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# IS COST COMPETITIVENESS A SUFFICIENT DRIVING FORCE FOR CROATIAN EXPORTS?

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***Abstract***

*This paper examines the extent to which Croatia relies on a cost-based export strategy by analyzing the link between cost competitiveness, measured by unit labor cost (ULC) and exports of manufacturing firms from 2002 to 2022. Using a panel first-differences OLS approach, the study finds that cost competitiveness significantly shapes export activity of firms of all sizes and technological intensities, but with considerable heterogeneity. The results show a non-linear relationship between ULC and exports that is not asymmetrical. The relationship is weaker for firms with lower export intensity and for high-tech firms. Higher ULC is associated with greater export sensitivity and lower productivity, confirming that export sensitivity is lower for more productive firms. In the future, a further strengthening of the link between costs and exports can be expected, i.e. exports will react more sensitively to cost fluctuations. As a result, price and cost stability will become even more crucial. Overall, this analysis provides the most comprehensive study to date on how cost factors affect Croatian merchandise exports, implying that boosting product quality and productivity can reduce cost pressures and promote long-term competitiveness.*

**JEL classification:** *F14, L25, L60, D24*

**Key words:** *cost competitiveness, manufacturing industry, exports, unit labour cost*

## 1. Introduction

As a small, open economy with strong trade and financial integration, Croatia relies on exports to demonstrate its competitiveness. Export growth is particularly effective when it is based on technologically advanced products with higher added value, due to favorable spillover effects. Nevertheless, Croatian exports have long remained modest, partly due to an export structure dominated by labor- and resource-intensive goods, where price and cost factors have a significant impact on export performance.

Accordingly, this paper examines the impact of changes in cost competitiveness – measured by the key indicator of unit labor cost (ULC) – on Croatian manufacturing exports at the firm level with the aim of identifying the main causes of the country's low competitiveness at the macro level. ULC refers to labor cost per unit of output and thus includes both cost

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and productivity data, the latter being an important dimension of non-price competitiveness (Giordano and Zollino 2016). As the ULC captures both price and non-price aspects of competitiveness, it has a strong explanatory power for exports (Keil 2024).

The analysis focuses on companies in the manufacturing sector, as this sector generates on average more than 80% of the country's total merchandise exports. Numerous researchers have analysed the importance of price (cost) competitiveness in the Croatian economy, mostly using sectoral and aggregate data, but their results remain mixed. This study provides the most comprehensive insight into the relationship between ULC and exports in the domestic and foreign literature to date, using a comprehensive firm-level panel dataset spanning two decades (2002 – 2022).

Unlike previous studies, it explicitly analyses the heterogeneous effects of ULC across different firm sizes, export and technology intensities and productivity levels – dimensions that are largely unexplored in both the Croatian and foreign literature. Furthermore, this work provides the first empirical evidence of non-linearities in the relationship between ULC and exports at the firm level, thus deepening the understanding of export dynamics and competitiveness. Additionally, the thesis contributes to international research by building on and deepening lines of enquiry in the international trade literature that emphasise heterogeneous firms (Bernard, Jensen, and Lawrence 1995) and productivity as the central role of firm export performance (Melitz 2003).

By adopting a microeconomic perspective and using disaggregated data, this study examines several dimensions of the relationship between cost competitiveness and exports at the firm level that have not been analyzed in this depth before. These questions are examined empirically in the third chapter. Chapter two presents the theoretical framework, methodology and data used in the study. Chapter four discusses the results, makes policy recommendations and highlights the limitations of the study.

## 2. Theoretical background

Competitiveness is a multidimensional concept that is crucial for sustainable growth and development. It operates simultaneously at the firm, sector and national levels, but originates at the micro level – without competitive firms, industries and economies cannot thrive. At the firm level, competitiveness includes market share, product quality and innovation; at the macro level, it includes productivity, income growth, living standards and the ability to generate income in foreign markets. These dimensions are interconnected – only firms capable of producing competitive products can sustain export success at the national level.

Achieving and maintaining such performance is becoming increasingly difficult in the face of global competition, especially given the rapid industrial rise of emerging economies and the innovation-driven strategies of advanced ones. In highly developed economies, non-price factors tend to dominate competitive dynamics, although cost-based indicators (particularly ULC), remain relevant for both price and non-price dimensions of international competitiveness (Škuflić, Šokčević, and Bašić 2024).

ULC, defined as total labor costs per unit of output, can increase prices and lower domestic and foreign sales. However, Kaldor's paradox shows that higher growth is often accompanied by rising labor costs (Kaldor 1978), implying that low wages or currency manipulation alone cannot maintain competitiveness. Instead, long-term success depends on productivity increases, innovation and operational efficiency (Škuflić 2000). Moreover, in a globalized environment with highly mobile production factors, domestic demand plays a limited role. Various scholars describe competitiveness as the effective use of resources to achieve profit and prosperity in global markets (Garelli 2006; Porter 1985; Ernst 2004; Buckley, Pass, and Prescott 1988).

To summarize, competitiveness can be assessed in terms of growth rates in income or sales and expansion of market share. However, it is a great challenge to identify the exact channels through which such improvements are achieved or to determine the factors that can improve competitiveness both in the short term and maintain it in the long term. Each country that has been successful has done so in a way that reflects its unique historical context and prevailing international conditions, making direct replication ineffective. Accordingly, this paper examines ULC and its relationship to Croatian exports and the extent of its influence on exporters' competitiveness. The results can inform the design of targeted industrial and innovation policies aimed at improving competitiveness.

The analytical foundation of this paper is based on new trade theory and the literature on heterogeneous firms literature, which emphasize that firm-level productivity and cost structures determine export behavior (Melitz 2003; Bernard, Jensen, and Lawrence 1995). In this framework, cost competitiveness, proxied by ULC, influences not only firms' pricing strategies but also their market access and survival in competitive international markets. The endogenous relationship

between productivity, factor costs and export performance implies that cost competitiveness is not an isolated factor but is embedded in broader firm capabilities and structural conditions, emphasizing the need to consider price and non-price dimensions of competitiveness together.

2.1. Methodology

To examine the relationship between cost competitiveness – measured by unit labor cost (ULC), and exports of Croatian manufacturing firms, this study uses a first-difference ordinary least squares (OLS) estimator:

$$\Delta y_{it} = \alpha \cdot \Delta ULC_{it} + \Delta \boldsymbol{x}'_{it}\boldsymbol{\beta} + \mu_s + \mu_t + \Delta\varepsilon_{it}, \quad i=1,...,N, \quad t=1,...,T \tag{1}$$

where Δ denotes first differences, $N$ is the number of cross-sectional units (firms), $T$ is the number of time periods (years), $y$ is the dependent variable, $\boldsymbol{x}'_{it}$ is a $1 \times K$ vector of regressors, $\boldsymbol{\beta}$ is a $K \times 1$ vector of parameters, $\mu_s$ is a time-invariant variable representing the fixed effect for the sector in which the firm operates (based on the first two digits of the NACE2 classification), $\mu_t$ is a time fixed effects common to all firms in a given year, $\varepsilon_{it}$ is the idiosyncratic error term.

