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THE IMPACTS OF EPCS ON PRAGUE'S RESIDENTIAL MARKET RENTS

Tomáš Podškubka, Barbora Rýdlová, Josef Arlt, Tomáš Krabec

Abstract

The EU has introduced legal regulations to mitigate climate change, and it is pertinent to investigate economic incentives to invest in higher Energy Performance Certificates (EPC). This paper examines the impact of EPCs on asking rents in Prague's residential property market using a hedonic regression model. A newly collected dataset of 1,118 rental advertisements is analyzed, with control for the apartment total area, condition, location, and energy efficiency. The results indicate that more energy-efficient residential properties command a rental premium, even though the magnitude varies across location segments. In highly desirable areas, factors such as accessibility and prestige play a crucial role, while in less attractive areas, the EPC ratings are less pronounced. The findings contribute to the existing literature on the economics of energy efficiency by providing empirical evidence from a Central and Eastern European city, offering insights for policymakers, investors, and tenants.

Keywords: *Energy Performance Certificate; Energy Efficiency; Asking Rent; Residential Property; Prague Real Estate Market; Hedonic Regression Model; Green Premium*

JEL classification: *Q58, R31, D12, O18*

Ing. **Tomáš Podškubka**, Ph.D.
MRICS (corresponding author)
Assistant Professor
Prague University of Economics and Business
W. Churchill Sq. 1938/4
130 67 Prague 3 – Žižkov, Czechia
E-mail: tomas.podskubka@vse.cz
ORCID: 0000-0002-8761-2661

Ing. **Barbora Rýdlová**, Ph.D.
Assistant Professor
Prague University of Economics and Business
Czechia
E-mail: barbora.rydlova@vse.cz
ORCID: 0000-0003-0701-730X

prof. **Ing. Josef Arlt**, CSc.
Professor
Prague University of Economics and Business
Czechia
E-mail: josef.arlt@vse.cz
ORCID: 0000-0001-8349-7419

doc. Ing. **Tomáš Krabec**, Ph.D., MBA
Associate Professor
Prague University of Economics and Business
Czechia
E-mail: tomas.krabec@vse.cz
ORCID: 0000-0003-4166-8800

1. Introduction

The housing sector is among the largest sources of CO_2 emissions in the European Union and therefore represents a key area for energy efficiency policy. This sector offers significant potential for emission reductions. For example, Germany, the EU's largest economy, stated in its Climate Action Plan 2050 that by 2016 it had reduced its total emissions by 38%, with 26% of this reduction coming from the housing sector (BMWK 2016). These figures illustrate that residential buildings play a crucial role not only in environmental policy but also in the economic effectiveness of climate mitigation strategies.

The global framework for emission reductions was established as early as 1997 through the Kyoto Protocol, when most countries committed to reducing greenhouse gas emissions (UNFCCC 1997). However, at that time, there were no specific tools available to enable effective implementation of these commitments at the national level particularly in sectors characterized by decentralized decision-making such as housing markets.

The European Union responded by adopting the Energy Performance of Buildings Directive (EPBD), which introduced Energy Performance Certificates (EPCs) as a standardized indicator of building energy efficiency (European Union 2010). The purpose of EPCs is to reduce information asymmetry between buyers and sellers or between owners and tenants regarding the energy performance of buildings and related costs. EPCs rate buildings on a scale from A to G, where grade A indicates excellent energy efficiency, while grade G signals very low efficiency requiring urgent improvements.

Several countries outside the EU have developed voluntary labeling systems. In the United States building energy performance ratings are not legally mandated; however, the two main voluntary rating systems the Energy Star and HERS ratings are used. Other major world economies and significant emitters of CO_2 emissions have adopted a combined system, where voluntary labeling systems are in place, however, certain types of properties are legally mandated to have an energy label. For example, in Japan, the CASBEE system is compulsory for large buildings in cities and in Australia, the CBD system is required for commercial premises larger than 1000 square meters.

The EPC framework represents the most comprehensive legally mandated system for labeling building energy performance worldwide. It not only supports environmental objectives, such as reducing greenhouse gas emissions, but also plays a pivotal role in real estate markets. By introducing a transparent and measurable quality attribute, energy efficiency is allowed to be capitalized into property prices and rental rates, thereby linking environmental performance with economic decision-making by market participants.

