) in the natural rate part and a monetary policy part, with the influence of the latter getting stronger while the influence of the natural part close to zero.

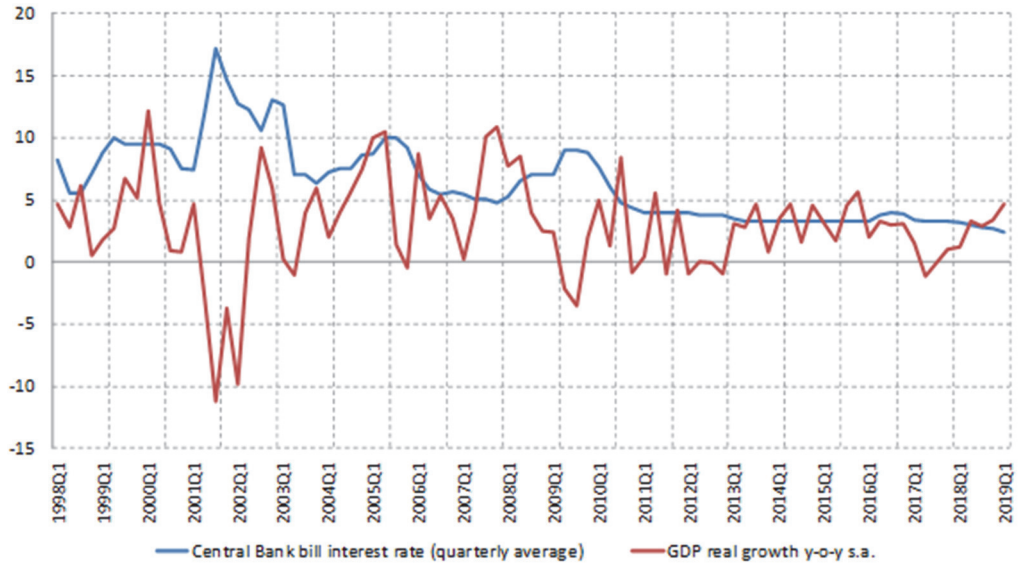
Lastly, the Laubach and Williams (2003) approach was used by Manrique and Marques (2004) for the estimation of the US and German natural rates of interest. Using quarterly data for the period from 1962 until 2001, the authors found that during the 90's the natural rate of interest and the output gap in both countries had shown volatility below their historical mean. Accordingly, the US natural rate of interest was situated between 1.6% and 2.3% in 2003 compared with the -0.6% of ex-post US real rate of interest, while in Germany it had fluctuated around 0.5% and 1.7%, closer to the observed real rate (0.3%) in this country.

3. Data and some stylized facts

We use quarterly data for a sample period from 2001 Q4 to 2019 Q3 (first estimate) to identify the Macedonian natural rate of interest. Data on domestic GDP at constant prices and inflation were obtained from State Statistical Office and data on foreign GDPs from Eurostat. The central bank bills rate of NBRNM was used as a measure of the actual nominal interest rate.

Figure 1 shows that the nominal interest rate on Central Bank bills had its highest levels during the years 2001 and 2002, reaching its peak of almost 18% in August 2001. The restrictive monetary policy during this period was taken to maintain macroeconomic stability during the times of the security crisis in the country, which severely affected the economy, resulting in deposit withdrawals, increased demand for foreign currency, decreased foreign exchange reserves, and pressures on the fixed exchange rate[1]. Additional contractionary measures were also adopted, among which was the increase of the reserve requirement

Figure 1. Central Bank bill interest rate and real GDP growth



rate and the Lombard rate, which helped to reduce the inflationary pressures and maintain price stability. The worsened security situation had a negative effect on the GDP, which experienced negative growth during this period. In the later period, during the pre-global financial crisis, the economy noted its highest real GDP growth with the referent nominal interest rates gradually falling. However, interest rates again started rising after the eruption of the global financial crisis in 2008. The main signs of the crisis included falling prices and a substantial fall in exports and private transfers. In such conditions, the decline of foreign exchange reserves again required a more restrictive monetary policy to support the sustainability of the fixed exchange rate regime, despite the absence of inflation pressures. After 2009, the nominal interest rate of the Central Bank bills was gradually reduced, reaching its lowest level of 2,25% in March 2019, and remaining at that level throughout the rest of the year. On the other hand, the GDP on average during this period has registered positive growth, with short episodes of stagnation in 2012 and 2017 as a result of the Eurozone debt crisis spillover effect and the escalation of the domestic political crisis.

Figure 2 shows the movement of inflation and the Central Bank bill interest rate. Overall, we can see that the inflation rate is relatively low and stable. However, exceptions are the periods in which there is a surge in the import prices of the primary commodities on the world market, which then swiftly translate into higher domestic prices. Furthermore, as mentioned before, if there are pressures on the foreign exchange rate, the central bank reacts by increasing the policy rate, which can happen even in times of low inflation, such as in 2009. The most interesting is the period after 2013, when we see relatively low inflation, despite the gradual lowering of the nominal policy interest rate and relatively solid GDP growth, which is opposite to the suggestions from economic theory. Admittedly, for quite some time now, the inflation rate has remained below the historical average of 2%.

4. Specification of the models and empirical results

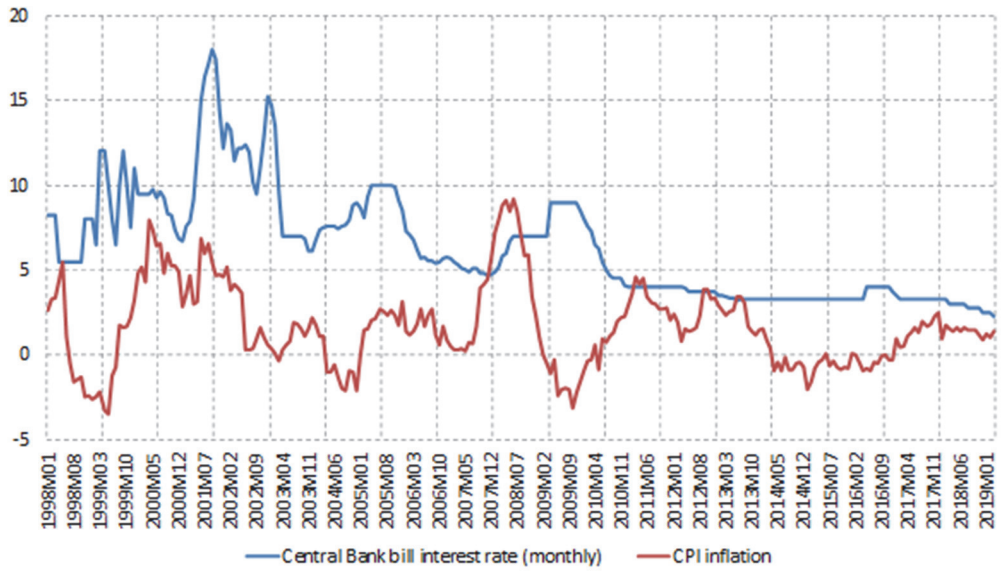
Given that the natural rate of interest is a latent variable, i.e. it cannot be directly observed, and its estimates are sensitive to the chosen methodology, we have opted to apply different model specifications to identify the natural rate of interest in the Macedonian case.

4.1. Holston-Laubach-Williams model

This section closely follows Scheerová (2017) and Fiorentini et al. (2018). Those are studies that rather systematically describe the technical characteristics and the very intuition behind the HLW (2017) methodology. Hence, providing enough detail necessary for the operationalization of the concepts established by the original research of HLW (2017).

Holston, Laubach, and Williams (2017) developed a methodology that offers a natural rate of interest evolution compatible with production structural

Figure 2. Central Bank Bills interest rate and annual inflation rate



changes, thus proposing a model structure that links the long-term movement in equilibrium real interest rate with the real characteristics of the economy. To this end, the real natural rate is being affected by both, the supply and demand-side structural factors. The supply side involves the potential growth of the economy (determined primarily by technology and factor endowments). The demand side is linked to demographical shifts, population growth, and the effects of aging on the elasticity of substitution and time preference (Scheerová 2017).

The equilibrium real interest rate is the rate that keeps the economy on a sustainable growth trajectory. In effect, it is the interest rate that allows the economy to grow in line with its potential and sustains full employment, while also ensuring that inflation meets the central bank's price stability target. It can also be thought of as the rate that balances planned investment and desired saving in an economy at full employment. In the long run, the rate is impacted by the amount of supply in the economy and is thus linked to potential GDP growth. Higher economic growth implies a higher return on capital, which in turn leads to stronger investment demand. In parallel, because it raises upcoming earnings, it guides forward-looking households to consume more and save less. Jointly, these outturns increase the natural real interest rate. The long-run equilibrium interest rate is not a directly measurable variable. That being the case, one has to infer it by considering the development of the actual interest rate.

Holston, Laubach, and Williams (2017) use the Kalman filter to jointly estimate the natural rate of interest, potential output, and potential output growth rate within a multi-equation specification. Therefore, they suggest a system of equations that jointly characterizes the behavior of inflation and the output gap. In addition, the authors allow for the presence of shocks that affect the output gap and inflation but not the natural rate of interest, which they define as a low-frequency concept. Consequently, in the long run, the short-term shocks (temporary real shocks regarding government spending, asset prices, or credit conditions) fade away and the natural rate is affected predominantly by changes in productivity or demography. However, Kiley (2015) shows that those factors, notably the credit spread are relevant for the estimated relationship between output and interest rates. Put differently, the natural interest rate can vary in time due to the low-frequency shifts in the IS curve as a consequence of the significant structural changes mentioned above, and not due to the cyclical shifts in the IS curve – for instance the precautionary savings creation during recession periods (Scheerová 2017).

The Holston, Laubach, and Williams model (2017) derives the natural interest rate based on the neoclassical growth theory. It states that the equilibrium real rate is an increasing function of the trend growth rate of the output (Scheerová 2017). The reduced form of the model thus contains several equations.

The first equation i.e. the IS curve (aggregate demand equation) illustrates the output gap, $\tilde{y}_t$, characterized as the percentage deviation of real from potential GDP, as a function of its lags, the lags of the differential between the short-term real interest rate r_t and the natural rate of interest r_t^* and an uncorrelated error term $\epsilon_{\tilde{y},t}$.

$$\tilde{y}_t = a_{y,1}\tilde{y}_{t-1} + a_{y,2}\tilde{y}_{t-2} + \frac{a_r}{2}\sum_{j=1}^{2}\left(r_{t-j} - r_{t-j}^*\right) + \epsilon_{\tilde{y},t}$$

The output gap lag structure and the error term are set to consider short-term dynamics and temporary shocks, while structural shifts in the relation between the output gap and the real interest rate (the long-term output gap dynamics) are reflected in the natural rate variations. a_r is the slope coefficient of the IS curve, which we initialized at -0.0025, following the HLW (2017) approach. The inclusion of the difference between the real and natural rates of interest indicates that the estimate of the latter has to be compatible with the real interest rate that would be obtained in an environment of stable inflation if the output gap were closed.

The second equation (i.e. the backward-looking Phillips curve) displays the inflation dynamics (π_t). It is defined as a function of its own lags and lagged output gap.

$$\pi_t = b_\pi\pi_{t-1} + (1 - b_\pi)\pi_{t-2,4} + b_y\tilde{y}_{t-1} + \epsilon_{\pi,t}$$

Factually, in this model inflation does not depend on expected inflation, which instead, we only proxy with the lags of inflation. The existence of significant stickiness in the formation of prices in the Macedonian economy is one argument in support of this assumption. This is in line with recent research based on a DSGE model with financial frictions by Copaciu et al. (2021) which concludes that the highest degree of stickiness is found for prices of domestic goods. We relax this assumption in our benchmark model and in our additional model, in which we construct a hybrid Phillips curve where current inflation depends on both past and expected inflation. In brief, the first and the second equation represent the measurement equations of the model in a state space form.

The natural rate of interest depends only on real factors, specifically the annualized trend growth rate of the output $4g_t$ and a series of long-term random factors (associated, for example, with changes in financial deregulation, rate of time preference of households, intertemporal elasticity of substitution, population growth, global saving, institutional changes or uncertainty), which are denoted by the variable z_t. This unobserved variable follows a random walk process.

$$r_t^* = 4g_t + z_t$$

$$z_t = z_{t-1} + \epsilon_{z,t}$$

In the original HLW (2017) model, the authors suppose a one-for-one relationship between the trend growth rate of output and the natural rate of interest. Our specification corroborates this assumption as well. This relationship makes the natural interest rate inherently dependent on the dynamics of the potential GDP, and essentially on the underlying GDP series published by the official statistics that is used to recover this latent variable. Here, one peculiarity of the Macedonian data should be emphasized, which is not characteristic of the US or the euro area data, for example, and that is the unusually high volatility of the Macedonian GDP series published by the State Statistical Office. Ex-ante, one would expect that some of this volatility would pass on to the estimate of the natural rate. Unfortunately, this problem may be considered endemic in research for economies such as the Macedonian.

The final equation relates to potential output y_t^*. It is supposed to follow a random walk and time variation is allowed in its growth rate, which in turn behaves according to a random walk model. The model permits temporary shocks to both the level of potential output and its growth rate through the inclusion of the error terms $\epsilon_{y^*,t}$ and $\epsilon_{g,t}$.

$$y_t^* = y_{t-1}^* + g_{t-1} + \epsilon_{y^*,t}$$

$$g_t = g_{t-1} + \epsilon_{g,t}$$

The latter four equations represent the transition equations of the state-space model.

In addition, to specify the lags built into the model, in our case the restrictions included in the HLW (2017) were taken as the initial reference. To this end, the output gap and inflation equations have a fairly broad lag structure. Thus, for the output gap polynomial a structure of two lags is set for the output gap itself. We decided to include two lags of the output gap in the IS equation, in line with Laubach and Williams (2003), which through estimation concluded that such a structure is appropriate and in line with previous relevant studies. A structure of two lags is set for the real interest rate gap to take account of the transmission lags of monetary policy to output as well as for reasons of parsimony, with a similar assumption as in HLW (2017) that the lags have equal weights (however, this assumption is not rejected by the data). In the inflation equation, four lags are included to capture the stickiness in the formation of prices in the Macedonian economy, and the restriction that the coefficients sum to unity is imposed. Further, for reasons of parsimony, an additional restriction requires the coefficients of lags two to four to be equal. The decision to use a single output gap lag is consistent with HLW. Moreover, following HLW (2017) we impose the constraints that the slope a_r of the IS equation is negative and the slope b_y of the Phillips curve is positive. These authors view these as minimal priors on the structure of the model that, in the event, facilitate the convergence of the numerical optimization during estimation. Moreover, this specification seems to be sufficient to characterize the cyclical episodes in the Macedonian economy based on the proposed model (empirical validation of this statement provides Figure 5 in the Appendix -- Output gap, HP filter vs HLW model estimate).

The empirical implementation of the HLW (2017) model proceeds in three steps.

Step 1: By omitting the interest rate gap from the IS equation and by assuming that the trend growth rate is constant, we estimate a simpler model to recover a measure of potential output. To help convergence in estimation, the model coefficients were initialized by their OLS estimates (or very close approximations of them) that incorporate the HP filter estimate for the output gap. To this end, the slope coefficient in the Phillips curve, which was initialized at 0.0025 implies a rather flat Phillips curve, (or inflation which is insensitive to the output gap). However, this is empirical factuality since it closely reflects the value of the slope coefficient from the auxiliary OLS estimate of the Phillips curve. The standard error of the innovation of the IS equation is assumed to be some very small number (i.e. it is initialized at 0.05). In parallel, the standard error of the innovation in the inflation equation reflects the one obtained by the corresponding OLS estimate. We compute the exponential Wald statistic of Andrews and Ploberger (1994) for a structural break with an unknown break date from the first difference of this preliminary estimate of the potential output to obtain the median unbiased estimate of λ_g.