Endogeneity of the ULC necessitates using estimators including generalized method of moments (GMM). However, the GMM has disadvantages as instruments in first-difference specifications can be weak. By contrast, a system GMM estimator is recommended for highly persistent variables (as in our case) since the difference estimator has poor finite sample properties. However, the system GMM estimator must satisfy the Blundell–Bond condition – if it is violated, the coefficient estimates are inconsistent (Blundell and Bond 1998). This assumption presupposes that the firms are in equilibrium at the beginning of the analysed period, which seems rather unrealistic.

Since this study attempts to identify heterogeneous relationships between exports and ULC via interaction terms, GMM is unsuitable. Weak instruments and high standard errors using GMM makes it difficult to detect significant effects even if they exist. Moreover, studies investigating the relationship between ULC and exports using a first-difference model and OLS provide similar results to GMM (see e.g. Carlin, Glyn, and Van Reenen 2001; Decramer, Fuss, and Konnings 2016). Consequently, we use a first-difference OLS model to estimate the relationship between ULC and exports at the firm level.

We recognise the possible endogeneity of ULC arising from the simultaneity of export performance and productivity at the firm level. Although our identification strategy mitigates some bias, alternative approaches could strengthen the causal inferences. In particular, lagged values of ULC or external shocks, such as energy prices, regulatory changes or sector-specific input costs, could serve as instruments. However, the lack of exogenous cost shifting factors at company level limit their application. Nevertheless, future research could benefit from the inclusion of such instruments, especially if credible external shocks or policy discontinuities can be identified and used for causality estimation.

Several changes were made to test robustness, including redefining the dependent variable (using the firm's sectoral export share instead of total exports), removing certain regressors, and restricting the sample to firms with fewer than 20 employees. This ensures validity for very small firms, whose number and contribution to manufacturing exports has increased significantly over the last decade. In addition, all specifications are estimated for two periods: 2002–2013 and 2013–2022 (before and after Croatia's EU accession) to check whether the conclusions hold in both periods. Additional robustness checks are available on request.

## 2.2. Data

The data used in this analysis (2002 – 2022) come from the Financial Agency of the Republic of Croatia (FINA), Eurostat and the World Bank. The year 2002 was chosen because there were significant methodological changes that prompted firms to submit their annual financial records to FINA, so number of firms increased sharply in 2002 (Valdec and Zrnc 2015). The dependent variable is exports (X), measured by revenue from foreign sales, or the share of exports (XMS), defined as the share of a company in the total exports of its NACE2 sector. The key regressor is unit labor cost (ULC), representing the ratio of personnel expenditure to total revenue. Other regressors are the number of employees (L), tangible capital (K), intangible capital (NK) and unit material cost (UMC), measured as the ratio of material expenditure to total revenue.

Exports are normalized by a price index for foreign products (based on the NACE2 classification), while material (K) and non-material capital (NK) are deflated by the Croatian GDP deflator. The number of employees (L) controls for firm size, and UMC takes into account the non-wage labor costs of domestic and imported inputs. Material capital (K) can boost exports while increasing the share of capital in production, which lowers ULC. It also captures R&D efforts (Griliches and Mairesse 1995) and approximates technological progress, indirectly influencing ULC through

labor productivity. Nevertheless, some factors are not captured by the deflators and therefore remain unreflected in the measured productivity (Carlin, Glyn, and Van Reenen 2001). For instance, if higher prices reflect better product quality, deflating these values may misleadingly indicate lower productivity. Therefore, non-material capital (NK) is included to address this issue.

All variables are transformed with natural logarithms. Since the FINA database is based on self-reporting by companies, the data quality is poorest for the smallest firms. Consequently, observations with sales lower than one thousand euros and/or zero employees are excluded, and all negative or implausibly large numerical values are replaced by missing values. In this adjusted dataset, foreign sales (exports) account for 99,39% of the total sample exports, maintaining the representativeness of the analysis.

## 3. Assessment of the export competitiveness of Croatia

Croatia's position in the international competitiveness rankings remains relatively weak compared to its European competitors. In 2019, the country ranked 63rd in the Global Competitiveness Index (GCI), behind the Czech Republic, Poland and Slovenia. Although there have been improvements in overall competitiveness since 2013, export competitiveness remains limited.

Compared to other new EU member states, the share of Croatian goods exports in GDP is still relatively low. Much of Croatia's increasing openness is due to tourism rather than exports of goods. Other new member states started with a more favorable export position and have since widened the gap. For example, in 2022 Slovenia, despite being a smaller country, reached almost five times Croatia's share of EU imports (1.51% vs. 0.33%) and more than four times its share of global imports (0.42% vs. 0.09%; Eurostat 2024).

In addition, the composition of Croatian goods exports is significantly less favourable than that of comparable economies. In 2013, for example, the share of food, beverages, tobacco, raw materials, mineral fuels, lubricants and chemical products in Croatia's export mix was higher than in the above-mentioned comparator countries, while the share of machinery and transport equipment (which usually generate higher value added) wasn't even half as high. A similar pattern continued in 2022, with the exception of a lower share of chemical products.

Since manufacturing accounts for the largest share of Croatia's merchandise exports and usually comprises more complex products than raw materials or agricultural products, the competitiveness of manufacturing is central to the country's overall export competitiveness. Unfortunately, Croatia is also here lagging behind. In 2013, low-tech goods accounted for 56% of manufacturing exports, compared to 40% in comparable countries, while medium-tech exports accounted for 32%, significantly less than 48% in the peer group. High-tech exports accounted for around 12% in both Croatia and the comparison group. Unfortunately, there was no significant shift until 2022 (World Bank 2024). These patterns of unfavourable export structure and market shares indicate low export competitiveness, which is examined in more detail in the following sections of this study.

### 3.1. Baseline estimation and non-linearity assessment

Based on the premise that Croatian exports are predominantly low-tech, the relationship between unit labor cost (ULC) and firms' export activity was examined (see Table 1). In all specifications, the ULC coefficient lies between –0.672 and –0.764, significant at the 1% level. On average, a 1% acceleration in ULC growth is associated with a 0.672% to 0.764% deceleration in export growth. ULC significantly predicts both export shares (XMS) and total exports (X) throughout the period, both before and after EU accession and for very small firms (20< employees). In addition, employees (L), material capital (K) and unit material cost (UMC) significantly predict exports (X). The importance of UMC and ULC underlines the important role of cost competitiveness in shaping the export performance of manufacturing firms.