From a theoretical economic perspective, EPCs can influence rental prices through several interrelated mechanisms. First, EPCs act as an information signal that increases transparency about expected energy consumption and operating costs, which are otherwise difficult for tenants to observe prior to occupancy. By reducing uncertainty and perceived risk, EPCs enable tenants to form a more accurate assessment of dwelling quality (Ou et al. 2025). Second, in rental housing markets, landlords typically bear the costs of energy-efficiency investments, while tenants directly benefit from lower energy bills. This misalignment–commonly referred to as the split-incentive problem–can lead to systematic underinvestment in energy efficiency. EPCs provide a credible signal of expected energy savings, allowing these benefits to be partially capitalized into higher rents and thus creating an incentive for landlords to invest in energy improvements (Singhal et al. 2025). Third, tenants may value energy efficiency not only through direct cost savings but also through enhanced comfort, such as stable indoor temperatures, improved air quality, and reduced noise, all of which are closely linked to higher energy performance. These aspects contribute to perceived housing quality and are often discussed in the literature under the concept of a "green premium" (Fisk et al. 2020). From this, the following theoretical causal logic emerges: EPCs act as an information-based signal of quality that reduces transaction uncertainty, partially resolves split incentives, and enables the capitalization of comfort and energy savings into rental prices. The greater the expected savings on energy costs, the stronger the tenants' motivation to accept higher rents.

In this context, empirical studies conducted in individual EU countries play a key role in examining whether and how a system based on the above-mentioned theoretical economic reasoning actually works in practice. These studies not only verify the validity of theoretical assumptions but also provide important insights for optimizing energy efficiency policies. By analyzing real-world data, they make it possible to identify factors that support or hinder the capitalization of energy efficiency into property prices and rents, and reveal differences between markets depending on institutional quality, the degree of EPC enforcement, or consumer awareness. The results of these studies are indispensable not only for improving the existing system but also for its further expansion and harmonization across EU member states, which is crucial for achieving climate goals and ensuring the functioning of a unified real estate market.

However, empirical evidence remains heavily concentrated in Western European countries, while Central and Eastern European (CEE) markets are largely underrepresented in the literature. This omission is particularly relevant given the specific characteristics of CEE housing markets, which are often marked by aging building stock, heterogeneous energy performance, and uneven enforcement of EPC disclosure requirements. These features may weaken or alter the price effects observed in more mature markets, making theoretical predictions less straightforward.

This study analyzes the impact of EPC ratings on rental prices in the residential market in Prague, which represents the largest and most significant real estate market in the Czech Republic. In this study, rent is understood as the asking price, i.e., the amount listed by landlords or real estate agencies in online rental advertisements. The Prague housing market is distinctive–issues of affordability have deepened due to slow construction of new apartments, high demand, and ongoing urbanization. Prague is the most expensive city in the country, with an average sale price of €5,153 per square meter (Deloitte 2025) and an average rent of €15.9 per square meter (Deloitte 2025). In the European context, Prague ranks among the least affordable locations: purchasing a residential property requires more than 13 annual salaries, placing it as the second least affordable city in the EU. This situation leads to rising rental prices and high market liquidity. Therefore, the Prague rental market provides a suitable environment for testing whether energy performance entails a measurable premium on rent.

To isolate the impact of energy performance on asking rents, a hedonic regression analysis is employed. In estimating the premium, the article justifies and explains the methodological choice of the model specification. Through an empirical comparison of models using ordinal versus dummy variable representations of the EPC scale, and by drawing on relevant econometric theory, it demonstrates why the selected specification delivers statistically robust and reliable results regarding the influence of EPC ratings on apartment rents.

The paper is structured into five sections (besides the introductory part). Section 2 reviews the relevant literature on energy performance in the residential rental markets. Section 3 describes the dataset and econometric methodology. Section 4 presents the estimation results of econometric analysis, while Section 5 discusses their implications. Section 6 concludes with main findings and suggestions for further research.

2. Literature review

Energy Performance Certificates have become an integral component in the EU real estate markets, especially in the context of the EU's directives focused on enhancing energy efficiency in buildings. It has prompted a substantial body of empirical work on their capital and rental prices effect. This literature review synthesizes findings from various studies to examine the impact of EPCs on rental prices. It aims to explore theoretical perspectives, methodological approaches, empirical evidence from different countries, and policy implications. Most studies use a hedonic regression model in their analysis decomposing property values into characteristics such as size, location and efficiency attributes. Occasionally, a survey analysis approach is used.

Early evidence by Brounen and Kok (2011), who confirmed a "green premium" for the Netherlands market, finding that A-rated dwellings sold at a higher prices than D- or E-rated units. The study was robust, the data sample amounted to 177,000 Dutch real estate transactions in 2008, using a hedonic model.