Namely, the natural interest rate and trend growth rate are likely to be subject to the pile-up problem for non-stationary processes explained by Stock (1994). In most of the samples, variations of natural interest rate and trend growth rate representing the permanent components of the time series are likely to be very small relative to the large transitory components included in the series. Because of this, the MLE estimator of the standard deviations of their changes (innovations) will be biased toward zero. The problem is tackled by median unbiased estimation of coefficient variance/standard deviation in a time-varying parameter model (Stock and Watson 1998; Scheerová 2017). The values of the Exponential Wald statistic are compared with the table provided in Stock and Watson (1998), Table 3, and converted into the median unbiased signal-to-noise ratios λ_g using the table. The ratio is then simply plugged into the formulas provided by Stock and Watson:

$$\lambda_g = \frac{\sigma_g}{\sigma_{y*}} = \frac{sd(g_t)}{sd(y^*)}$$

as a relationship between the standard deviations of trend growth rate g_t and the potential output.

Step 2: The second step consists of imposing the estimated value of λ_g from the first step, followed by the inclusion of the real interest rate gap in the output gap equation under the assumption that z_t is constant. The real interest rate enters the model as an exogenous variable. Following HLW (2017), we construct it as the nominal interest rate net of a four-quarter moving average of past inflation. Admittedly, we use past inflation as a proxy for future (expected) inflation only as an initial assumption, which we relax in the other models that we construct. Namely, as we previously mentioned, our aim is in the first step to apply the seminal HLW model on Macedonian data, and then to continue with our benchmark model which includes forward-looking fully model-consistent expectations. This would help us understand how these different model assumptions may affect our conclusions. The slope coefficient a_r in the IS curve was initialized to -0.0025. We estimate the five model equations and apply the exponential Wald test for an intercept shift in the IS equation at an unknown date to obtain an estimate of λ_z.

λ_z gives us the second restriction that needs to be imposed on the general model:

$$\lambda_z = \frac{\sigma_z a_r}{\sigma_{\tilde{y}}\sqrt{2}} = \frac{sd(z_t)}{sd(\tilde{y})}$$

as a relationship between the standard deviations of z_t and the output gap. The equation differs from the one related to λ_g due to the following reasons. The term $\sqrt{2}$ is used since in the IS equation of the general model it is assumed that the output gap is influenced by two lags of the interest rate gap and the current interest rate gap is determined by the current z_t, as mentioned in the description of the variables in the general model. Such specification implies that the potential output is affected by $z_t(-1)$ and $z_t(-2)$ via the coefficient a_r.

Step 3: In the final stage of the estimation, the above-mentioned restrictions on variances are imposed on the whole system of all equations in the general model, and the Maximum Likelihood method is used to estimate its parameters. The estimated values of the slope parameters a_r and b_y remain close to -0.0025 and 0.0025, respectively, (i.e. they are only marginally lower than the above-mentioned initial values in absolute terms) and are not significant at any conventional significance level. The lack of significance in IS and Phillips curve slopes is one of the reasons why the estimates of the natural interest rate and the potential output are highly imprecise and barely identified. However, the precision of the HLW (2017) estimates dramatically falls when either the output gap is insensitive to the real interest rate gap (flat IS curve), or inflation is insensitive to the output gap (flat Phillips curve). In those cases, it is not possible to uniquely identify the unobserved growth and non-growth components of r^* from the data. Unfortunately, those two cases are empirically relevant according to a wide set of estimates reported in the existing literature (Fiorentini et al. 2018). Moreover, the variability of the natural interest rate components (trend growth rate and other factors) allowed in the model, or the value of initial parameters can also significantly alter the resulting estimates (Scheerová 2017). The associated uncertainty could prevent the straightforward use of the estimated natural interest rate in policy applications. As a result, policy decisions, should not take the HLW (2017) type of estimate of the natural interest rate for the Macedonian economy into much consideration. In other words, this estimate should be taken as indicative, and not as an incentive for a change in monetary policy.

Against this background, the natural rate of interest is a theoretically reasonable notion for assessing the monetary policy stance. Deriving the natural rate is another question, however. Given that it is an unobserved variable, it has to be extracted from data by imposing some identifying assumptions. To this end, the

actual estimate is almost fully based on the assumptions decided by the researcher and imposed on the data going into the economic model. In other words, there are a number of issues to be addressed by the estimation process. Estimation concerns are likely not induced by omitted variables exclusively, and the omitted equations might be an issue as well. Consequently, the estimated trajectory of the unobserved variables like equilibrium interest rate or trend growth rate can reflect movements of other macroeconomic variables influencing the economy, which were not embedded in the model, so the relations become spurious (Scheerová 2017).

In addition, Laubach and Williams model, but also many others, focusing on long-term developments are inherently prone to potential imprecision and poor reliability notably due to the presence of a large number of unobserved variables in them (Scheerová 2017).

Another potential source of the low robustness is a one-sided filtering technique for real-time estimates, in which the estimate at a defined point in time is based uniquely on the information available at that time. As a consequence, the one-sided estimates normally include much more noise (Scheerová 2017).

We believe those are the main limitations that one should take note of.

Against this background, policy inference did not take the time-varying estimates of the equilibrium interest rate into much consideration.

All this said, the HLW model serves as a starting point in our analysis since it is a seminal model used for estimating the natural rate of interest for many countries, the USA and the euro area included. In addition, it is considered simple, tractable, and rather easy to implement on a regular and more frequent basis. However, our main focus is put on the benchmark MAKPAM model that is used for comprehensive policy purposes. Namely, this core model addresses most of the disadvantages of the HLW model, most prominently, it has a much richer model structure able to capture more consistently the long-term factors affecting the natural interest rate, it incorporates forward-looking model-consistent expectations and is closed by a policy rule. For that reason, we analyze the results from the HLW model only in comparison with the benchmark MAKPAM results, to gain a broader understanding of the concept of natural interest rate, which as we stated earlier is a very elusive concept, sensitive to the chosen estimation methodology. In other words, we opt to be very prudent in our approach, to obtain the most robust results possible in order to understand how our conclusions might change. This commitment of ours is shown also by estimating a third model with forward-looking inflation expectations, but which is different in its structure from the other ones in that it considers another determinant of the natural rate of interest, which some authors argue that is relevant for small open economies, namely the real equilibrium exchange rate.

In what follows, we present the core and the additional small-scale model for the estimation of the natural interest rate and discuss the results.

4.2. A structural model of the Macedonian economy – modified MAKPAM model

As a benchmark, we utilize the Macedonian Policy Analysis Model[2] (MAKPAM) in order to quantify the natural rate of interest for the purpose of this research, in which the main modification that is made pertains precisely to the natural rate equation[3]. MAKPAM model is a structural, New Keynesian gap model, which can capture the broad macroeconomic relationships in the Macedonian economy, as a small open economy with a fixed exchange rate regime. It is a linear, calibrated model, in which all variables are in natural logarithms, expressed as percentage deviations from the trends. The trends (equilibria) and the deviations (gaps) are unobserved and the Kalman filtration is used for their identification. The model has three main building blocks: the real economy block, the price block, and the monetary policy and balance of payments block. A detailed explanation of the model is out of the scope of this paper. Instead, we focus only on the key model equations, determining the natural rate of interest. The main difference with the previously used identification methodology of HLW (2017) is that this model represents a structural economic model, which is important given that the whole model structure, not only the model equations that are used to identify the natural rate of interest, are being utilized to appropriately determine the rate. MAKPAM is also an open economy model, contrary to the HLW (2017) model. The model is also closed by an exchange regime-specific monetary policy rule and incorporates forward-looking model-consistent expectations, as opposed to the absence of policy rule and the moving average of past inflation used in the HLW (2017) model. In addition, calibration instead of Bayesian estimation is used to find the model parameters that enable the model to best fit the data, which is verified by both data filtration, impulse responses, and in-sample simulations. In what follows, the main model equations are presented.

According to the Fisher equation, the real interest rate (R) is the difference between theP nominal interest rate (I) and model consistent expected inflation (π_{exp}):

$$R_t = I_t - \pi_{exp}$$

The real interest rate is then decomposed into the natural rate and the gap. The interest rate gap is defined as:

$$R_{gap,t} = R_t - R_{eq,t}$$

It is a function of the real interest rate R_t and the natural interest rate $R_{eq,t}$.

In line with Laubach and Williams (2003) and Holston, Laubach, and Williams (2017), we assume that the natural rate of interest is determined by the annual growth rate of the potential GDP $\Delta 4Y_{eq,t}$ and a time-varying unobserved component z_t:

$$R_{eq,t} = \delta R_{eq,t-1} + (1-\delta)\Delta 4Y_{eq,t} + z_t$$

However, it should be noted that unlike LW (2003) and HLW (2017), we have also introduced some persistence in the natural rate equation.

Everything that affects potential growth, such as investment, labor supply, or government shocks, will proportionately affect the natural rate of interest. In the model, the growth of potential GDP is a weighted sum of the equilibrium growth rates of private consumption, government consumption, investment, exports, and imports, which in turn are modeled as an AR(1) process of the following functional form:

$$\Delta C_t^{eq} = \vartheta \Delta C_{t-1}^{eq} + (1-\vartheta)\Delta C_{ss}^{eq} + \varepsilon_t^{\Delta Ceq}$$

The natural rate is also assumed to be affected by transitory shocks through the auto-regressive process z_t, which represents all the other determinants mentioned before which are not directly linked to domestic potential growth:

$$z_t = \mu z_{t-1} + \varepsilon_t^z$$

As a result, the natural interest rate should fluctuate over time with changes in its long-term fundamentals.

It should be pointed out that any equation in the model that includes either the natural interest rate or the real rate is used as a cross-restriction for its identification (Hlédik and Vlček 2018). The first such restriction comes from the real economy block (output gap). However, the output gap is highly disaggregated in the model, meaning that it is a weighted sum of the gaps of private consumption, government consumption, investment, exports, and imports. Thus, the equations directly relevant for the natural interest rate identification are only the ones for the private consumption gap and investment gap:

$$C_{gap,t} = \alpha_0 C_{gap,t-1} + \alpha_1 R_{gap,t-1} + \alpha_2 RDI_{t-1} + \varepsilon_t^C$$

The private consumption gap $C_{gap,t}$ is a function of its lag, lagged real interest rate gap $R_{gap,t-1}$ and lagged real disposable income gap RDI_{t-1}, where the latter is a sum of the real wage bill, real pensions, and real private transfers gaps, all modeled with separate behavioral equations.

$$J_{gap,t} = \beta_0 J_{gap,t-1} + \beta_1 R_{gap,t-1} + \beta_2 X_{gap,t-1} + \beta_3 FDI_{gap,t-1} + \beta_4 YF_{gap,t-1} + \varepsilon_t^J$$

The real investment gap $J_{gap,t}$ is a function of its lag, lagged real interest rate gap, lagged exports gap $X_{gap,t-1}$, lagged FDI gap $FDI_{gap,t-1}$ and lagged foreign effective demand gap $YF_{gap,t-1}$.

Another restriction is the equation for the private transfers, as a specific factor for the Macedonian economy.

$$PT_{gap,t} = \gamma_0 PT_{gap,t-1} + \gamma_1 R_{gap,t-1} + \gamma_2 DD_{gap,t-1} + \gamma_3(\pi_{\Delta 4,t-1} - \pi_{ss}) + \varepsilon_t^{PT}$$

The real private transfers gap $PT_{gap,t}$ is a function of its lag, lagged real interest rate gap, lagged domestic demand gap $DD_{gap,t-1}$ and the deviation of the inflation from the steady state $(\pi_{\Delta 4,t-1} - \pi_{ss})$. This equation also enters into the monetary policy rule, which differs from the usual Taylor-type policy rule (in which the natural rate enters directly). Instead of the Taylor rule, we use an arbitrage condition stating that domestic and foreign interest rates can differ only if the risk premium is different from zero. In other words, the policy rate is a function only of the foreign interest rate i_t^* and the risk premium $prem_t$, and the latter depends, among the other, on the private transfers as one of the components (together with net export and FDI) that determine the foreign reserves flow gap $flow_{gap,t}$. Thus, this equation is especially important, since it allows the monetary policy rule to serve as an indirect restriction for the natural rate of interest.

$$i_t = i_t^* + prem_t + \varepsilon_t^i$$

$$prem_t = -\tau_1(flow\_gap_t + flow\_gap_{t+1} + flow\_gap_{t+2} + flow\_gap_{t+3})/4$$

$$flow_{gap,t} = f(NX_{gap,t}, FDI_{gap,t}, PT_{gap,t})$$

The price block consists of an aggregated New Keynesian Phillips curve (without the administered prices component):

$$\pi_t = \omega_1 \pi_{t+1} + (1-\omega_1)\pi_{t-1} + (1 - MC_{Ss})\left(\omega_2 Y_{gap} + \omega_3 MC_{Ss} Q_{gap,t}\right) + \varepsilon_t^{\pi}$$

According to this equation, consumer price inflation π_t is a linear combination of one-quarter ahead inflation, one-quarter lagged inflation, the output gap Y_{gap} and the real exchange rate gap $Q_{gap,t}$. Total inflation is then simply obtained by adding the administered prices component. The output gap captures the domestic price pressures, whereas the real exchange rate captures the import price pressures. Its depreciation (appreciation) translates into higher (lower) domestic inflation, due to the rise (decline) of the price of imported factors of production.

The exchange rate channel is included to capture the fact that the Macedonian economy is a small and open economy. The real exchange rate Q_t is defined as:

$$Q_t = e_t - p_t + p_t^f$$

where e_t is the nominal exchange rate, p_t is the domestic price level, and p_t^f is the foreign price level. The real exchange rate gap then is:

$$Q_{gap,t} = Q_t - Q_{eq,t}$$

Besides the import price pressures, it also captures the effects on the output gap from its impact on exports, which is a standard transmission mechanism in small and open economies. $Q_{eq,t}$ is the equilibrium price level, governed as:

$$\Delta Q_t^{eq} = \varphi \Delta Q_{t-1}^{eq} + (1-\varphi)\Delta Q_{ss}^{eq} + \varepsilon_t^{\Delta Qeq}$$

4.3. Empirical results

This section first discusses the results for the natural rate of interest, as identified with the benchmark MAKPAM model, and then compares them with the estimates from the Holston, Laubach, and Williams (2017) model. In addition, within the section we focus on the MAKPAM results in order to analyze the monetary policy stance as well as to compare the Macedonian natural interest rate with the one of the euro area.