The original log-linear specifications assume a negative link between ULC and exports, but non-linear relationships can result from greater cost pass-through or thin profit margins where additional price increases sharply reduce sales. When ULC is high (low), prices may be uncompetitive (competitive), cost pass-through can be greater (lower), and some products may already have low (high) profitability. Under these conditions, the price elasticity of demand is higher (lower), and any further price increase (decrease), especially in the absence of market power, can significantly (marginally) reduce sales, increasing the sensitivity of exports to ULC.

This leads to a non-linear link, with exports reacting more strongly to cost changes at higher cost levels. Appendix 1 confirms this through the negative coefficients for the squared ULC term and the interaction between ULC changes and their initial level: the

**Table 1. Baseline estimation**

| | (1) baseline | (2) no UMC and NK | (3) L < 20 | (4) before 2013. | (5) after 2013. | (6) y = ΔXMS |
|---|---|---|---|---|---|---|
| **ΔULC** | **-0.722*** ** | **-0.737*** ** | **-0.672*** ** | **-0.685*** ** | **-0.753*** ** | **-0.764*** ** |
| | **[0.022]** | **[0.023]** | **[0.026]** | **[0.037]** | **[0.027]** | **[0.043]** |
| ΔL | 0.783*** | 0.796*** | 0.692*** | 0.844*** | 0.703*** | 0.790*** |
| | [0.021] | [0.021] | [0.027] | [0.031] | [0.029] | [0.026] |
| ΔK | 0.049*** | 0.049*** | 0.043*** | 0.035*** | 0.059*** | 0.038*** |
| | [0.007] | [0.007] | [0.009] | [0.012] | [0.010] | [0.014] |
| ΔUMC | -0.129*** | | -0.131*** | -0.117** | -0.140*** | -0.161*** |
| | [0.025] | | [0.031] | [0.046] | [0.028] | [0.049] |
| ΔNK | 0.006* | | 0.001 | 0.007 | 0.006 | 0.001 |
| | [0.004] | | [0.008] | [0.006] | [0.005] | [0.007] |
| N | 47867 | 47900 | 26126 | 19191 | 26549 | 48443 |
| $R^2$ | 0.125 | 0.124 | 0.104 | 0.134 | 0.120 | 0.047 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% i 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

higher the ULC, the greater the export sensitivity to cost shifts.

Apart from the non-linearity, the relationship between exports and ULC can also be asymmetrical, i.e. an identical change in ULC does not necessarily cause an equally strong but opposite export reaction. One reason for this is downward price rigidity: Empirical evidence shows that prices rise faster and more strongly when cost increase than they fall when costs decrease (Peltzman 2000).

A second reason for asymmetric export reactions is the upward rigidity of quantities. Rapid expansion of production and sales volumes is difficult due to capacity constraints, resource availability and higher adjustment costs. Companies also have to accept various sunk costs when entering new foreign markets. These include setting up new distribution networks, investing in marketing, product adaptation, and staff training (Valdec and Zrnc 2015). Consequently, it is easier to reduce sales and exports when ULC is rising than to increase them when ULC is falling. Exports could therefore react more strongly to an increase in ULC than to a decrease, at least in the short term.

Appendix 2 examines this issue. Specifications (1) – (6) test whether an interaction between ULC and a dummy for falling ULC (ULC_fall) shows asymmetry, but the results are not statistically significant. Since such asymmetry may only occur for large cost shifts, specifications (7) – (12) look at the largest ULC declines (lowest decile) also finding no significance. The relationship between ULC and exports thus appears to be non-linear, but not asymmetric.

## 3.2. Company size and the stability of the link

The results in Table 1 assume a uniform export elasticity for all firm sizes. However, small Croatian firms adjust their prices less frequently, suggesting that firm size affects price flexibility (Kunovac and Pufnik 2012), so the relationship between ULC and exports may vary by firm size. In addition, more productive (often medium and large) firms adjust their profit margins more robustly to cost shocks than less productive (often smaller) firms (Melitz and Ottaviano 2008), which may also impact export sensitivity. Since there are relatively few highly productive (usually larger) and many less productive (smaller) firms in Croatia (a pattern observed in other countries aswell), the elasticity of exports with respect to ULC by firm size is examined.

Appendix 3 shows that medium and large firms exhibit higher export sensitivity (specifications (1) – (2)) before but not after Croatia's EU accession (specifications (3) – (4)). The results also indicate that export sensitivity to ULC rises with firm size – measured by employees (L) or total revenue (TR) but only before accession to the Single Market (specifications (6) – (11)). The absolute value of the ULC coefficient

is higher after EU accession, indicating a stronger export response to ULC (confirmed by Appendix 4). The interaction term between ULC and the EU accession dummy (taking value 1 after 2013) is negative and statistically significant in three out of four specifications. The results in the Appendix 4 also confirm that following the EU accession export elasticity has increased for small companies, while it has fallen sharply for large firms. After joining the EU, small firm export sensitivity seems to be enchanced, while the opposite is true for large enterprises.

### 3.3. The role of technology level

Technology intensity can also affect the link between exports and cost competitiveness. High-technology sectors invest more in R&D than low-tech sectors, so increasing ULC may reflect higher product quality or human capital rather than increased production costs. Consequently, export performance in these sectors is more dependent on product quality, innovation and consumer preferences. By contrast, low-tech sectors compete primarily on price, highlighting importance of cost effectiveness.

Appendix 5 shows that the ULC and UMC coefficients are significant for all technology levels, including high-tech, underlining the importance of cost for export performance regardless of technology intensity. However, the absolute value of the ULC coefficient is lower in high-tech sectors, suggesting that labor costs are less important for exports there. Conversely, medium-high tech sectors show a stronger correlation between costs and exports. Kiel (2024) also concludes that medium-high tech sectors exhibit the highest output sensitivity to ULC in major EU economies.

A disaggregated analysis (results available upon request) confirms that ULC is a significant export predictor in every manufacturing sector, ranging from –0.474 in sector C27 (manufacture of electrical equipment) to –1.439 in sector C12 (manufacture of tobacco products). The unweighted average ULC coefficients for low, medium-low, medium-high and high technology sectors are –0.721, –0.708, –0.803 and –0.650, respectively, confirming that the coefficient is slightly larger in the medium- high tech sector, while it is lower in the high-tech sector, which is consistent with the estimates in Appendix 5.

The results also suggest that rising labor costs increase export sensitivity in all sectors except the high-tech sector (results available upon request), and the same pattern holds for the share of labor costs in total expenditure. In the high-tech sectors, higher labor costs appear to be associated with a more skilled workforce, so an increase in ULC does not undermine competitiveness.