Subsequent studies in Germany (Cajias and Piazolo 2013; Kholodilin et al. 2017; Cajias, Fuerst, and Bienert 2019 and März, Stelk, and Stelzer 2022) and Ireland (Hyland, Lyons, and Lyons 2013 and Collins and Curtis 2018) corroborated this result, demonstrating statistically significant positive coefficients for higher energy ratings in both sales and rental regressions. However, the magnitude of the rental premium typically lags behind that of sales, reflecting shorter contract horizons and landlords' limited ability to fully capitalize energy-efficiency gains fully. In the study by Cajias and Piazolo (2013), the authors examined residential properties in Germany for transactions and rents between 2008 and 2010. They found a price premium between energy-efficient and inefficient properties, with a premium of 3.15% for sales and €0.76 per m^2 for rentals, respectively. Cajias, Fuerst, and Bienert (2019), based on the evidence of about 760,000 observations in the German market, reported that energy-efficient units are rented at a premium. Kholodilin, Mense, and Michelsen (2017) and März, Stelk, and Stelzer (2022) confirm the conclusions for the German rental market. Hyland, Lyons, and Lyons (2013) found that the most energy-efficient properties in Ireland rated category A were sold at a price premium of 11% and rented at a rental premium of 2%. The authors used a hedonic regression model for their analysis. Collins and Curtis (2018) examined the effect of EPCs on residential rents in Ireland, concluding that tenants are willing to pay an average of €38 extra to improve the energy performance of a dwelling by one grade. However, in this case, the methodological approach differed as the authors did not go down the hedonic regression model route but applied a survey analysis.

The effect of EPCs on commercial property was analyzed by Fuerst and McAllister (2011) for the market in England, but they found no evidence of an impact of EPCs on rent.

Beyond Western Europe Khazal and Sønstebø (2020) documented the EPC rental price effect in Norway finding comparable patterns. Using a sample of 440,000 rental contracts between 2011 and 2018 and a hedonic regression model, they find a premium for properties with a higher EPC rank. Moreover, if a professional agent rented the property, the premium that can be assigned to the EPC rank was higher than if the property was rented directly by the owner. Evidence for the existence of a green premium is further demonstrated by Gerassimenko, Defau, and De Moor (2024), who analyzed the Flanders region in Belgium. They had a dataset with more than 177,000 sales transactions and rentals between 2016 and 2021. The results show the presence of a premium for sales of less-energy intensive properties, and this premium is significantly higher than the premium for rentals of higher EPC-rank properties.

Numerous studies bring empirical evidence also for areas outside Europe with different frameworks of voluntary or legally mandated energy labeling system, such as Australia, China or the USA.

Fuerst and Warren-Myers (2018) using Australian data for the Australian Capital Territory, which is the only area where EPC disclosure is mandatory documented that there is a green premium present on rents and sales as well.

Authors Gabe and Rehm (2014), who examined Sydney commercial property in Australia, are of the same view. In contrast, Reichardt (2014) studied commercial real estate for the central and eastern US and found that properties with EPC ratings from Energy star or LEED have a rent premium.

On the other hand, Zheng et al. (2012) conducted a study on the Chinese real estate market with opposite results. They concluded that there is a premium in the pre-sale phase, but this premium disappears afterward, and the same properties are sold or rented at a discount, the dataset containing residential properties in Beijing.

The performed literature review is summarized in the following table.

Table 1. Literature Review Summary

Country	Author	Transaction Type	Property Type	EPC Impact on Residential rents	Method Used
Australia	Fuerst and Warren-Myers 2018	Sales and Rentals	Residential	Yes	Hedonic regression model
Australia	Gabe and Rehm 2014	Rentals	Residential	No	Hedonic regression model
Belgium	Gerassimenko, Defau, and De Moor 2024	Sales and Rentals	Residential	Yes	Hedonic regression model
China	Zheng et al. 2012	Sales and Rentals	Residential	Yes, but negative	Hedonic regression model
England	Fuerst and McAllister 2011	Sales and Rentals	Commercial	No	Hedonic regression model
Germany	Cajias, Fuerst, and Bienert 2019	Sales and Rentals	Residential	Yes	Hedonic regression model
Germany	Cajias and Piazolo 2013	Sales and Rentals	Residential	Yes	Hedonic regression model
Germany	Kholodilin, Mense, and Michelsen 2017	Sales and Rentals	Residential	Yes	Hedonic regression model
Germany	März et al. 2022	Rentals	Residential	Yes	Hedonic regression model
Ireland	Hyland, Lyons, and Lyons 2013	Sales and Rentals	Residential	Yes	Hedonic regression model
Ireland	Collins and Curtis 2018	Rentals	Residential	Yes	Survey analysis
Norway	Khazal and Sønstebø 2020	Rentals	Residential	Yes	Hedonic regression model
United States	Reichardt 2014	Rentals	Commercial	Yes	Hedonic regression model

Source: Authors.