4.3.1. Estimates of the natural rate of interest

The results from the modified MAKPAM model are reasonable, suggesting that the natural rate of interest moves in tandem with the real interest rate, both of which follow downward dynamics. They suggest that on average, the level of the natural rate of interest was 3.5% in the period 2002Q1-2019Q3, slightly above the average real interest rate. However, two different phases can be detected in the dynamics of the natural rate in the analyzed period (Figure 3). First, prior to the global economic crisis, the natural rate was higher, hovering around 5%. During this period, the Macedonian economy experienced high growth of potential GDP, which thus had the highest contribution to the rate (Figure 4). However, since the onset of the global crisis, the natural rate of interest started declining (from 2008Q4 onwards), driven mainly by the deceleration of the potential GDP growth. In the after-crisis period, the natural rate of interest nearly halved, amounting to 2.4%, which is lower than the historical average by around 1 percentage point. However, there are positive signs that the natural rate of interest is again on the way up at the end of the estimation period, which leaves space for the monetary policy to efficiently create a negative real interest rate gap to stimulate the economy if needed, even in the case of low or slightly negative inflation. For the overall period, we find that potential growth has a downward sloping trend, which explains the decline in the natural rate of interest, while the component z is more stable (Figure 1 in the Appendix). It is also evident that the natural rate displays certain volatility, an observation that is again consistent with the high variability of potential growth of Macedonian GDP. However, it should be pointed out that this volatility decreased in the period after the global crisis (by around 15%), in line with the reduction of the volatility of potential growth. Here, one peculiarity of Macedonian data should be noted, and that is the unusually high volatility of the Macedonian GDP series published by the official statistics, which in turn translates into volatile estimates of the potential GDP and hence the natural interest rate, as previously mentioned. Similarly to Brzoza-Brzezina (2003), we also find evidence that the natural rate is, in general, a pro-cyclical variable – with a few exceptions (such as the last period) its level is increasing in expansionary times and decreases in recessionary times (Figure 2 in the Appendix).

Figure 3. Natural interest rate and real interest rate from MAKPAM, in %

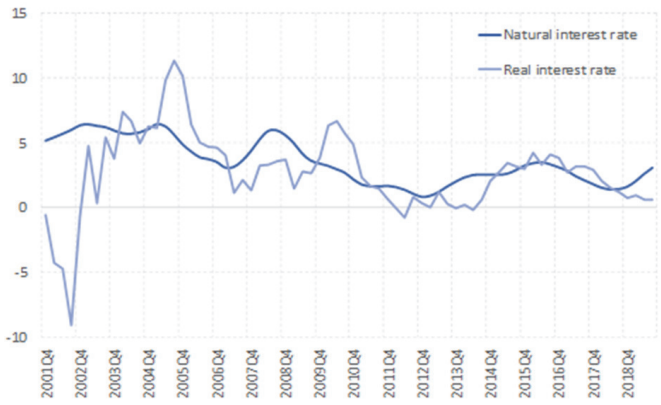
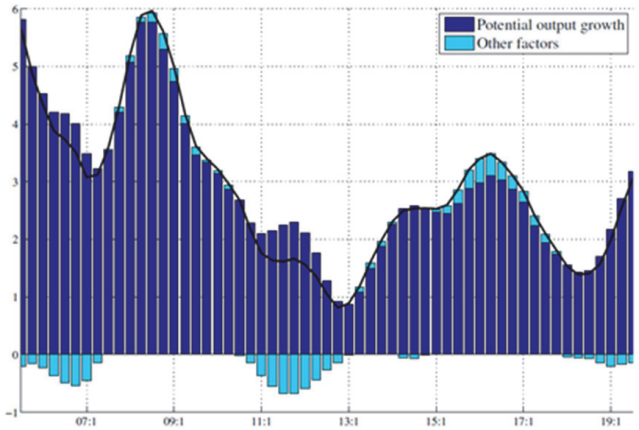


Figure 4. Natural interest rate and decomposition (MAKPAM)



The comparison with the estimates from the HLW (2017) model (Figure 6) shows that the natural rate of interest follows very similar dynamics in the two models and has a similar cyclical nature. Similarly to the MAKPAM estimates, the HLW natural rate of interest estimate peaked prior to the global financial crisis, i.e. in 2007-2008, and turned sharply lower afterward. In fact, the post-crisis averages of the natural rate are identical according to both the MAKPAM and the HLW (2017) model (2.4%). However, analyzed on average for the 2006-2019 period, the HLW estimate is higher by 0.5 percentage points than the MAKPAM estimate (3.3% according to the HLW model and 2.8% according to the MAKPAM model). Moreover, three different periods can be observed in which the two estimates differ. First, up until the second half of 2011 (prior to the European debt crisis and the global economic crisis) the level of the natural rate of interest based on the HLW (2017) methodology tends to be above the MAKPAM estimate in a systematic way. Second, the HLW model points to a lower natural rate of interest for the 2011Q3–2017Q2 period. During the European debt crisis, the HLW estimate of the natural interest rate even enters into negative territory (from mid-2012 until mid-2013). Third, the HLW estimate is again somewhat above the MAKPAM estimate from 2017Q3 onwards. Another difference is that the natural rate of interest estimated from the HLW model is more volatile compared to the MAKPAM estimate.

Figure 5. Natural interest rate and real interest rate from HLW (2017), in %

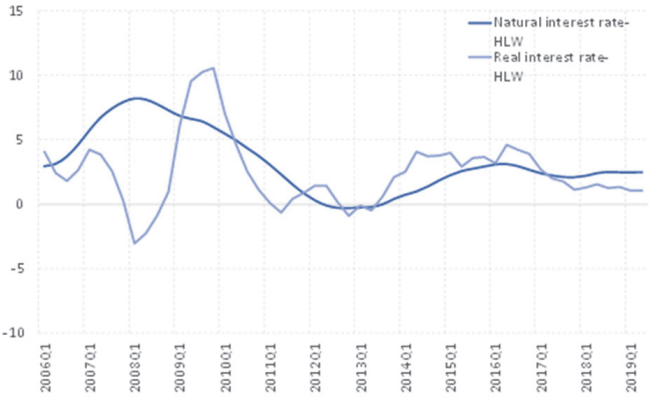
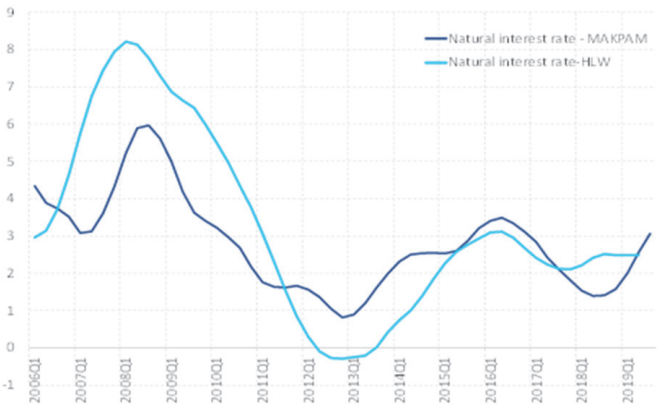


Figure 6. Comparison of the two estimates

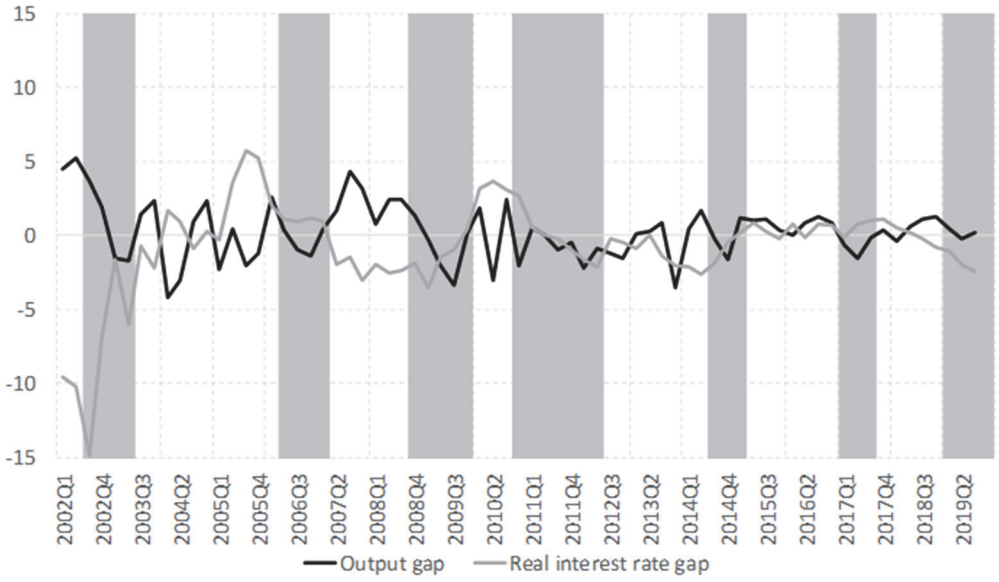


4.3.2. Assessment of the monetary policy stance and comparison of the Macedonian and the euro area interest rate using the MAKPAM model

In the following subsection, we proceed by analyzing the monetary policy stance using the benchmark MAKPAM model estimates and we provide a comparison with the euro area natural interest rate.

It is well known that our focus should not be only on the level of the natural rate of interest per se, but also on the difference between the real rate and the natural rate (the gap) since the latter is indicative of the stance of monetary policy and its implications for the domestic economy. For example, if the central bank intends to stimulate the economy, not only it should lower the interest rate, but it should also bring it below the natural rate of interest and produce a negative real interest rate gap. This will allow the actual output to grow at a faster rate than the potential output so that eventually the discrepancy between the two would be closed. It can be seen from Figure 7 that during the analyzed period, the gap between the real interest rate and the natural rate had divergent effects on the domestic economy and that in general, when the real rate gap was negative, the output gap tended to increase, and vice versa. Namely, from 2004 until the beginning of 2007, when the Macedonian economy experienced high GDP growth, the real interest rate gap was positive, so the real interest rate did not contribute to further fueling this growth. Conversely, the results suggest that in the period just before and during the global economic crisis as well as in the period during the Greek debt crisis, the real interest rate was supportive of the real economy. On the other hand, in 2010-2011, we again observe a tightening of the monetary policy conditions through the real interest rate. From 2016 to 2018, the real interest rate gap was relatively small, and the real interest rate was hovering near the natural rate. However, we observe that at the end of our sample, the level of the real interest rate falls again below the natural rate, thus pointing to accommodative monetary policy conditions in the recent period. These conclusions broadly hold also according to the HLW (2017) model results. This accommodative stance of the monetary policy has been reasonable, given that according to the estimated data for GDP in the first three quarters of 2019, the Macedonian economy was in the recessionary phase of the cycle, and there were no inflationary pressures from the demand side (Figure 7)[2]. It should be noted that for the purpose of identifying whether the economy is in an expansionary or recessionary phase of the business cycle in this paper, we use the BBQ algorithm for detection of cyclical turning points, developed by Harding and Pagan (2002). A detailed explanation of this method is out of the scope of the paper and can be found in Miteski and Georgievska (2016) instead. On the other hand, if we analyze the movements of the output gap in this period as a more simplistic way of looking at the cycle, it can be seen in Figure 7 that it gravitates around zero in the recent sample period, indicating no substantial expansions or contractions of the economy.

Figure 7. Output gap, real interest rate gap, and the phase of the economy (MAKPAM)



*Shaded areas depict recessionary phases, determined with the turning point methodology of Harding and Pagan (2002).

Figure 8. Comparison of Macedonian and euro area natural rate of interest

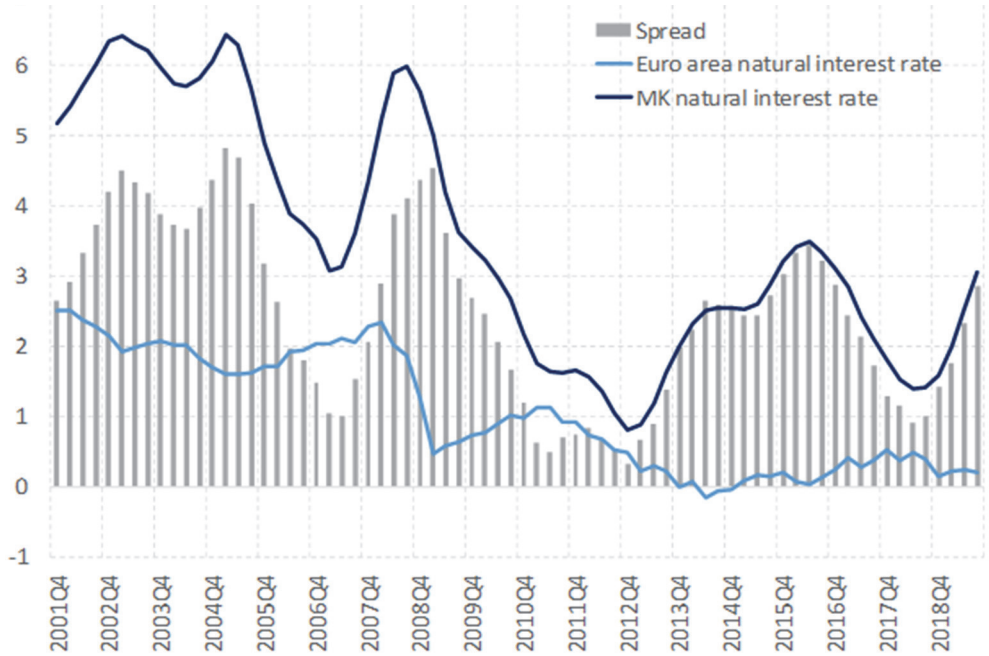


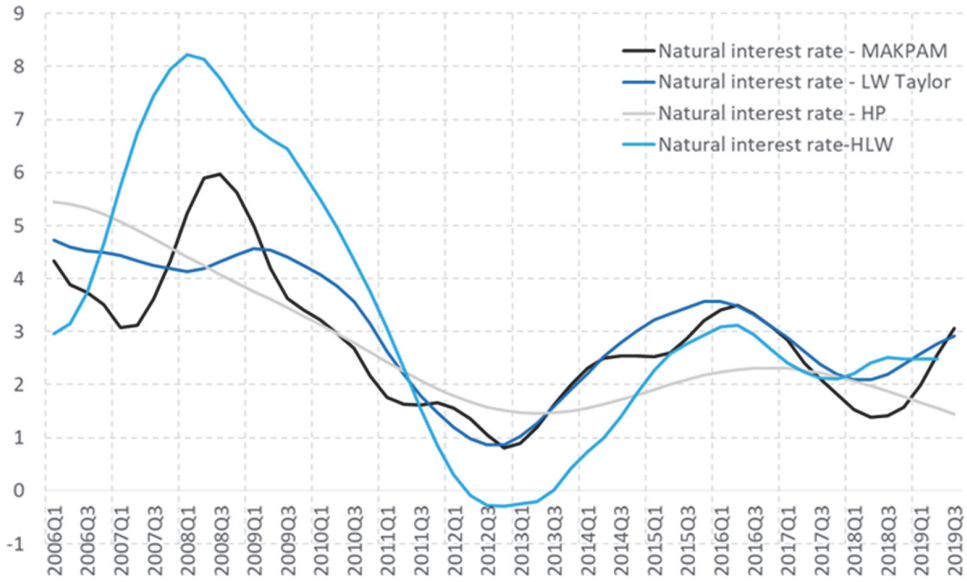
Figure 8 shows a comparison between the Macedonian and the euro area natural rates of interest. It can be seen that the Macedonian natural rate of interest follows a similar downward trend as the euro area natural rate of interest[3], although the level is expectedly higher. The average difference between the two natural rates of interest is 2.5 percentage points[4] for the whole period. Although, it is evident that the differential has narrowed in the period after the global economic crisis (by around 1 percentage point) as compared to the before-crisis period[5], which seems to be consistent with the narrowed potential growth differential between the two countries. The similar movements of the euro area and Macedonian natural interest rates imply that developments in the euro area, which are modeled through the inclusion of the foreign effective demand indicator[6], may also play a role in the dynamics of the Macedonian natural rate of interest, besides the domestic factors, although the latter appears to have the predominant role.