### 3.4. Total factor productivity

Total factor productivity (TFP) measures shifts in production efficiency, i.e., producing more output with a given set of resources or the same output with fewer resources. Research shows that firms with high productivity adjust their profit margins more easily in response to cost shocks (Melitz and Ottaviano 2008), which might reduce their export elasticity with respect to ULC. These firms' exports are also less sensitive to real exchange rates (Berthou and Dhyne 2018; Demian and di Mauro 2015; Berman, Martin, and Mayer 2012), indicating that export elasticity decreases as productivity increases. For example, the least productive 20% of firms can have an export elasticity up to eight times higher than the most productive 20% (Berthou and Dhyne 2018).

In Appendix 6, we calculate TFP as in Dvouletý and Blažkova (2022) and compare the 10% most productive firms (top TFP decile) with the 10% least productive firms (bottom TFP decile). The results (Appendix 6, specification (7)) show a notable but smaller gap than that observed for the real exchange rate elasticity. For the least productive firms, the ULC coefficient is –0.978, while for the most productive firms it is almost cut in half (–0.572). Thus, a 1% increase in ULC growth correlates with a 0.572% slowdown in export growth for the most productive firms, compared to 0.978% for the least productive. Other results in Appendix 6 suggest that the sensitivity of exports to ULC rises with firm productivity, but is limited to the period after EU accession and does not apply to export market shares.

### 3.5. Export intensity

Export sensitivity can vary with export intensity. Companies whose output is more strongly oriented towards foreign markets can be more sensitive to cost pressure, since foreign markets are usually more competitive. This is highlighted in Appendix 7 – export sensitivity increases with export intensity, meaning that exports are more sensitive to cost shifts not only in absolute terms but also in relative terms. Higher export intensity implies greater exposure to international markets, which are usually more competitive than domestic markets. The elasticity of output sold abroad can therefore react more sensitively to costs and prices.

This is significant since in our sample, about 15%

of the firms with the highest export intensity (90 – 100% of revenues from exports) generate almost a third of the total export revenue of all manufacturing firms. An idiosyncratic shock to these companies could disproportionately affect domestic exports and the economy. Maintaining the stability of largest exporting companies is therefore critical to stabilising exports and avoiding harsh contractions in the future.

## 4. Discussion of the results and research limitations

The empirical analysis conducted in this study shows a strong negative relationship between cost competitiveness measured by ULC and exports of Croatian manufacturing firms, emphasizing the importance of cost factors in shaping export performance. The relationship between ULC and exports is non-linear, but not asymmetric. The non-linearity of export elasticity is consistent with the simulations in Dekle, Jeongy, and Ryoo (2007), who show that the sensitivity of output to the real effective exchange rate can be either low or high. If the productivity of a particular product is low and approaches the threshold at which exports become unprofitable, a negative shock may cause exports of that product to cease, resulting in a high elasticity. Conversely, the elasticity is lower for products that already have a higher productivity and are actively exported.

While previous literature suggests that downward price rigidity and capacity constraints could lead to asymmetric export responses to rising or falling ULC, our empirical results do not support this hypothesis. The lack of a statistically significant asymmetry indicates that such frictions may exist, but on average are not strong enough to generate a different sensitivity of exports to cost increases and decreases.

Our results suggest that, on average, an individual firm improves its export performance by lowering costs, while higher costs tend to worsen competitiveness. However, this dynamic at the firm level does not necessarily translate to the industry level. If an individual firm lowers its unit costs, it gains a relative advantage over its competitors; however, if all firms do the same, overall competitiveness remains unchanged. The result also depends on the behaviour of foreign competitors, which is beyond the scope of this study. Moreover, since the empirical strategy does not fully eliminate endogeneity, these results should be interpreted with caution. Future research using exogenous shocks to ULC, such as those triggered by discrete policy interventions, would provide a more solid basis for causal inference.

Our study also confirms that firm heterogeneity strongly shapes the relationship between cost competitiveness and export activity. Export sensitivity varies according to firm size, technology intensity, productivity, export intensity and the share of labour costs in total expenditure. The more productive the companies are, the lower their export sensitivity to ULC. Companies in the highest decile of the TFP distribution (the most productive) have almost half the elasticity of companies in the lowest decile (the least productive).

This result suggests that increasing the total factor productivity of firms, especially large firms that account for the majority of production and exports, can strengthen the economy's resilience to cost shocks. Since most firms have lower productivity, a reallocation of labour and other resources towards more productive firms could improve the dynamic efficiency of the economy and increase overall productivity while simultaneously increasing resilience to cost shocks.

The analysis also shows that ULC is a significant predictor of exports for firms of all sizes, but only for the period prior to Croatia's accession to the EU. For the average firm, export elasticity has increased in the post-accession period, suggesting that cost competitiveness as measured by ULC has become a relatively more important factor in export dynamics. This increasing export sensitivity can be observed across the entire sample and is primarily due to the higher sensitivity of small firms, while the export sensitivity of large companies has decreased significantly. Croatia's accession to the EU facilitated access to the markets of other member states and lowered trade costs, which potentially increased the response of foreign trade to prices and costs. Non-tariff barriers were removed and the signalling effect of prices increased, which may have strengthened the impact of cost competitiveness on export performance. Orsini and Perić (2021) also confirm that Croatian merchandise exports react more strongly to relative price changes after EU accession.

Our results show that export sensitivity increases with export intensity, i.e. the greater the proportion of revenue generated by exports, the stronger the correlation between exports and ULC, not only in absolute terms but also in relative terms. This is significant insofar as in our sample around 15% of the companies with the highest export intensity, i.e. with an export intensity between 90-100%, generate almost a third of the total exports of all manufacturing firms. An idiosyncratic shock to these firms could have a disproportionate impact on domestic exports and the economy.

In addition, joining the Eurozone has made prices directly comparable, reinforcing the link between

costs and export performance. Also, the member states of a monetary union lack the flexibility to adjust their exchange rates. Consequently, cost changes, such as shifts in the ULC, have a direct impact on competitiveness as there is no mechanism to devalue the domestic currency (Alhola and Keränen 2022), although this channel was already limited by Croatia's existing exchange rate regime prior to joining the monetary union.

Joining the Schengen area facilitates trade by reducing frictions and simplifying cross-border transactions. Greater trade integration may lead to increased cost sensitivity of exports due to market consolidation, increased competition and stronger price signalling. Simultaneous accession to the eurozone and the Schengen area might lead to higher cost and price sensitivity of exports, which remains a topic for future research. These developments place even more emphasis on price and cost stability, which is particularly important for Croatian policymakers given the constraints on the implementation of an independent monetary policy.

Furthermore, Croatia's competitiveness is highly dependent on labour costs, which will inevitably rise in the near future due to convergence policies, inflationary pressures and labour shortages. While there may be scope to reduce tax and social contribution rates that affect labour costs, these are currently around the EU average (Eurostat 2024), suggesting that other ways of increasing competitiveness need to be considered. While rising labour costs are a natural part of economic convergence, they pose a growing challenge to maintaining export competitiveness, particularly in cost-sensitive sectors.

To alleviate this pressure, Croatia should pursue a multi-faceted policy strategy. Firstly, productivity growth should be boosted through targeted support for technological modernisation, digitalisation and R&D activities, especially among small and medium-sized enterprises. Second, labour market policies should focus on improving human capital by investing in vocational training, STEM education and lifelong learning initiatives that match the skills of the workforce with higher value-added production. Third, transitional support for firms facing acute cost pressures, such as tax incentives linked to productivity-enhancing investments can facilitate adjustment without causing long-term distortions. Overall, such measures can cushion the impact of rising labour costs and at the same time strengthen structural change towards sustainable, innovation-driven competitiveness.

In addition to rising labour costs, the government should also monitor the development of other cost-related factors. When costs surge, e.g. due to higher energy costs, industrial policy should include targeted measures to ensure that the firms under the most pressure receive subsidies to withstand these conditions. However, these measures should be limited in time so as not to prop up unproductive and cost-inefficient firms indefinitely. Such incentives are only economically justifiable if they ultimately promote productivity growth and/or structural shifts in production through technological improvements. Otherwise, there is a risk that these measures will become inefficient and counterproductive in the long term.

Further empirical evidence from this study shows that high-tech sectors have a lower export sensitivity to ULC compared to their counterparts in low- and medium-tech sectors. Furthermore, neither higher ULC levels nor a high share of personnel costs in total expenditure are significantly associated with increased export sensitivity in high-tech companies. This suggests that higher labour costs do not make these companies more susceptible to cost shocks. In the low- and medium-tech sectors, on the other hand, a higher wage level correlates more strongly with cost pressure, which leads to greater export sensitivity.

Although the estimated sectoral differences in the coefficients are modest, they do not support the conclusion that high-tech sectors rely much more heavily on non-price elements of competitiveness. This could reflect a potentially sub-optimal competitive positioning. Conversely, the relatively higher ULC sensitivity observed in medium-high tech sectors compared to low and medium-low tech sectors could indicate technological obsolescence and insufficient innovation, forcing firms to compete predominantly on price.

Given the comparatively lower ULC sensitivity of high-tech firms, industrial policy should consider strategically allocating additional resources to these sectors to increase resilience to cost shocks. Such targeted support could promote innovation, productivity growth and the long-term sustainability of competitiveness. At the same time, increasing productivity and promoting technological modernisation in the low- and medium-tech sectors remains essential to ensure a balanced development of the overall industrial base.

Other studies have produced mixed results. For example, Carlin, Glyn, and Van Reenen (2001) confirm a higher sensitivity of exports to changes in ULC in high-tech sectors, while Decramer, Fuss, and Konings (2016) find no difference in elasticity between sectors with different technology intensities. According to domestic studies, the real effective exchange rate is also a significant predictor of output in low-tech sectors or exports in medium- low tech sectors, but not in medium- or medium-high and high tech sectors (Tkalec

and Vizek 2009; Bogdan, Cota, and Rogić 2015).

Our results emphasise the need to invest more in human capital and increase capital intensity. Government should promote lifelong learning and at the same time encourage firms to invest in capital and technology through targeted incentives. In the longer term, improving the quality of manufacturing production towards technologically advanced products with higher added value is crucial, as high-tech exports are less cost sensitive, as already emphasized. Ultimately, competition based on innovation and product quality offers a more sustainable growth path than cost-based competition, which only offers short-term advantages before being eroded by lower-cost producers.

Accordingly, industrial policy should be complemented by efforts to attract strategic foreign direct investment, deepen integration into global value chains and facilitate the transfer of foreign technology and know-how. It is equally important to strengthen the resilience of supply chains and reduce dependence on external energy sources by diversifying and switching to domestic alternatives. Together, these measures can increase the resilience of the Croatian economy to external shocks and support long-term competitiveness.

## 5. Conclusion

Unit labor cost (ULC) is an indicator of a firm's competitiveness, with any increase implying higher labor costs per unit of output and thus indirectly a potential increase in the export price. This study examined the relationship between ULC and exports at the firm level in the Croatian manufacturing industry, the main driver of merchandise exports. The results provide the most thorough perspective to date on the link between exports and cost competitiveness as measured by ULC. The motivation to investigate this relationship and to explore the degree of export sensitivity stems from Croatia's persistently low export competitiveness compared to other new EU Member States and the dominance of low value-added products among Croatian exporters.

The results confirm that ULC is a significant predictor of exports for firms of all sizes and across different levels of technology intensity. However, there is considerable heterogeneity. In particular, the export performance of high-tech sectors is less sensitive to shifts in ULC, and in these sectors neither a higher ULC nor a larger share of labor costs in total costs increases the sensitivity of exports to ULC. Costs are less strongly linked to export performance in these sectors, meaning that higher costs do not necessarily lead to a loss of competitiveness. Non-price factors such as product quality and human capital play a greater role in driving competitiveness in high-tech. Nevertheless, these products are still underrepresented in the Croatian export structure. At the same time, the link between exports and costs proves to be stronger in the low and medium tech sectors, making cost control crucial for export performance.

After Croatia's accession to the EU, export sensitivity has decreased among large firms, while it has increased among smaller ones. As small firms make up the majority of companies, the export sensitivity of the average company has also increased. Part of this lower sensitivity among large firms can be attributed to their level of multi-factor productivity and their reliance on imported inputs, with EU membership providing access to cheaper inputs and thus contributing to lower cost sensitivity. The increased export sensitivity of small firms is worrying, as they make an important contribution to economic activity and are likely to play a greater role in the country's export activities in the future. Therefore, the causes of these trends should be further investigated.

In the absence of a significant increase in high-tech exports or greater complexity of exports compared to competitors and given Croatia's accession to the Schengen area and the European Monetary Union, there is likely to be an even stronger link between costs and exports in the future. This exerts pressure to keep cost growth below that of competitor countries. Given Croatia's relatively low level of economic development, it will be a challenge to achieve this goal, as faster convergence is required. Overall, price and cost stability are crucial, and the role of fiscal policy is becoming increasingly important due to the limitations of an independent monetary policy. Policy makers should closely monitor cost developments in large and export-intensive ones, as idiosyncratic shocks in these firms could significantly weaken overall exports and affect the domestic economy. In the event of a sudden increase in costs, e.g. due to rising energy prices, selective policy measures should be taken to provide short-term subsidies to the firms and sectors most affected by the costs.