5. Additional specifications

In this section, we provide a comparison of the previous estimates of the natural rate with the ones from some alternative specifications[7].

Hlédik and Vlček (2018) argue that the natural rate of interest in a small open economy that follows a path of convergence to the more advanced economies is a function of the potential GDP growth adjusted for the appreciation of the real equilibrium exchange rate. We follow their logic and develop a similar model for the Macedonian economy with forward-looking inflation expectations, which is also closed by a Taylor-type monetary policy rule, unlike the MAKPAM model. As can be seen from Figure 9, these results are similar to the MAKPAM and HLW estimates, especially in the period after the European debt crisis. Additionally, we compare the estimates from the models with the results from the univariate HP filter. In this case, the natural interest rate identified with the economic models deviates from the HP estimate and the difference is more pronounced at the end of the sample (the well-known end-point bias). Namely, we observe that the HP estimate is biased in the direction of the recent movements of the actual interest rate, which is not the case with the economic models. However, the HP estimates are not seen to be very in line with the theoretical concept of natural interest rate and should serve only as an indication.

Figure 9. Comparison of natural interest rates obtained by different models



6. Conclusion

The main goal of this paper was to quantitatively estimate the level of the natural rate of interest in the Macedonian economy, which is a significant yet underexplored issue. This issue is important since it allows central banks to assess their monetary policy stance at any given time and hence make appropriate monetary policy decisions. Yet, any attempt to model the natural rate of interest is challenging, especially in an economy such as the Macedonian, due to the highly volatile macroeconomic series. To the best of our knowledge, this paper is the first to estimate the natural rate for the Macedonian economy. To this end, the estimation was made using different models, such as the Holston, Laubach, and Williams (2017) model and the full-fledged country-specific structural MAKPAM model. We identify the natural rate of interest by assuming that its dynamics depends on the movement of the potential GDP growth over time, as well as on other determinants generally captured by a random process. In the Holston, Laubach, and Williams models that we develop, we use two equations (IS curve and Phillips curve) to identify the natural rate of interest. In an alternative specification we include the real equilibrium exchange rate as a determinant of the natural interest rate and we add a Taylor-type monetary policy rule, among the other changes, whereas within the MAKPAM model the entire model structure, not only the several cross-restriction equations were used to estimate this unobserved variable, simultaneously with many other variables. Despite the substantial differences in model specification, the key finding from the models is in essence very similar and indicate that the natural rate of interest in the Macedonian economy has declined over time. Namely, it is evident from the results that the natural rate of interest in the recent period fluctuates around a new, lower level than before the global crisis. This finding is in line with other recent international empirical studies (see for example, Rachel and Smith 2015; Holston, Laubach, and Williams 2017), which also find evidence of a large decline in the natural rate of interest since the onset of the global economic crisis. In addition, the results show that the natural rate of interest follows very similar dynamics in all of the models and has a similar cyclical nature. The main difference in the results is that, on average, the level of the natural rate of interest based on the HLW (2017) methodology is somewhat higher and more volatile than the MAKPAM estimates. However, both results point to accommodative monetary policy conditions in the Macedonian economy in the recent period. The decomposition using the MAKPAM model shows that over the estimated period, the dynamics of the natural rate was predominantly determined by the decline of the Macedonian potential output growth, with other factors, such as household preferences, also being at work but without a major role. From the aspect of robustness, the results of the other alternative models are also very comparable and confirm the main findings of the study. Overall, these findings provide useful insights into the natural rate of interest dynamics, which can provide guidance to Macedonian policymakers about the appropriate changes in monetary policy implementation.

Endnotes

1 Since January 2002 the National Bank has been implementing monetary strategy of fixed nominal exchange rate of the Denar against the Euro.

2 This figure also shows that the calibration of the model satisfies the cyclical profile of the Macedonian economy, i.e. that recessions are set out fairly accurately (also separately shown in Figure 3 in the Appendix). The path of other key unobservable variables that are jointly determined seems to be reasonable as well (not presented here for the sake of brevity).

3 The estimated natural interest rates for the euro area can be downloaded from the website of Federal Reserve Bank of NewYork: https://www.newyorkfed.org/research/policy/rstar. It also includes interest rates for USA, Canada and the United Kingdom.

4 The average difference between the HLW estimates of the Macedonian natural rate and the euro area natural rate is also 2.5%.

5 The spread before the crisis was 3.3 p.p., whereas after the crisis it was 1.9 p.p.

6 Foreign effective demand is calculated as the weighted sum of GDPs of the most important trading partners for the Macedonian economy. 70% of the countries included are members of the euro area.

7 For the sake of brevity, we do not present these specifications in the paper.

8 A detailed description of an earlier version of the model can be found in Hlédik et al. (2016).

9 In the original MAKPAM model the equilibrium interest rate is modeled as an exogenous AR process.

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APPENDIX

Figure 1. Natural rate of interest and potential growth (left panel), and component z (right panel) estimated with the MAKPAM model

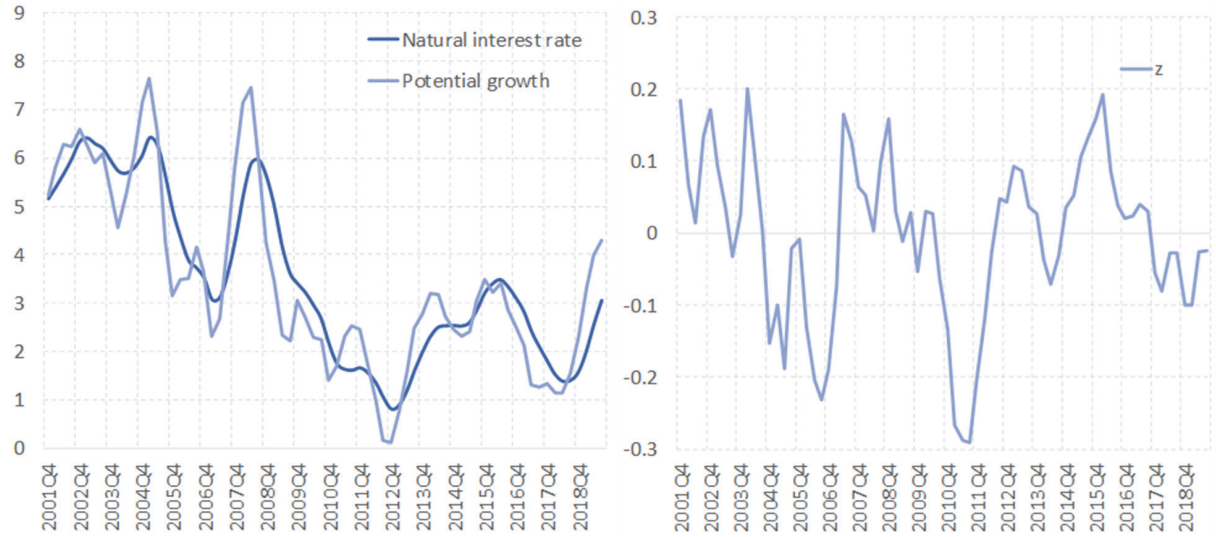
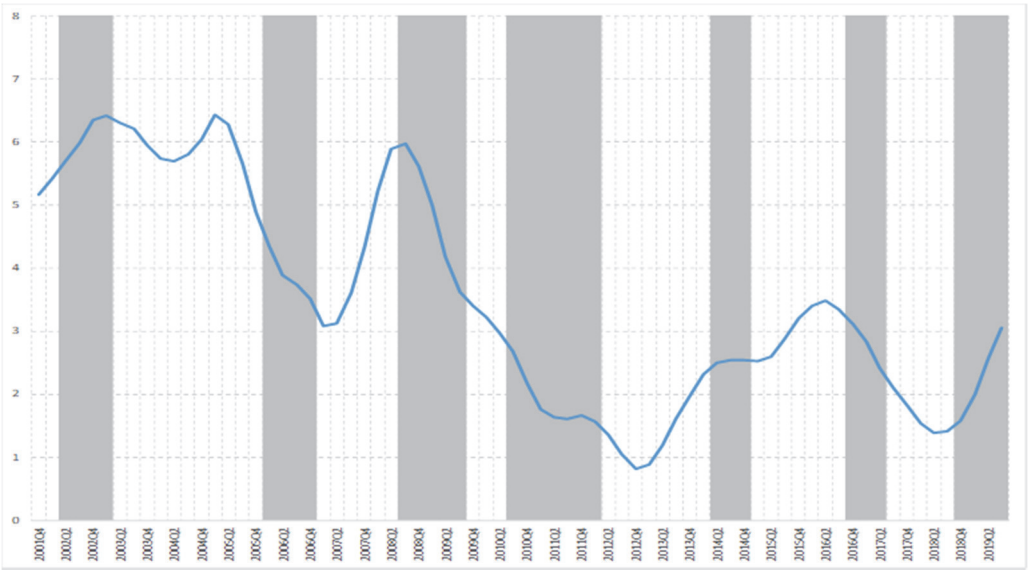
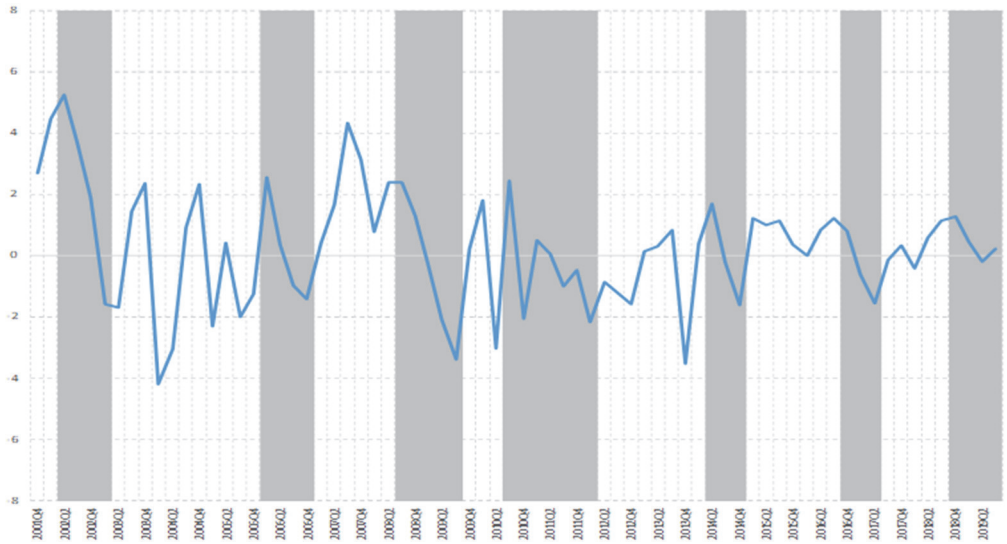


Figure 2. Estimate of the natWural rate of interest using the MAKPAM model



*Recessionary phases are determined with the turning point methodology of Harding and Pagan (2002).

Figure 3. Estimate of output gap using the MAKPAM model



*Recessionary phases are determined with the turning point methodology of Harding and Pagan (2002).

Figure 4. Natural rate of interest and potential output growth estimated with the HLW (2017) model

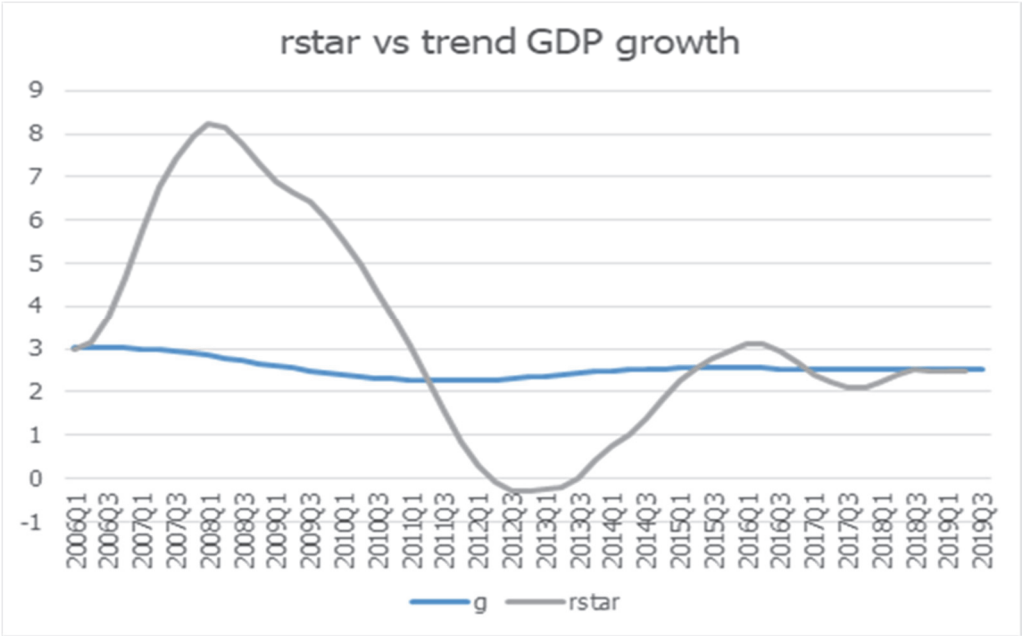
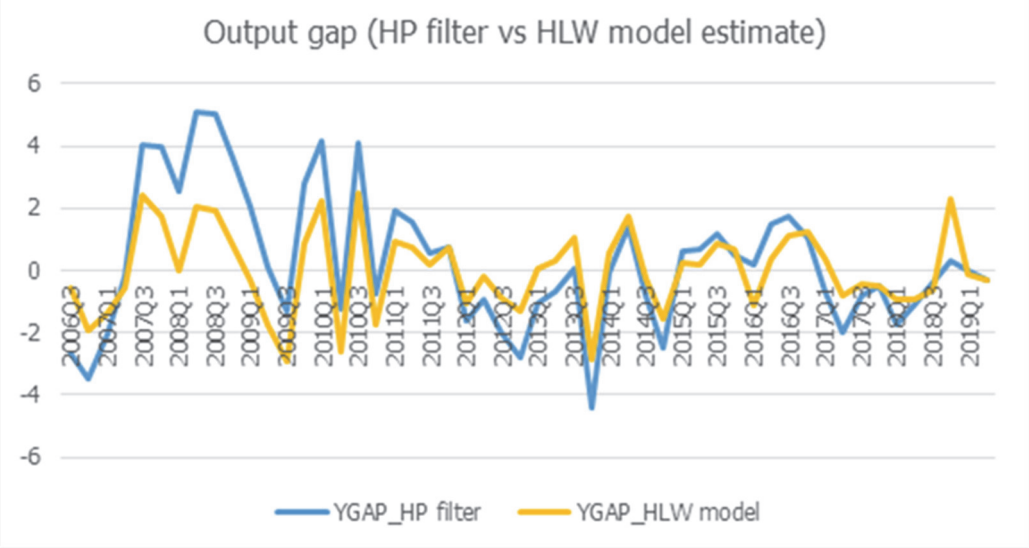


Figure 5. Estimates of output gap using the HLW (2017) model



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ECONOMIC CONSEQUENCES OF THE COST OF GOVERNMENT BORROWING IN EUROPEAN TRANSITION ECONOMIES

Berat Havolli

Abstract

Given the need of transition economies to fund the investments necessary for development partly through borrowing, this paper investigates empirically the economic consequences of the government cost of borrowing for European transition economies during the period 2003-2016. The investigation analyses the impact of sovereign borrowing costs, in turn, on interest rates on loans to businesses and households, on the growth rates of investment and consumption, and, ultimately, on general economic activity. By utilizing a panel VAR technique our results indicate that consequent upon a positive shock to the cost of sovereign borrowing, the cost of borrowing for loans to both Non-Financial Corporations (NFCs) and households increases. We find that the price transmission from government borrowing costs to the private sector is at play with respect not only to borrowing rates but also to macroeconomic activity at large. Following an increase in sovereign borrowing costs, we observe substantial negative responses in the growth rates of investment, household consumption, and GDP growth. Also, while a price of borrowing increase for NFCs is found to negatively affect investment, household consumption is unaffected by an increase in household borrowing rates. These findings have valuable policy implications for policymakers and stakeholders in transition economies. Specifically, the results suggest that efforts to reduce the cost of sovereign borrowing could have a positive impact on the economy by lowering borrowing costs for households and businesses, promoting investment and consumption, and ultimately boosting economic growth.