In the long run, it is advisable to increase the quality of manufacturing output and focus on products with higher added value and advanced technology, as the sale of such goods is less sensitive to cost pressures than that of goods with lower complexity. Competition based on innovation and product quality promotes sustainable economic growth, while cost-based competition only offers short-term opportunities. In this context, effective industrial policy, attracting foreign direct investment into productive

segments of the economy, deeper integration into global value chains and the import of foreign technology and expertise are crucial. Building global value chains that are more resilient to shocks such as those triggered by the COVID-19 pandemic is recommended, as is greater use of domestic energy sources. These efforts include an energy transition, diversification of energy supply and reduced dependence on other countries.

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# Appendix

**Appendix 1. Nonlinearities in the relationship between ULC and exports**

| | (1) baseline | (2) no UMC and NK | (3) L < 20 | (4) before 2013. | (5) after 2013. | (6) y = ΔXMS | (7) baseline | (8) no UMC and K | (9) L < 20 | (10) before 2013. | (11) after 2013. | (12) y = ΔXMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ΔULC | -0.965*** | -0.985*** | -0.965*** | -0.870*** | -1.048*** | -0.940*** | -0.869*** | -0.884*** | -0.869*** | -0.811*** | -0.914*** | -0.910*** |
| | [0.046] | [0.040] | [0.046] | [0.077] | [0.046] | [0.050] | [0.033] | [0.030] | [0.033] | [0.052] | [0.037] | [0.037] |
| **ΔULC²** | **-0.066*** ** | **-0.071*** ** | **-0.066*** ** | **-0.051*** ** | **-0.078*** ** | **-0.048*** ** | | | | | | |
| | **[0.011]** | **[0.009]** | **[0.011]** | **[0.017]** | **[0.011]** | **[0.016]** | | | | | | |
| **ΔULC*ULC** | | | | | | | **-0.082*** ** | **-0.089*** ** | **-0.082*** ** | **-0.072*** ** | **-0.087*** ** | **-0.087*** ** |
| | | | | | | | **[0.014]** | **[0.012]** | **[0.014]** | **[0.021]** | **[0.015]** | **[0.015]** |
| ΔL | 0.758*** | 0.780*** | 0.758*** | 0.820*** | 0.678*** | 0.772*** | 0.763*** | 0.787*** | 0.763*** | 0.825*** | 0.682*** | 0.680*** |
| | [0.021] | [0.020] | [0.021] | [0.032] | [0.029] | [0.028] | [0.021] | [0.020] | [0.021] | [0.031] | [0.029] | [0.029] |
| ΔK | 0.049*** | | 0.049*** | 0.035*** | 0.059*** | 0.038*** | 0.049*** | | 0.049*** | 0.035*** | 0.059*** | 0.058*** |
| | [0.007] | | [0.007] | [0.012] | [0.010] | [0.014] | [0.007] | | [0.007] | [0.012] | [0.010] | [0.010] |
| ΔUMC | -0.088*** | | -0.088*** | -0.077* | -0.099*** | -0.133** | -0.098*** | | -0.098*** | -0.083* | -0.114*** | -0.116*** |
| | [0.025] | | [0.025] | [0.045] | [0.028] | [0.054] | [0.025] | | [0.025] | [0.045] | [0.028] | [0.028] |
| ΔNK | 0.006 | 0.007* | 0.006 | 0.007 | 0.006 | 0.001 | 0.006 | 0.007* | 0.006 | 0.008 | 0.006 | 0.006 |
| | [0.004] | [0.004] | [0.004] | [0.006] | [0.005] | [0.007] | [0.004] | [0.004] | [0.004] | [0.006] | [0.005] | [0.005] |
| N | 47867 | 50217 | 47867 | 19191 | 26549 | 48443 | 47867 | 50217 | 47867 | 19191 | 26549 | 26549 |
| $R^2$ | 0.128 | 0.135 | 0.128 | 0.137 | 0.124 | 0.047 | 0.127 | 0.134 | 0.128 | 0.137 | 0.122 | 0.114 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 2. Asymmetry in the relationship between ULC and exports**

| | (1) baseline | (2) no UMC and NK | (3) L < 20 | (4) before 2013. | (5) after 2013. | (6) y = ΔXMS | (7) baseline | (8) no UMC and K | (9) L < 20 | (10) before 2013. | (11) after 2013. | (12) y = ΔXMS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ΔULC | -0.751*** | -0.766*** | -0.673*** | -0.745*** | -0.745*** | -0.771*** | -0.721*** | -0.730*** | -0.721*** | -0.690*** | -0.746*** | -0.741*** |
| | [0.029] | [0.029] | [0.033] | [0.043] | [0.040] | [0.043] | [0.023] | [0.021] | [0.023] | [0.038] | [0.028] | [0.028] |
| **ΔULC_fall*ULC** | **0.062** | **0.063** | **0.004** | **0.129**** | **-0.015** | **0.016** | | | | | | |
| | **[0.043]** | **[0.043]** | **[0.052]** | **[0.063]** | **[0.060]** | **[0.052]** | | | | | | |
| **ΔULC_highest_fall*ULC** | | | | | | | **-0.002** | **-0.005** | **-0.002** | **0.013** | **-0.016** | **-0.019** |
| | | | | | | | **[0.015]** | **[0.014]** | **[0.015]** | **[0.023]** | **[0.020]** | **[0.020]** |
| ΔL | 0.782*** | 0.795*** | 0.692*** | 0.843*** | 0.703*** | 0.790*** | 0.784*** | 0.812*** | 0.784*** | 0.844*** | 0.703*** | 0.702*** |
| | [0.021] | [0.021] | [0.027] | [0.031] | [0.029] | [0.026] | [0.021] | [0.020] | [0.021] | [0.031] | [0.029] | [0.029] |
| ΔK | 0.049*** | 0.049*** | 0.043*** | 0.035*** | 0.059*** | 0.038*** | 0.049*** | | 0.049*** | 0.035*** | 0.059*** | 0.057*** |
| | [0.007] | [0.007] | [0.009] | [0.012] | [0.010] | [0.014] | [0.007] | | [0.007] | [0.012] | [0.010] | [0.010] |
| ΔUMC | -0.128*** | | -0.131*** | -0.116** | -0.140*** | -0.161*** | -0.129*** | | -0.129*** | -0.117** | -0.140*** | -0.142*** |
| | [0.025] | | [0.031] | [0.046] | [0.028] | [0.049] | [0.025] | | [0.025] | [0.046] | [0.028] | [0.028] |
| ΔNK | 0.007* | | 0.001 | 0.008 | 0.006 | 0.001 | 0.006* | 0.008** | 0.006* | 0.007 | 0.006 | 0.007 |
| | [0.004] | | [0.008] | [0.006] | [0.005] | [0.007] | [0.004] | [0.004] | [0.004] | [0.006] | [0.005] | [0.005] |
| N | 47867 | 47900 | 47867 | 19191 | 26549 | 48443 | 47867 | 47900 | 47867 | 19191 | 26549 | 48443 |
| $R^2$ | 0.125 | 0.124 | 0.104 | 0.135 | 0.120 | 0.047 | 0.125 | 0.130 | 0.125 | 0.134 | 0.120 | 0.112 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 3. Export elasticity and firm size**

| | (1) baseline | (2) no UMC and NK | (3) before 2013. | (4) after 2013. | (5) y = ΔXMS | (6) L as firm size | (7) L as firm size (before 2013) | (8) L as firm size (after 2013) | (9) TR as firm size | (10) TR as firm size (before 2013) | (11) TR as firm size (after 2013) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| ΔULC | -0.694*** | -0.708*** | -0.625*** | -0.751*** | -0.754*** | -0.643*** | -0.559*** | -0.722*** | -0.539*** | -0.305** | -0.788*** |
| | [0.023] | [0.024] | [0.040] | [0.027] | [0.050] | [0.033] | [0.054] | [0.040] | [0.093] | [0.135] | [0.117] |
| **ΔULC*Medium_ firm** | **-0.164*** ** | **-0.164*** ** | **-0.230*** ** | **-0.086** | **-0.043** | | | | | | |
| | **[0.061]** | **[0.062]** | **[0.079]** | **[0.098]** | **[0.089]** | | | | | | |
| **ΔULC*Large_ firm** | **-0.242*** | **-0.256** ** | **-0.534*** ** | **-0.176** | **-0.106** | | | | | | |
| | **[0.126]** | **[0.129]** | **[0.128]** | **[0.166]** | **[0.141]** | | | | | | |
| **ΔULC*L** | | | | | | **-0.039*** ** | **-0.059*** ** | **-0.017** | | | |
| | | | | | | **[0.013]** | **[0.019]** | **[0.017]** | | | |
| **ΔULC*TR** | | | | | | | | | **-0.022** ** | **-0.045*** ** | **0.004** |
| | | | | | | | | | **[0.011]** | **[0.015]** | **[0.014]** |
| ΔL | 0.784*** | 0.796*** | 0.845*** | 0.703*** | 0.790*** | 0.782*** | 0.842*** | 0.702*** | 0.785*** | 0.851*** | 0.703*** |
| | [0.021] | [0.021] | [0.032] | [0.029] | [0.026] | [0.021] | [0.032] | [0.029] | [0.021] | [0.032] | [0.029] |
| ΔK | 0.050*** | 0.050*** | 0.036*** | 0.059*** | 0.038*** | 0.050*** | 0.036*** | 0.059*** | 0.050*** | 0.035*** | 0.059*** |
| | [0.007] | [0.007] | [0.012] | [0.010] | [0.014] | [0.007] | [0.012] | [0.010] | [0.007] | [0.012] | [0.010] |
| ΔUMC | -0.127*** | | -0.105** | -0.140*** | -0.160*** | -0.129*** | -0.113** | -0.141*** | -0.134*** | -0.126*** | -0.138*** |
| | [0.025] | | [0.045] | [0.028] | [0.049] | [0.026] | [0.046] | [0.028] | [0.025] | [0.044] | [0.028] |
| ΔNK | 0.006* | | 0.007 | 0.006 | 0.001 | 0.006 | 0.007 | 0.006 | 0.007* | 0.008 | 0.006 |
| | [0.004] | | [0.006] | [0.005] | [0.007] | [0.004] | [0.006] | [0.005] | [0.004] | [0.006] | [0.005] |
| N | 47867 | 47900 | 19191 | 26549 | 48443 | 47867 | 19191 | 26549 | 47867 | 19191 | 26549 |
| $R^2$ | 0.126 | 0.125 | 0.137 | 0.120 | 0.047 | 0.126 | 0.136 | 0.120 | 0.125 | 0.136 | 0.120 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 4. Changes in export elasticity following EU accession**

| | (1) Sample: all firms, baseline | (2) Sample: all firms, no UMC and NK | (3) Sample: L < 20 | (4) Sample: all firms, y = ΔXMS | (5) Sample: small firms (L < 50) | (6) Sample: medium firms (50 < L < 250) | (7) Sample: big firms (L > 250) |
|---|---|---|---|---|---|---|---|
| ΔULC | -0.678*** | -0.693*** | -0.590*** | -0.771*** | -0.605*** | -0.906*** | -1.240*** |
| | [0.035] | [0.035] | [0.043] | [0.086] | [0.038] | [0.069] | [0.145] |
| **ΔULC *EU** | **-0.085*** | **-0.086**** | **-0.150***** | **0.015** | **-0.154***** | **0.053** | **0.613***** |
| | **[0.044]** | **[0.043]** | **[0.052]** | **[0.092]** | **[0.047]** | **[0.114]** | **[0.197]** |
| ΔL | 0.782*** | 0.794*** | 0.690*** | 0.790*** | 0.740*** | 0.923*** | 0.855*** |
| | [0.021] | [0.021] | [0.027] | [0.027] | [0.024] | [0.057] | [0.096] |
| ΔK | 0.049*** | 0.049*** | 0.043*** | 0.038*** | 0.043*** | 0.093*** | 0.112** |
| | [0.007] | [0.007] | [0.009] | [0.014] | [0.008] | [0.022] | [0.044] |
| ΔUMC | -0.128*** | | -0.129*** | -0.162*** | -0.130*** | -0.121* | 0.112 |
| | [0.025] | | [0.031] | [0.050] | [0.027] | [0.064] | [0.167] |
| ΔNK | 0.006 | | 0.001 | 0.001 | 0.003 | 0.010* | 0.006 |
| | [0.004] | | [0.008] | [0.007] | [0.006] | [0.005] | [0.010] |
| N | 47867 | 47900 | 26126 | 48443 | 35722 | 9414 | 2731 |
| $R^2$ | 0.125 | 0.124 | 0.105 | 0.046 | 0.109 | 0.211 | 0.334 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 5. Export elasticity and the level of technological intensity**