Keywords: *Government bonds, risk transmission, lending rates, sovereign debt.*

JEL classification: *C32, C33, E43, E52, G21*

1. Introduction

In recent years, public finances and their nexus with other sectors of the economy have undergone thorough scrutiny in both policies as well as academic discussions. This increased interest in government fiscal stance and its long- and short-term sustainability was motivated by at least two major moments that characterized the recent period. First, the recent global financial crisis and the following European sovereign debt crisis transmitted negative effects through multiple channels simultaneously onto the economy. And secondly, the discussion around the most effective public policy response to the deteriorating output, increasing unemployment rates, weaker financial system, and, ultimately, the decline in living standards as

Berat Havolli, PhD
Independent Researcher
Str. Shpetim Robaj, Nr. 192
10000 Prishtina, Kosovo
E-mail: berat.havolli@gmail.com
ORCID ID No: 0000-0002-5530-7574

a consequence of the financial and sovereign debt crisis (Neri and Ropele 2015).

As the crisis unfolded, especially the European sovereign debt crisis, divergence emerged at the EU country level and also the regional level with regard to the dynamics of key fiscal and macroeconomic indicators (Eller and Reininger 2016). Given the differences among countries in Europe in their fiscal and macroeconomic developments, significant differences were also observed with regard to sovereign bond yields, this coming after a slow convergence that was observed in the run-up to the crisis period. The deteriorated macroeconomic environment and the induced pressures on the public finances, together with the rise in the public cost of borrowing in the countries of the less-developed European "periphery" (including those in "transition"), increased even further the stock of public debt, which consequently gave rise to uncertainties with regards to government creditworthiness and the associated sovereign credit risks. The increased uncertainties regarding sovereign credit risk during the crisis periods adversely affected banks' funding conditions to a level close to the deterioration of the creditworthiness of the sovereign (CGFS 2011).

With these macroeconomic and fiscal developments at play affecting sovereign creditworthiness with potential adverse spillover effects to the financial sector, divergence in the lending conditions to firms and households for investments and consumption in European countries emerged as well (Neri and Ropele 2015; Del Giovane et al. 2013). In addition to the monetary policy rates impacting the lending rates, these fluctuations in lending rates were to a large extent ascribed to changes in government creditworthiness (Eller and Reininger 2016). Given these fluctuations in the lending rates and the importance of external financing for the non-financial sector, the public policy debate renewed its attention to the determinants of lending rates and the channels of stress transmission from the government to the private sector (Altavilla et al. 2022; Eller and Reininger 2016; Neri 2013).

In light of these developments, the aim of this paper is to empirically investigate the impact of government cost of borrowing on the private sector borrowing rates and its impact on the general economic activity of the European transition economies. By focusing on European transition economies – as a set of countries that are different from emerging economies – this paper brings evidence from a largely neglected set of countries in the literature.

The remainder of the paper is organized as follows. In the following section (2), we review the literature by focusing on the risk transmission channels through which sovereign creditworthiness is expected to affect bank funding conditions and possible reflection in private lending rates. In Section 3 we present the methodology and data. Estimated results are presented in Section 4 and Section 5 presents conclusions.

2. Literature Review

Several channels have been proposed by the literature through which governments – via policies or via unintended spillovers from their actions – affect the interest rates on lending to the private sector. These literature suggestions can be classified into two main pillars. First is the traditional thesis that argues in the context of the monetary transmission mechanism, and highlights the effects of changes in the key policy rate on the money market and their effect on lending rates to the private sector. In the context of the monetary transmission mechanism, the credit channel thesis is proposed – which is decomposed into the balance sheet channel and the bank lending channel – that considers the implications of monetary policy shifts on the balance sheets of firms and the balance sheets of banks as providers of financing. And, secondly, a more recent and narrow view focuses on the influence of sovereign creditworthiness on bank funding conditions and lending rates via the possible deterioration of, among others, asset holdings, collateral values, and ratings by rating agencies. Our interest and focus in what follows and the upcoming empirical specifications is positioned in the second strand of the literature that considers the spillover risks from government risk, particularly from the government cost of borrowing to private sector lending rates.

The report from the Bank for International Settlements (CGFS 2011) gives a review, albeit relatively brief, on the potential channels of transmission of government stress to the private borrowing conditions. According to this report, there are at least four possible specific channels of transmission of stress from the sovereign to the financial sector that has the potential to result in higher interest rates and/or lower quantitates of loans supplied to the private sector. The first potential channel is via the asset side of banks. Due to holdings of government debt on the asset side of the banks, deteriorated sovereign creditworthiness, devalues sovereign assets, weakens the balance sheets of banks, and, therefore, has a negative impact on the cost of funding and the ability of banks to secure liquidity. Secondly, as government debt is used by banks as collateral in their interbank lending, a reduction in the value of government securities due to an increase in sovereign risk lowers the banks' funding capacity. The third channel is via the credit

ratings undertaken by credit rating agencies (e.g. S&P, Moody's, and Fitch). In the event of a downgraded rating for the sovereign resulting from an increase in credit risk, the rating of banks in the downgraded country is expected to face a similarly downgraded scoring as well. And, finally, with the increase in sovereign risk, the ability to provide an implicit and explicit guarantee by the government for banks is reduced, which in turn increases banks' funding costs.

In addition to the above four specific channels through which government risk has the potential to influence the banking sector and, therefore, the cost and quantity of private borrowing, there is also a possibility of influence via the general economic activity channel. An increase in sovereign risk could result also in a general economic recession, which in turn may result in an increase in private sector borrowers' riskiness and also may lead to the deterioration of banks' funding costs. Irrespective of the banks' exposure to the government debt, this may result in credit tightening to the private sector either through an increase in interest rates and/or lowering of the number of loans as a result of increased business environment risks for banks and also the increasing risks of business operating in the downgraded economy (BCBS 2017).

Considering the influence of the sovereign debt issuance from peripheral EU countries on the stock market performance of 65 European banks, Angeloni and Wolff (2012) find some evidence of a negative influence from deteriorated sovereign creditworthiness on the banks' market valuation (asset holding channel). Nevertheless, the authors point out also that the financial performance of banks cannot be ascribed to the bank's portfolio composition only, hence, sovereign exposure, but other factors determine the overall market value of the banks such as the location of the banks. In a somewhat similar line of investigation, De Bruyckere et al. (2012) use a longer time dimension that covers also the period of the financial crisis (2006-2011) for more than 50 banks in 16 European countries. The focus of their study is on the risk spill-over between sovereign and banks. Moreover, they also shed light on the determinants of risk spill-over between the sovereign and the banking sectors; more specifically, they explore the differences in the risk spill-over based on the characteristics of the sovereigns and the banks in their sample. In this consideration, their findings suggest that contagion (or excess correlation) between sovereigns and banks has increased in recent years and that this increased correlation is more visible during the global financial crisis and the European sovereign debt crisis. Their results support the asset holding channel by suggesting that the contagion and therefore the risk transmission is greater in countries that have a higher share of domestic debt held in banks' portfolios. In addition, their results also indicate that bank size matters, in that the larger the banks are in a specific country, the higher the contagion between the sovereign and banks. Given the positive results with respect to the bank size variable, the authors further suggest that this positive result represents evidence for the existence of the government guarantee risk transmission channel, by noting that the larger the banks in a particular country the higher the pressures are for a bail-out from the public sector in times of financial distress. As in the case of Angeloni and Wolff (2012), also De Bruyckere et al. (2012) find evidence of home-biased holdings of sovereign security by banks.

Altavilla et al. (2020) utilize OLS estimation to investigate the determinants of banks' exposure to government debt and the effects on the bank lending activities of the banks located in the euro area. Their results confirm the findings of several previous studies with similar interest by showing that domestic banks, publicly-owned banks, and recently bailed-out banks have a higher likelihood of holding government bonds as compared to other banks. Moreover, in addressing the effects of sovereign debt exposure on bank lending activities, the study finds that an increase in government bond yields (10-year and 5-year maturity) would lead to a decline in the quantity of lending to the private sector by banks that are more exposed to sovereign debt. Conversely, these reactions to the sovereign bond yield movements are not present when foreign-owned banks are considered. In addition to the quantity of loans, also interest rates on loans charged to non-financial corporations tend to increase in the event of deterioration in sovereign creditworthiness (as measured by government bond yields). The changes in interest rates, similar to the changes in the quantity of loans, are more visible for those banks that have higher exposure to public debt. Given these results, the authors indicate the existence of the asset holding channel and the collateral channel as risk transmission mechanisms.

In a recent study, Bouis (2019) suggest different reasoning for the negative relationship between banks' holdings of domestic government debt and credit growth to the private sector. Differently from Altavilla et al. (2020), Bouis (2019) uses macroeconomic-level data as compared to the bank-level data used in most studies with a similar aim. In unbalanced panel data from around 80 countries in emerging markets and developing economies covering the period 2001 to 2016, the evidence of the fall in loans extended to the private sector, especially in stressed times, is ascribed to the banks' portfolio rebalancing strategy and

"run to safety" operations rather than as an outcome of adverse effects on the increase in banks' cost of financing.

Differentially from Altavilla et al. (2020), Williams et al. (2015) argue for a relatively modest role of the collateral and government guarantees channels in risk transmission from the sovereign to the banking sector. In a sample of 19 emerging market economies with 277 banks and using fixed effects estimation, the authors argue for the strong impact of the credit rating channel as the risk transmission mechanism. According to their findings, both positive and negative rating changes by credit rating agencies for a particular sovereign have an impact on the banks' market valuations (share prices of banks residing in the rated country). Thus, downgraded sovereign creditworthiness influences negatively the banks' market valuations.

The effects of government risk and sovereign defaults on banks' balance sheets have been further explored in a study by Gennaioli et al. (2014). Employing OLS estimation, their study takes into consideration a large number of countries in emerging and developing countries across a relatively long time dimension (1980-2005). According to their results, sovereign default is shown to be followed by a banking crisis in the majority of countries in their sample, hence, reinforcing the argument for a sovereign and banking sector nexus. Moreover, in the event of sovereign default, credit activities are more disrupted for banks that hold more public debt as compared with other banks and these credit disruptions are more pronounced in countries with more developed financial institutions. The reasons for the latter point are due to more engagement in financial intermediation, with the private sector as well as the public sector, of the banking sector in more developed financial markets. These conclusions indicate that the asset holding channel and possibly the collateral channel are at work in sovereign risk transmission to the banking sector and, ultimately, to real economic activity.

In addition to the above empirical studies that provide evidence for the various links between the sovereign and the banking sector (via influences on the bank's cost of borrowing), another avenue of research focuses on the effects of sovereign creditworthiness – as expressed by the sovereign bond yields – on banks' lending activities. This strand of research, which includes the sovereign bond yields in the empirical specifications, has gained interest only more recently and has yet to gain appropriate empirical attention (Eller and Reininger 2016). From the current empirical work, there are a few papers that focus on Italian banks, while there are still only very few papers with a cross-country dimension. From the limited studies with a cross-country dimension, the focus is on the EU advanced economies, while there are no systematic studies that include less advanced transition economies.

In the context of Italian banks, by employing a VAR estimation method, Zoli (2013) investigates the determinants of Italian government bond spreads and the pass-through of sovereign spreads to the Italian banks' bond yields, interest rates on lending to the private sector, and lending growth rates. The results indicate that an increase in the sovereign bond spreads influences positively the CDS spreads (a proxy for banks' risks) as well as the bond yields of the five largest banks in Italy. This influence is found to be larger for banks with weaker fundamentals, such as lower capital ratios and higher non-performing loans. Furthermore, as for the impact of sovereign bond spreads on firm lending rates, their results suggest a fast pass-through of government higher borrowing rates to private borrowing conditions.[1] More specifically, during the first 3-months of the increased sovereign spreads, around 30-40 percent of the increase is passed to the firms' lending rates and around 50-60 percent within a 6-month period. In addition to the impact on lending rates, a deteriorated Italian sovereign position is shown to impact also the quantity of lending. However, the decrease in credit growth has been ascribed to the slowdown of credit demand as well as the worsening of loan supply conditions.

Similar findings to the ones presented by Zoli (2013) are presented also by Albertazzi et al. (2012) that investigate the effects of Italian sovereign bond spreads on the cost of borrowing for non-financial corporations and households in Italy for the period 1991 – 2011. In investigating the effects of sovereign bond spreads on the interest rate on loans and also the cost of banks' financing, the authors utilize an autoregressive distributed lags (ARDL) model. Their results suggest that an increase in sovereign bond spreads increases the cost of borrowing for both non-financial corporations and households. In addition to the price of borrowing increase, this paper presents evidence of a decrease in the volume of lending as a result of deteriorated conditions in the sovereign cost of borrowing. However, the pass-through of the price increase into the cost of private borrowing has been shown to depend both on the existing rate and on its volatility: Albertazzi et al. (2013) provide evidence for non-linear effects of the sovereign bond spreads in Italy – i.e. when sovereign spreads are higher, there is a higher rate of pass-through to private borrowing conditions, for both non-financial corporations as well as households; and sovereign bond spreads in Italy are higher when the sovereign experiences higher volatility in its

cost of borrowing.

Neri and Ropele (2015) investigate the effects of the sovereign debt crisis – measured by sovereign bond spreads – on the main macroeconomic indicators for a panel of 11 EU countries. Overall their results suggest that an increase in the sovereign bond spreads of Greece influences negatively the sovereign bond spreads of EU peripheral countries significantly, while for the EU core countries government bond spreads are not affected. In addition, a shock to sovereign bond spreads is shown to influence negatively the cost (by between 50 and 40 b.p.) and quantity (by between 2 to 3 percent) of borrowing by non-financial corporations in EU peripheral countries. In contrast, for the EU core countries, the cost of borrowing increase following a sovereign spread shock is significantly lower. The highest increase in the cost of borrowing for the EU core countries is shown to be in France (with an increase of 10 b.p.) and with lesser magnitudes for the other EU core countries. In addition, similar behavior is also observed with regard to loans to households. Moreover, their results also show that sovereign spread shocks have a negative influence on overall economic activity in the EU peripheral as well as in the EU core countries. The results presented show that an increase in government bond spreads has a negative influence on the annual growth rates of industrial production and also increases the rate of inflation.