| | (1) Sample: low tech firms | (2) Sample: medium-low tech firms | (3) Sample: medium-high tech firms | (4) Sample: high tech firms | (5) Sample: all firms, baseline | (6) Sample: all firms, no UMC and NK | (7) Sample: all firms, L < 20 | (8) Sample: all firms, before 2013 | (9) Sample: all firms, after 2013 | (10) Sample: all firms, y = ΔXMS |
|---|---|---|---|---|---|---|---|---|---|---|
| **ΔULC** | **-0.703*** ** | **-0.683*** ** | **-0.841*** ** | **-0.571*** ** | **-0.730*** ** | **-0.746*** ** | **-0.730*** ** | **-0.689*** ** | **-0.765*** ** | **-0.772*** ** |
| | **[0.035]** | **[0.040]** | **[0.043]** | **[0.084]** | **[0.023]** | **[0.023]** | **[0.023]** | **[0.039]** | **[0.026]** | **[0.045]** |
| **ΔULC*high_tech** | | | | | **0.152*** | **0.162*** | **0.152*** | **0.059** | **0.229*** | **0.167*** |
| | | | | | **[0.089]** | **[0.089]** | **[0.089]** | **[0.121]** | **[0.126]** | **[0.098]** |
| ΔL | 0.790*** | 0.744*** | 0.813*** | 0.818*** | 0.784*** | 0.796*** | 0.784*** | 0.844*** | 0.726*** | 0.791*** |
| | [0.034] | [0.032] | [0.054] | [0.099] | [0.021] | [0.021] | [0.021] | [0.031] | [0.028] | [0.026] |
| ΔK | 0.053*** | 0.061*** | 0.039** | -0.005 | 0.050*** | 0.049*** | 0.050*** | 0.035*** | 0.059*** | 0.038*** |
| | [0.012] | [0.012] | [0.018] | [0.027] | [0.007] | [0.007] | [0.007] | [0.012] | [0.009] | [0.014] |
| ΔUMC | -0.105*** | -0.103** | -0.174*** | -0.213** | -0.128*** | | -0.128*** | -0.117** | -0.134*** | -0.160*** |
| | [0.037] | [0.048] | [0.044] | [0.088] | [0.025] | | [0.025] | [0.046] | [0.027] | [0.049] |
| ΔNK | 0.009 | 0.011* | -0.002 | -0.011 | 0.006 | | 0.006 | 0.007 | 0.005 | 0.001 |
| | [0.006] | [0.007] | [0.009] | [0.017] | [0.004] | | [0.004] | [0.006] | [0.005] | [0.007] |
| N | 19777 | 16660 | 9161 | 2269 | 47867 | 47900 | 47867 | 19191 | 28676 | 48443 |
| $R^2$ | 0.123 | 0.110 | 0.176 | 0.100 | 0.125 | 0.124 | 0.125 | 0.134 | 0.120 | 0.047 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 6. Export elasticity and total factor productivity**

| | (1) baseline | (2) no UMC and NK | (3) L < 20 | (4) before 2013. | (5) after 2013. | (6) y = ΔXMS | (7) low and high TFP |
|---|---|---|---|---|---|---|---|
| ΔULC | -0.807*** | -0.828*** | -0.807*** | -0.752*** | -0.895*** | -0.789*** | -0.709*** |
| | [0.042] | [0.043] | [0.042] | [0.059] | [0.041] | [0.044] | [0.024] |
| **ΔULC*TFP** | **0.101*** ** | **0.111*** ** | **0.101*** ** | **0.082** | **0.153*** ** | **0.030** | |
| | **[0.037]** | **[0.037]** | **[0.037]** | **[0.051]** | **[0.033]** | **[0.070]** | |
| ΔL | 0.771*** | 0.780*** | 0.771*** | 0.846*** | 0.683*** | 0.786*** | 0.759*** |
| | [0.021] | [0.021] | [0.021] | [0.030] | [0.029] | [0.029] | [0.021] |
| ΔK | 0.050*** | 0.050*** | 0.050*** | 0.037*** | 0.060*** | 0.038*** | 0.049*** |
| | [0.007] | [0.007] | [0.007] | [0.011] | [0.010] | [0.014] | [0.007] |
| ΔUMC | -0.105*** | | -0.105*** | -0.084** | -0.118*** | -0.154** | -0.114*** |
| | [0.024] | | [0.024] | [0.039] | [0.028] | [0.061] | [0.026] |
| ΔNK | 0.006 | | 0.006 | 0.006 | 0.006 | 0.001 | 0.006 |
| | [0.004] | | [0.004] | [0.006] | [0.005] | [0.007] | [0.004] |
| **ΔULC*low_TFP** | | | | | | | **-0.270*** ** |
| | | | | | | | **[0.046]** |
| **ΔULC*high_TFP** | | | | | | | **0.137*** ** |
| | | | | | | | **[0.050]** |
| N | 47867 | 47880 | 47867 | 21318 | 26549 | 48443 | 47867 |
| $R^2$ | 0.126 | 0.126 | 0.126 | 0.134 | 0.122 | 0.047 | 0.128 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share

**Appendix 7. Export elasticity and export intensity**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | baseline | no UMC and NK | L < 20 | before 2013. | after 2013. | y = ΔXMS |
| ΔULC | -0.840*** | -0.857*** | -0.840*** | -0.856*** | -0.824*** | -0.929*** |
| | [0.026] | [0.026] | [0.026] | [0.042] | [0.033] | [0.072] |
| **ΔULC*export_ intensity** | **-0.077*** ** | **-0.078*** ** | **-0.077*** ** | **-0.109*** ** | **-0.048** ** | **-0.107*** ** |
| | **[0.017]** | **[0.017]** | **[0.017]** | **[0.027]** | **[0.021]** | **[0.027]** |
| ΔL | 0.779*** | 0.791*** | 0.779*** | 0.832*** | 0.703*** | 0.784*** |
| | [0.021] | [0.021] | [0.021] | [0.031] | [0.029] | [0.026] |
| ΔK | 0.049*** | 0.048*** | 0.049*** | 0.034*** | 0.058*** | 0.037*** |
| | [0.007] | [0.007] | [0.007] | [0.012] | [0.010] | [0.014] |
| ΔUMC | -0.125*** | | -0.125*** | -0.120*** | -0.135*** | -0.156*** |
| | [0.025] | | [0.025] | [0.045] | [0.028] | [0.047] |
| ΔNK | 0.007* | | 0.007* | 0.008 | 0.006 | 0.001 |
| | [0.004] | | [0.004] | [0.006] | [0.005] | [0.007] |
| N | 47867 | 47900 | 47867 | 19191 | 26549 | 48443 |
| $R^2$ | 0.127 | 0.127 | 0.127 | 0.139 | 0.121 | 0.047 |

Source: authors' calculations

Note: Clustered standard errors in brackets. ***, ** and * denotes statistical significance at the 1%, 5% and 10%. All specifications include time and sector fixed effects. Δ = first difference, ULC = unit labour cost, L = number of employees, K = material capital, UMC = unit material cost, NK = non-material capital, N = observations, $R^2$ coefficient of determination, y = dependent variable, XMS = export market share