Again, in the context of Italian financial sector developments in conjunction with sovereign creditworthiness, Del Giovane et al. (2013) analyze the role of demand and supply factors in explaining the overall credit development between two crisis periods, that is, the global financial crisis and the sovereign debt crisis. Similar to the findings of Neri and Ropele (2015), Zoli (2013) and Albertazzi et al. (2013), also Del Giovane et al. (2013) find that increase in government bond spreads increases the cost of borrowing for firms and households and that the magnitude of the increase is found to be similar to the previous empirical findings. However, unlike the previous studies, Del Giovane et al. (2013) do not find evidence for a fall in the quantity of credit to the private sector after an increase in the sovereign borrowing cost.

A more comprehensive analysis – both from the perspective of the number of countries under investigation and of the empirical methodologies employed – on the influence of sovereign bond yields on bank lending rates has been done by Eller and Reininger (2016). In addition to the consideration of core EU countries, this paper, by including also the countries from Central and Southern Europe, stands out as the only study – to the best of our knowledge – with such a broader country consideration. Given this large set of countries, the first empirical approach in this analyze consists of a fixed effects panel model with variables for the long-term loan rates, deposit rates, money market rates, and government bond yields. Moreover, besides the panel fixed-effects model, individual country models are estimated by means of Vector Error Correction Models (VECM) and VAR models. From the panel model estimation, the results suggest that long-term borrowing rates for the private sector are largely influenced by movements in government creditworthiness – as measured by government bond yields. Also, given that the period in this paper covers the pre-, during- and post-crisis periods, it is further suggested that the changes in private sector borrowing rates are not only crisis-related movements, but these changes are visible throughout the entire period. As for the individual country estimations, the positive results are confirmed for the EU core countries, although this paper finds a rather limited role for sovereign bond yields in the cost of private borrowing for the countries in Central and South Europe (with the exception of Hungary). The lack of positive results for the influence of sovereign creditworthiness on the private cost of borrowing is attributed to the ownership structure of the banking sector in these economies – as there is large foreign ownership – and also to the relatively short time-series dimension of the data.

The impact of sovereign creditworthiness on the cost of private sector borrowing rates has been explored by Hristov et al. (2014) in the context of studying the effect of the ECB's Outright Monetary Transaction (OMT) program on the monetary policy transmission process. By using a VAR methodology, this paper is able to distinguish between different time-periods for the effects that changes in government bond rates have on borrowing rates for the private sector. Overall, their results suggest that the link between the government cost of borrowing and the private borrowing cost has been weakening over time. According to their findings, the link between the two was stronger before the European sovereign debt crisis but much weaker thereafter. In this consideration, a drop in government bond rates during the period before the sovereign debt crisis was found to be transmitted to banking lending rates by nearly 40 percent. However, after this period, the pass-through of sovereign bond rates to bank lending rates has been weak, if not non-existent.

From the above review of the literature, a few general highlights have emerged. First, the literature has established a strong nexus between the sovereign and banking sector and compelling evidence has been found identifying the transmission of government risk to the banking sector through various

channels of risk transmission. Second, the literature with a similar focus as ours that explores the effects of sovereign creditworthiness – as expressed by the sovereign bond yields – on banks' lending activity finds evidence of risk pass-through from sovereign on interest rates on lending to the private sector. However, this evidence is mainly presented for a few selected advanced economies while a large gap persists in the literature in terms of studies with a focus on other European economies. Hence, our aim is to bridge this gap in the literature by examining the impact of sovereign creditworthiness on the banks' lending activity and extend the analysis by considering the impact on the growth rate of investment and consumption, and, ultimately, on general economic activity for the European transition economies.

3. Methodology, Variables and Data Description

The main focus of this paper is to explore the transmission of price shocks – if any – from the government cost of borrowing to the private borrowing cost using quarterly data. Considering the transition context of our countries under consideration, the nature of the data, and the literature, for our empirical estimation we will employ a VAR methodology based on panel data.

The panel VAR specification that we will be using in our empirical specification takes a form similar to the simple VAR framework; however, since the data set that we aim to explore consist of a panel of countries, it includes also the cross-section specification as below (Ciccarelli and Canova 2013):

$$Y_{it} = A_{Oi}(t) + A_i(l)Y_{i,t-1} + F_i(l)W_{t-1} + u_{i,t} \quad (1)$$

where i represent the cross-section units and t indexes years. Y_{it} is the vector of our endogenous variables, while $W_{t\text{-}1}$ represents the vector of exogenous variables. All deterministic components of the data – which may contain the constant, seasonal dummies and deterministic polynomial in time – are compacted in $A_{Oi}(t)$. A_{Oi} and $F_i(l)$ are polynomials in the lag operators. $u_{i,t}$ are the identically and independently distributed errors $u_{i,t} \sim iid(0,\Sigma_u)$. Lags of all variable units enter the model for each i, hence allowing for dynamic interdependencies.

Depending on the nature of the data sets and also the questions to be addressed, practitioners have developed different methods to impose restrictions on the parameters (to achieve identification). Following the vast majority of the literature, we implement the recursive identification method based on Choleski decomposition as originally applied by Sims (1980). According to Sims (1980), in order to isolate the shock to one of the VAR variables, residuals need to be rendered orthogonal (uncorrelated). To achieve this, Sims (1980) proposes that the VAR structure should have a recursive causal order, meaning that the variables ordered first in the VAR system are allowed to have an effect on the subsequent variables and their lags but later variables are not allowed to contemporaneously affect the previous variables.

In this regard, the variable ordered first in our PVAR system would be *government bond yields* followed by the interest rates of loans to non-financial corporations. Under the recursive identification approach, the ordering of *the interest rates of loans to non-financial corporations* as a second variable implies that interest rates on loans to non-financial corporations are allowed to be affected only by government bond yields, whereas loans to non-financial corporations can have a contemporaneous effect on other variables ordered subsequently in the sequence. A similar approach to the ordering of these two variables has been implemented by Eller and Reininger (2016). Moreover, motivated by a simple IS – LM model, in which investments are a function of borrowing conditions, we take into account the behavior of *investments growth rate* – as the third variable – in the process of price transmission shock from bond yields to private borrowing conditions. This ordering implies that investment growth rates in the period of the shock are allowed to be affected by the movement of variables ordered before, namely the loans to non-financial corporations and government yields; however, the growth rate of investments are not allowed to be affected by variables ordered after it in the period of shock. In other words, we assume that the interest rates of loans to non-financial corporations have an effect on the contemporaneous investments growth rate, while the investment growth rate is allowed to have an effect – if any – on the interest rate of loans to non-financial corporations only with a lag. In this setting, it is expected that an increase in interest rates will discourage investments, which, in turn, will contribute negatively to output growth rates (ECB 2005; Sims 1992). In accounting for the latter, the fourth variable that enters the baseline PVAR system is the *GDP growth rate*. The ordering of GDP growth rates as the last variable in the PVAR system is motivated by the study from Sims (1992) that investigates the effects of monetary policy on some macroeconomic variables.[2]

The quarterly data used for our empirical estimation are taken from the ECB and Eurostat databases. The database is characterized by an unbalanced panel

for our eight European transition economies and includes Bulgaria, Croatia, the Czech Republic, Romania, Poland, Hungary, Slovenia, and Slovakia. The dataset starts in the first quarter of 2003 for Hungary (the earliest available data); for the Czech Republic in the first quarter of 2004; for Poland, Slovakia and Slovenia in the first quarter of 2005; and for Romania and Bulgaria in the first quarter of 2007. Similarly, for all the countries, the sample ends in the fourth quarter of 2016.

The data on our endogenous variables in the PVAR system includes Government Bond Yields (G), which are defined as nominal long-term interest rates, used as a convergence criterion for the European Monetary Union, based on the Maastricht Treaty, and are expressed in percentages. The second variable of interest is the interest rates on Loans to Non-Financial Corporations (L), expressed in percentages and defined in nominal terms. As earlier noted, in different model specifications different loan maturities will be investigated; we will take into account the interest rates on loans to non-financial corporations starting from loans with a maturity of up to 1 year (L1) and above 5 years of maturity (L5), which are all expressed in percentages. Additionally, besides loans to non-financial corporations, we will also be interested in exploring the reactions of interest rates on loans to Households. Similarly to interest rates on loans to NFC, in different model specifications, we will be using different maturities also for loans to households: starting from loans with a maturity of less than 1 year (HH1), and then above 5 years of maturity (HH5), which are all expressed in percentages. The third variable that enters our PVAR system is the real gross capital formation (I) expressed in percentage growth rates from quarter to quarter. Lastly, the fourth variable is the real GDP growth rates (Y) expressed as percentage changes compared to the same period of the previous year. Table 1 in the Appendix presents the variables used in our empirical models, their description, abbreviations, and the source of the data.

In the list of our considered variables as outlined in the table above, we have variables defined in nominal terms and also variables that are expressed in real terms. More specifically, the interest rate variables – interest rates on loans to non-financial corporations, interest rates on loans to households at different maturities and government bond yields – are defined in nominal terms, while macroeconomic variables (GDP growth, investment growth and household consumption growth) are all expressed in real terms. Using real macroeconomic variables with nominal monetary/financial variables is a standard practice in monetary literature and not only in the models that apply panel VAR estimation methodology. Among others, the practice of mixing nominal and real variables can be found in the study of Sims (1982), Bernanke and Mihov (1998), Brischetto and Voss (1999), Cheng (2006), Amarasekara (2009) and Vinayagathasan (2013). Therefore, in line with the previous practices, we too use real macroeconomic variables with other nominally defined financial variables in our PVAR models.

The structural form of our baseline PVAR system in a matrix form can be presented as follows:

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -\alpha_{GL} & 1 & 0 & 0 \\ -\alpha_{GI} & -\alpha_{LI} & 1 & 0 \\ -\alpha_{GY} & -\alpha_{LY} & -\alpha_{I} & 1 \end{bmatrix} \begin{bmatrix} G_{i,t} \\ L_{i,t} \\ I_{i,t} \\ Y_{i,t} \end{bmatrix} = \mathrm{A} \begin{bmatrix} G_{i,t-1} \\ L_{i,t-1} \\ I_{i,t-1} \\ Y_{i,t-1} \end{bmatrix} + Bc_i + \begin{bmatrix} \varepsilon_{it}^{G} \\ \varepsilon_{it}^{L} \\ \varepsilon_{it}^{I} \\ \varepsilon_{it}^{Y} \end{bmatrix} \quad (2)$$

In the matrices in Eq.2, the endogenous variables are represented by G, L, I and Y, and *i* and *t* denotes countries and time, respectively. The zero elements in the first matrix represent the restrictions imposed by the recursive identification approach and α_{nm} represent the contemporaneous reaction of variable m to a shock on variable n. The country-specific fixed effects are an exogenous variable represented by c_i. A and B are corresponding vectors of coefficients and ε_{it} is the structural shock in each of the equations.

4. Estimated Results

When estimating a VAR system, including in the panel context, the estimated coefficients are rarely of interest in applied work. In the estimations of our model(s) that follow, and similar to other empirical studies in the literature that use VAR methodology, we instead make use of Impulse Response Functions (IRFs) to interpret our estimates.[3] The output of the IRFs are presented in graphical format (with 95% confidence interval bands generated by Monte Carlo simulation with 1000 replications), which describes the reaction of one variable to the innovation of another variable while holding the shocks to other variables at zero.[4] Following Comunale (2017), we consider IRFs from a one-unit positive shock. Using IRFs, we interpret the dynamic interrelationships between our variables in the system and investigate both the possibility and potential magnitude of price effects transmitted from the cost of public borrowing to the cost of private borrowing. The vertical axes of IRFs in Figure 1 display the percentage point responses of the variable to a one-unit shock in the variable to which the shock is imposed, while the horizontal axes display the periods, in our case quarters. The 1st column represents the shock imposed on Government bond yields (G), the 2nd column represents the shock imposed on Loans with maturity up to 1 year (L_NFC_1),

the 3rd column represents the shock imposed on Investments, and the 4th column the shock imposed on GDP growth rates (Y).

From the reported IRF results presented below, a number of interesting relationships can be observed amongst our variables in the PVAR system. The IRF results presented below suggest that, during the period 2003-2016 a shock to the government cost of borrowing is relatively persistent, as the shock fades away only after the 7th quarter from the shock (Row 1, 1st Column) as it becomes statistically insignificant. Moreover, and most importantly for our research question, a one percentage point positive shock imposed on the government cost of borrowing (G) has a positive and significant effect on the cost of borrowing for private non-financial corporations on loans with maturity below one year (L_NFC_1). This can be viewed in the 2nd Row, 1st Column. According to our results, the peak transmission of the shock materialized in the 3rd quarter, indicating that a unit shock (one percentage point) to Government Bond Yields (G) will induce an increase in the cost of borrowing for NFC by 0.59 percentage points. In subsequent quarters, the impact gradually decreases and becomes insignificant in the 7th quarter. The reported results suggest clear evidence that in the event of a positive shock to the price of Government borrowing, the price of borrowing for private businesses tends to increase immediately and that this higher price of borrowing persists up until the end of the second year after the shock, after which the impact fades away. Our findings are somewhat similar to the findings reported by Zoli (2013) and Albertazzi et al. (2013) for the case of Italy.

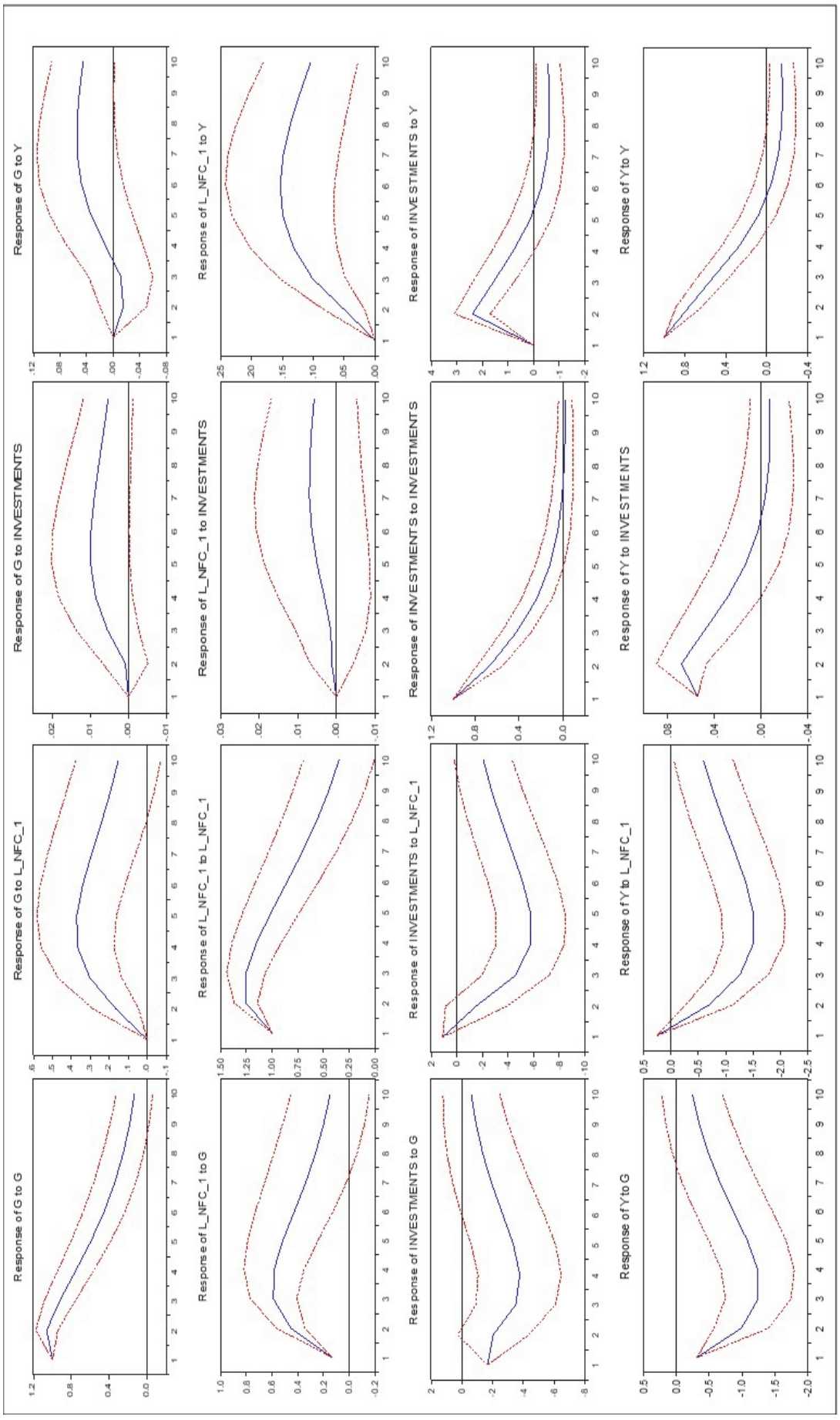
In addition, a shock to the government cost of borrowing has a negative and significant impact on the growth rate of gross capital formation growth (investments) from the 3rd quarter from the shock until the 5th quarter, after which the impact remains negative, although not statistically significant. Similarly to investments, also GDP growth rates decline in the event of a positive shock to the government cost of borrowing, this negative response being visible from the first quarter up until the end of the 7th quarter, after which the impact becomes statistically insignificant (Row 4, Column 1).

Moreover, in addition to the shock to the Government cost of borrowing and the chain effects (1st Column), the IRF results above give indications also for the effects of positive shocks to the other variables included in the PVAR system and their respective relationships. In this consideration, in the second Column, we report the relationship of variables in the event of the shock imposed on the cost of borrowing for NFCs. As can be observed from the relationship between the cost of NFC borrowing and investment growth rate (3rd Row, 2nd Column), with an increase in the cost of borrowing for NFC, the IRF suggests that in the period of the shock (1st quarter) investments growth rate remain positive and statistically significant. However, from the beginning of the 3rd quarter and onwards, the expected negative impact materializes – with the peak in the 5th quarter – and remains negative up until the end of the 9th quarter. These results indicate that similar to the case when there was an increase in the government cost of borrowing, also when the NFC borrowing cost increases, investment growth rates are expected to decline from the 3rd quarter and throughout the period. Moreover, the initial positive response might give an indication that the adjustment of investments to the higher cost of borrowing might take some time, and that investments in capital formation are not elastic and fast adjusting operations. Therefore, at least 2 quarters need to pass for the decrease in investment growth rate to take place after an increase in the borrowing rate for NFCs.

Moreover, the relationship between GDP growth rates and NFC borrowing rates can be observed in the 4th Row, 2nd Column. As can be observed, the GDP growth rate declines in the event of an increase in the cost of private borrowing in the second quarter, and this negative impact is persistent and continues until the end of the reported period. According to our results, the peak of this negative response is reached in the 4th and 5th quarter after the shock. The decrease in investment growth rates and GDP growth rates consequent upon an increase in the price of NFC borrowing might give some indication of the price effect in the overall formation of expectations in the private sector and their corresponding impact on overall business confidence. The increased price of borrowing can lead to uncertainties about profitability from investment projects, which would lead to a more conservative investment strategy implemented by investors with a correspondingly depressing effect on GDP growth rates.

Furthermore, in the 4th Row, 3rd Column is displayed the response of GDP growth rates (Y) to a shock in investment growth rates. In line with our expectations, in the period of the shock to the investment growth rate, the GDP growth rate responds positively by reaching its peak in the 2nd quarter. However, this positive impact fades away after 1 year from the shock and remains insignificant until the end of the 10th quarter. As one would expect, the IRF results suggest that a one-off increase in the investment growth rate – resulting from the positive shock to the investment growth rate – only positively affects GDP growth

Figure 1. IRFs, Loans to NFC with maturity below 1 year – European Transition Economies



rates for around 1 year. However, this one-off increase in investment growth rate would not have a long-run effect on GDP growth rates, as the impact becomes insignificant from the 5th quarter and onwards.

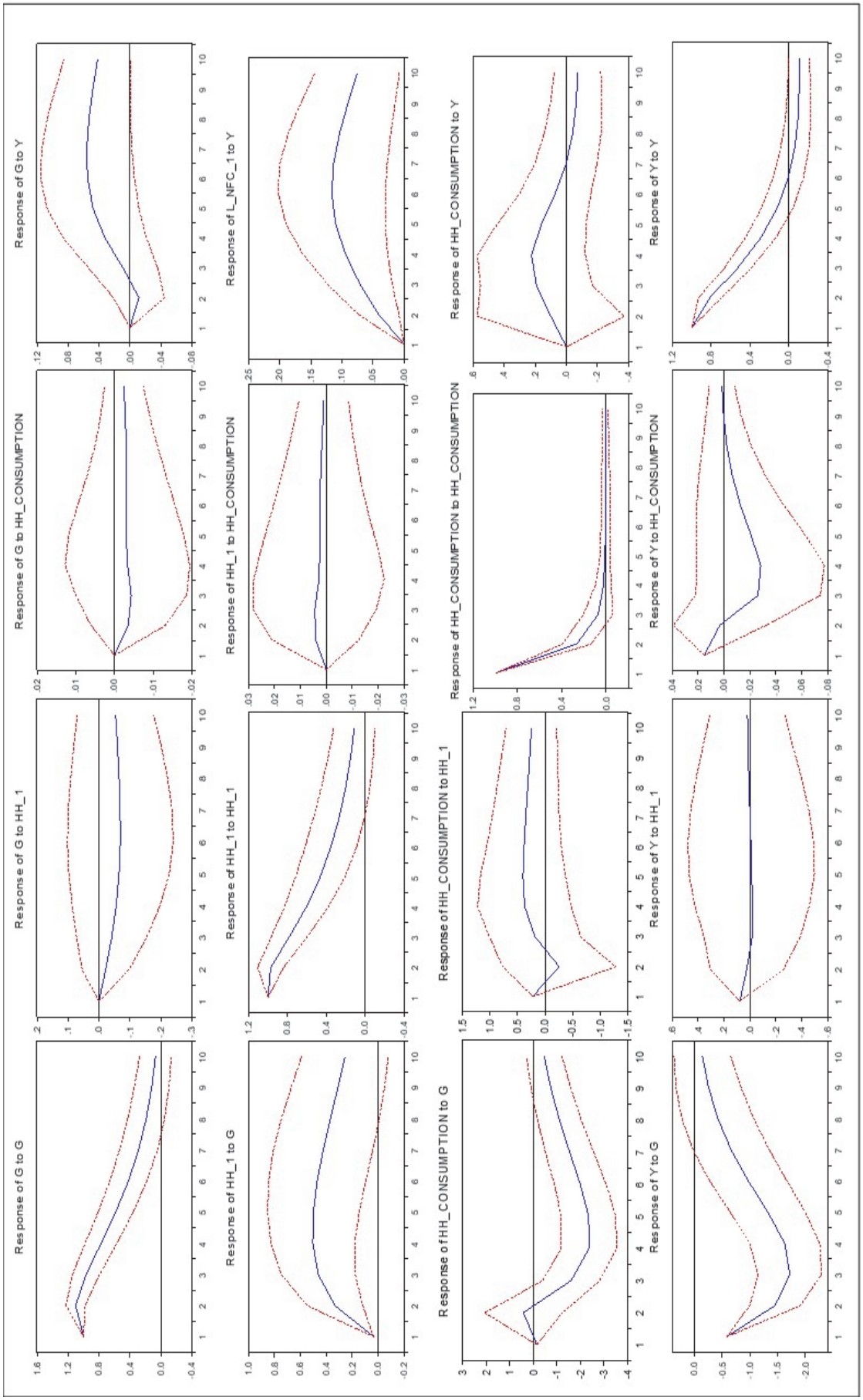
From the individual results presented above during our sample period 2003-2016, it is observed that a positive shock to the public borrowing cost (G) increases the cost of borrowing for the private sector for loans with maturity below 1 year (L_NFC_1). In investigating further other macroeconomic consequences from this relationship, the results suggest that an increase in the price of private borrowing for NFCs will hurt the growth of capital formation (investments), which, in turn, will have a negative impact on growth rates (Y). Hence, the chain reactions of our variables indicate that an increase in public borrowing cost will ultimately have a negative impact on GDP growth via gross capital formation. Not only do the results establish strongly this chain transmission impact, but also the IRFs confirm this interrelation in direct form – as can be viewed from the IRF in the 4th Row, 1st Column, which shows the reaction of GDP growth rates to a shock in the Government cost of borrowing. These results, besides giving valuable information with regard to the relationship between our variables of interest, also give us additional confidence with regard to the robustness of the findings, since the specific relationships between variables are confirmed when one views the results also from different angles. Finally, the consistency of our estimates is not only qualitative but also quantitative; for example, the impact of a one percentage point rise in the cost of government borrowing on investment growth rate (Row 3, Column 1) is – as expected – much larger than on GDP (Row 4, Column 1). Nevertheless, to add more to the confidence of the reported results, additional robustness has been performed, however, not reported here.[5]

Having considered the interrelationship of the cost of public borrowing with NFC borrowing costs, we consider also the cost of borrowing for Households. The importance of Household considerations stems not only from their deposit placements – as an important source of financing for bank lending to the economy – but also from their borrowing to finance consumption and mortgages that have the potential for extended influence on other macroeconomic indicators. Therefore, it is important to explore whether the cost of Household borrowing is influenced by the increased cost of public borrowing in a manner similar to NFC borrowing. In the following, we take into account interest rates on loans to Households at one year and above five years maturities together with their respective responses to shocks imposed on government borrowing costs.

The model specification for this analysis takes the form of the baseline specification; i.e., we allow for the lag of order 2 and include the country-fixed effects and year dummies as exogenous variables. In addition, in our PVAR system, we are interested to explore the possible transfer of prices from public to private borrowing as well as how this affects overall private consumption growth, and, ultimately, GDP growth rates. In this regard, we make use of the variable real household final consumption growth. In the PVAR to be estimated, the variables take the following order: Government Bond Yields (G); Interest Rates of Loans to Households (HH_1); real Household Consumption growth (HH_Consumption); and real GDP growth rates (Y). The sample period continues to be the same as in the baseline mode.

The estimated IRF results presented in Figure 2 below show in the vertical axes the percentage point responses of the variable to a one-unit shock to the variable to which the shock is imposed, while the horizontal axes display the periods, in our case quarters. The 1st column represents the shock imposed on Government bond yields (G); the 2nd column represents the shock imposed on Loans with maturity up to 1 year (HH_1); the 3rd column represents the shock imposed on the Consumption growth rate; and the 4th column the shock to GDP growth rates (Y). The results suggest that the cost of Household borrowing with a maturity of up to one-year during our sample period 2003-2016 increases with innovation in the public cost of borrowing. This increase in the price of household borrowing is persistent over seven quarters, reaching its peak in the 4th and 5th quarters, after which the effect slowly decreases (2nd Row, 1st Column). According to the IRFs, a one percentage point increase in the cost of public borrowing induces an increase in the cost of Household borrowing at a maximum of 0.50 percentage points. If one compares the magnitude of the impact of the increase in the cost of borrowing for Households and NFCs resulting from an increase in public borrowing costs, then it is observed that the impact of an increase in the private borrowing rate is slightly higher for NFCs as compared to Households for shorter maturity loans. Moreover, our newly included variable – household consumption growth – responds negatively to an increase in the government cost of borrowing (3rd Row, 1st Column), as per significant negative effects from the 4th quarter until the 8th quarter. These results might indicate that households anticipate that an increase in Government borrowing rates might signal a future tax increase and/or government spending cuts and, therefore, adjust downwards their consumption. In addition, and similarly to the case when loans to NFC

Figure 2. IRFs, Loans to Household with maturity up to 1 year – European Transition Economies



were part of the equation, also here a shock to the Government cost of borrowing has a negative effect on GDP growth rates for close to two years (4th Row, 1st Column).

In inspecting further the consumption growth rate behavior from the perspective of other relationships between the variables in the system, the IRF results suggest – perhaps surprisingly – that even with the price of Household borrowing increased, the final consumption of the household is not affected, although there is a hint of a negative effect (albeit statistically insignificant) in the 2nd quarter (3rd Row, 2nd Column). Moreover, a positive shock to Household consumption does not seems to impact GDP growth rates as per the insignificant effect throughout the period depicted (4th Row, 2nd Column).[6]

From the estimated results presented and discussed above, overall the results suggest that when government borrowing costs are subjected to a shock, this effect is (i) transmitted to household borrowing costs at both short and long maturities and (ii) that this impact lasts longer for the loans at longer maturity as compared to shorter-term loans. In addition, (iii) household consumption is negatively affected by an increase in the government cost of borrowing as well as GDP growth rates. However, an increase in the household borrowing rate does not seem to affect overall household consumption.

5. Conclusions

This paper provides empirical analyses of the effects of the government cost of borrowing on the cost of private borrowing and other macroeconomic variables, for both Non-Financial Corporations and Households in eight European transition economies (namely, Bulgaria, Croatia, The Czech Republic, Romania, Poland, Hungary, Slovenia, and Slovakia) during the period 2003-2016. Our results indicate that a one percentage point increase in the government cost of borrowing in European transition economies increases instantly the cost of borrowing for NFCs and that this increase in NFC borrowing costs is persistent for around two years after the shock. The maximum increase in the interest rate of loans to NFC with maturity below one year was found to be 0.59 percentage points. According to our results, price transmission mechanisms from government borrowing increase to the private sector are largely at play not only in borrowing rates but also in macroeconomic activity at large. With the increase in the government cost of borrowing, investment growth rates deteriorate from the second quarter after the increase in government borrowing rates. However, this negative response of investment growth rate is statistically significant only for around one year. GDP growth rates also are shown to be very responsive to the increase in the government cost of borrowing, as the GDP growth rates decreased by around one percentage point with the increase by one percentage point in the cost of government borrowing.

Even when we modify the baseline model to take into account the price of borrowing for households instead of NFCs, a similar transmission mechanism is visible. Similar to NFC borrowing costs, the price of borrowing for households in European transition economies has proven to be sensitive to changes in government borrowing costs, although the price increase is of a smaller magnitude compared to NFC borrowing rates. The price increase for household borrowing was found to be 0.50 percentage points for loans with maturity below one year. In addition, a price increase in government borrowing was shown to have a negative effect on Household consumption and GDP growth rates, although household consumption was found to be unaffected by an increase in Household borrowing rates.

These empirical findings suggests that policies directed towards reducing sovereign risk (e.g. institutional and macroeconomic stability), hence improving sovereign creditworthiness, are not only important from the perspective of decreasing the level of the sovereign cost of borrowing but also from the perspective of mitigating the transmission of sovereign risk to the private sector. Our comprehensive analysis revealed that increased levels of sovereign risk adversely affects the cost of private sector borrowing (both, for non-financial corporations and households) and also, in turn, the macroeconomic development of the country by negatively influencing investment, consumption and economic growth rates. Therefore, active policy engagement is required in order to guard a country from slipping into a vicious circle, in which deterioration of macroeconomic fundamentals increases sovereign risk, hence the sovereign cost of borrowing, which, in turn, adversely affects the cost of private borrowing and, ultimately, further deteriorates macroeconomic fundamentals.

Endnotes

1. The endogenous variables used in this VAR system are lending rates, the 10-year government bond spread, the average CDS spreads of the five largest Italian Banks, and changes in the 3-month Euribor.
2. The variables in the VAR system implemented in Sims (1992) are ordered as follows: Short-term Interest Rates, followed by Monetary Aggregate, the CPI, and the Industrial Production Index.
3. While detailed tables of estimated coefficients will be available upon request.
4. The vertical axes of IRFs display the percentage point responses of the variable to a one-unit shock in the variable to which the shock is imposed, while the horizontal axes display the periods.
5. In addition to short-term loans, we do estimate also loans at maturity above 10 years. Since the results are fairly similar to those with short-term maturity, we do not present the results but are available upon request.
6. In addition to short-maturity loans to households, we calculate also household loans with a maturity of more than five years, however, these are not presented here as the results are fairly similar but are available upon request. Similar to loans at a shorter maturity, also loans with a maturity above five years increase in the event of a shock to the Government cost of borrowing. As compared to loans with a maturity of up to one year, the response of loans at this higher maturity is more gradual, while the magnitude of the increase is slightly smaller as compared to the loans with shorter maturity. Moreover, different from loans with a maturity of up to one year, in the model with loans with a maturity above five years, the increase is persistent through the period. Moreover, similar to the model with loans with a maturity of up to one year, household consumption growth and GDP growth rates are negatively affected by an increase in the government borrowing rate; and household consumption growth is unaffected by a shock to the cost of household borrowing.

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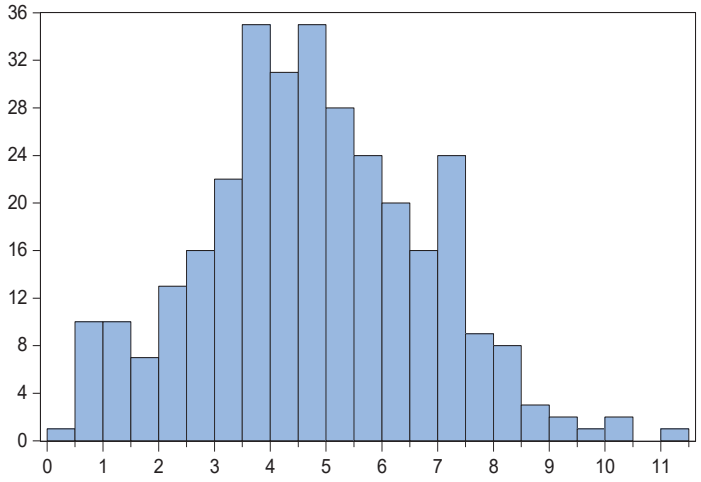
APPENDIX

1. Definition of variables and data sources

Variable	Description	**Abbreviations**	**Source**
Government Bond Yields	Quarterly average nominal long-term government bond yields with a maturity of close to ten years are used for convergence criteria by the EMU. They refer to central government bond yields on the secondary market expressed in percentages.	G	European Central Bank
Loans to Non-Financial Corporations of up to 1 year	Quarterly average nominal bank interest rates on loans to Non-Financial Corporations with an original maturity of up to one year (outstanding amounts) expressed in percentages.	L1	European Central Bank
Loans to Non-Financial Corporations of over 5 years	Quarterly average nominal bank interest rates on loans to Non-Financial Corporations with original maturity of over five years (outstanding amounts) expressed in percentages.	L5	European Central Bank
Loans to Households of up to 1 year	Quarterly average nominal bank interest rates on loans to Households for house purchase with original maturity of up to one year (outstanding amounts) expressed in percentages.	HH1	European Central Bank
Loans to Households of over 5 years	Quarterly average nominal bank interest rates on loans to Households for house purchase with original maturity of over five years (outstanding amounts) expressed in percentages.	HH5	European Central Bank
Real GDP growth	Chain linked volumes, percentage change compared to the same period in the previous year in real terms.	Y	Eurostat
Investments	Gross capital formation, percentage change compared to the same period in the previous year in real terms.	I	Eurostat
Household Consumption	Final consumption expenditure of households, percentage change compared to the same period of the previous year in real terms.	HH_Consumption	Eurostat

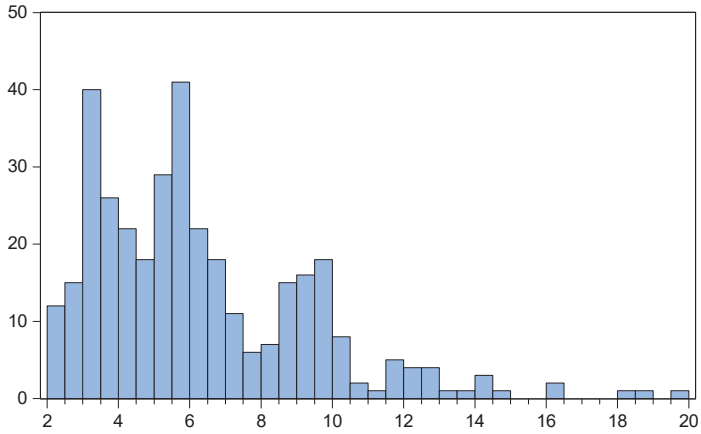
2. Descriptive Statistics

i) Government Bond Yields



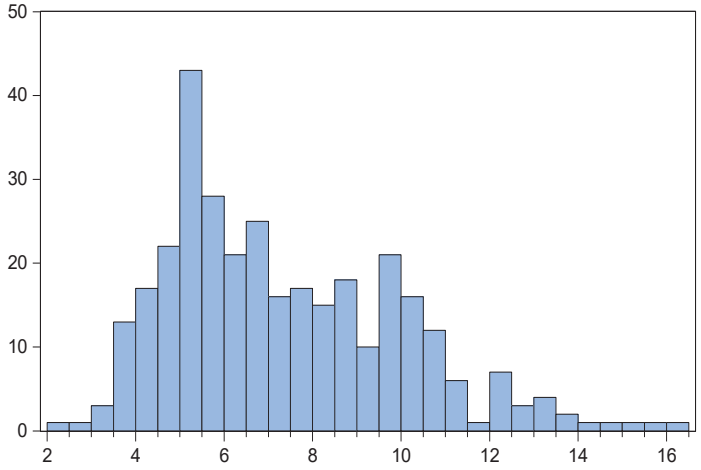
Series: G	
Sample 2003Q1 2016Q4	
Observations 318	
Mean	4.776069
Median	4.690000
Maximum	11.31000
Minimum	0.370000
Std. Dev.	2.017022
Skewness	0.149566
Kurtosis	2.889707
Jarque-Bera	1.346797
Probability	0.509973

ii) Loans to Non-Financial Corporations



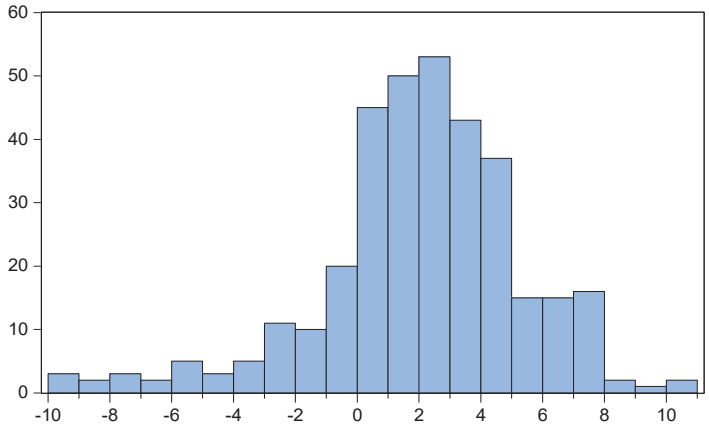
Series: L_NFC_1	
Sample 2003Q1 2016Q4	
Observations 351	
Mean	6.296290
Median	5.600000
Maximum	19.52333
Minimum	2.203333
Std. Dev.	3.051965
Skewness	1.270971
Kurtosis	5.001895
Jarque-Bera	153.1099
Probability	0.000000

iii) Loans to Households



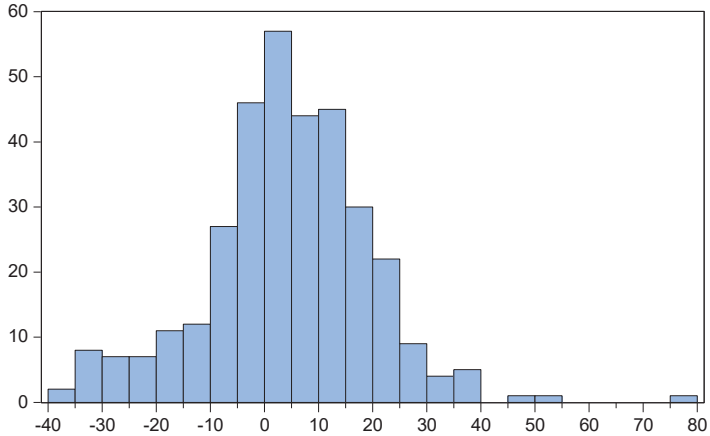
Series: HH_1	
Sample 2003Q1 2016Q4	
Observations 327	
Mean	7.342222
Median	6.756667
Maximum	16.18000
Minimum	2.496667
Std. Dev.	2.626665
Skewness	0.732128
Kurtosis	3.083937
Jarque-Bera	29.30858
Probability	0.000000

iv) GDP growth



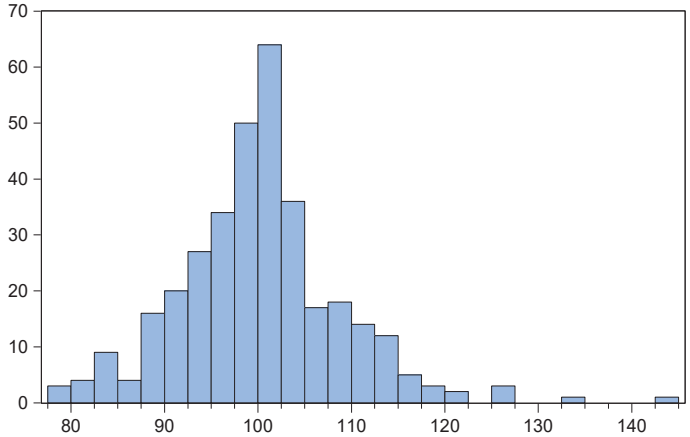
Series: Y	
Sample 2003Q1 2016Q4	
Observations 343	
Mean	2.016618
Median	2.200000
Maximum	10.70000
Minimum	-9.500000
Std. Dev.	3.282657
Skewness	-0.741050
Kurtosis	4.471330
Jarque-Bera	62.33212
Probability	0.000000

v) Investments



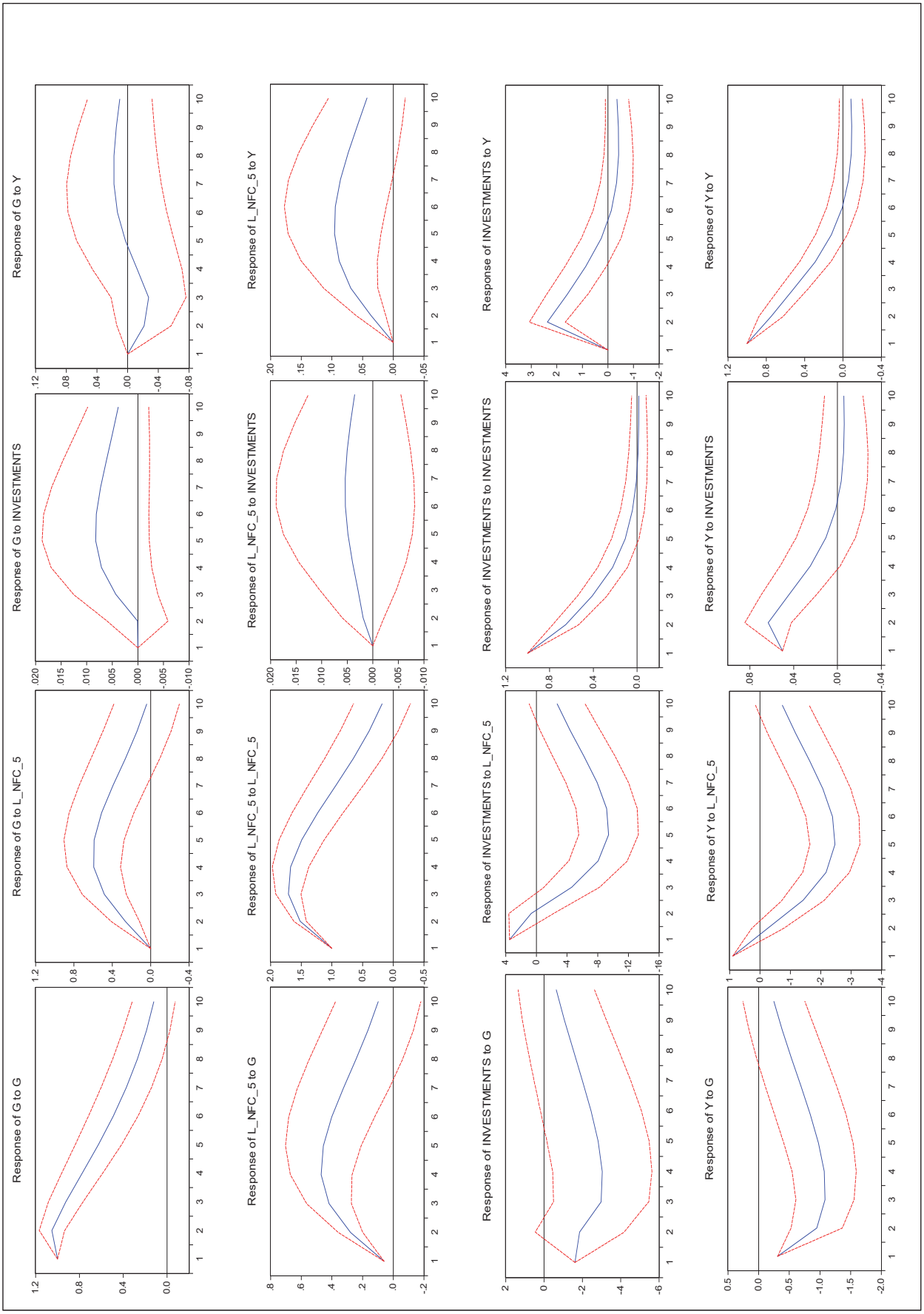
Series: INVESTMENTS	
Sample 2003Q1 2016Q4	
Observations 339	
Mean	4.321736
Median	4.386044
Maximum	78.63886
Minimum	-35.95563
Std. Dev.	15.41459
Skewness	0.011635
Kurtosis	4.695151
Jarque-Bera	40.59636
Probability	0.000000

vi) Household Consumption



Series: HH_CONSUMPTION	
Sample 2003Q1 2016Q4	
Observations 343	
Mean	100.1449
Median	100.0000
Maximum	142.8000
Minimum	78.80000
Std. Dev.	8.672709
Skewness	0.601822
Kurtosis	5.181564
Jarque-Bera	88.72239
Probability	0.000000

Appendix 3. IRFs, Loans to NFC with maturity above 5 years – European Transition Economies



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