The existing literature on the impact of EPCs on property prices and rental values has focused on sales transactions as well as rentals. These findings collectively support the hypothesis that energy efficiency is valued in markets where certification is standardized and transparent.

Several studies have confirmed a positive effect of EPCs on property prices, some have explored their impact on rental prices, particularly in the context of residential properties. For instance, studies such as those by März et al. (2022) in Germany, Collins and Curtis (2018) in Ireland, and Khazal and Sønstebø (2020) in Norway have established a sales premium for energy-efficient properties. Fewer studies focus on commercial real estate EPCs and also bring contradictory results. However, the total number of studies conducted with the focus on rental transactions is still quite limited. Moreover, the existing evidence predominantly comes from highly developed economies, like Australia and western European Union countries. Only one of the studies covers the Chinese market and one the US market. We can attribute this to the fact that European Union is a global leader in ESG adoption setting the trends in the market as well as legislation. Therefore, EU is one of the locations where the impact of the legislation is subject to more extensive research.

However, the majority of research in EU has been conducted in countries like Germany, Ireland, and Norway, with no or limited number of studies focusing on Central and Eastern European markets. Based on our review, there has been no scientific study published and indexed in WOS or Scopus databases covering the Czech Republic. The specific dynamics of Prague's real estate market, characterized by high demand, low housing affordability, slow construction of new housing, and significant urbanization, have not been yet analyzed in the context of EPCs.

This article therefore aims to address these gaps by:

1. Focusing on the rental market: Investigating the impact of EPCs on asking rents in Prague, thereby contributing to the relatively limited literature on rental premiums associated with energy efficiency.
2. Regional focus: Research for Central and Eastern Europe (CEE) remains scarce. To the authors' knowledge, only Mullen and Prochazka (2025) have examined the Czech Republic's residential rental market. But given Prague's distinct characteristics–limited housing supply, high urban density, and rapid growth in the rental sector–examining the EPC impact here fills a significant regional research gap.

By filling these gaps, the study aims to enhance the understanding of how energy performance influences asking rents in a major Central European city, providing valuable insights for policymakers, investors, tenants, and academics.

3. Data and methodology

3.1. *Data Description*

The original dataset was collected and processed using the following methodology. Using a Python script, advertisements for apartment rentals and sales from the publicly accessible portal Sreality.cz were extracted as of September 22, 2023, covering the entire territory of the Czech Republic. Given that the Prague rental market is the most liquid and exhibits a high number of transactions, the first step of the research focused exclusively on the rental market in Prague; therefore, for this study, data related to apartment rentals in the capital city, including the EPC, were selected. The Sreality.cz portal was chosen as the data source because it represents the most extensive publicly available database of rental offers in the Czech Republic. This choice was necessary due to the absence of a centralized, publicly accessible database of actual rental prices, which is caused by legislative restrictions, market fragmentation, and the protection of business and personal data. In the Czech Republic, there is no legal obligation to disclose actual rental prices or energy performance certificates for rented properties, primarily because the rental housing market is considered a purely private-law domain where the state does not intervene in price formation and does not require transparent record-keeping. Another reason is the protection of contractual freedom between landlords and tenants, where transaction prices are part of individual contractual agreements, and their disclosure could be perceived as an infringement of trade secrets and the privacy of market participants. Information on actual transaction prices is therefore considered sensitive business data and is not made available to the public.

It is important to emphasize that data from the Sreality.cz portal contain only asking prices, not actual transaction prices, which cannot practically be obtained because they are not recorded in any public database and their availability is limited to internal systems of real estate agencies. This fact represents a methodological limitation that must be considered when interpreting the analysis results, as asking prices tend to be systematically higher than transaction prices. In hedonic models that examine the impact of EPC and other factors on rental prices, the use of asking prices may lead to an overestimation of the absolute level of rents and distortion of estimated coefficients. The result may be an overvaluation of the significance of EPC or other attributes because the model works with prices that do not reflect actual market behavior. Nevertheless, quantifying this effect using robustness tests is difficult because there is no reference sample of transaction prices that would allow model calibration. Without access to actual transaction data, it is impossible to estimate the size of the deviation or verify whether the distortion is constant across market segments. Moreover, the difference between asking and transaction prices is not fixed–it depends on location, property type, listing duration, and the negotiating power of the parties (Kolbe et al. 2021).

As part of preparing the dataset for econometric analysis, it was found that not all downloaded listings contained the complete information necessary for robust modeling of price relationships. Therefore, a systematic filtering process was applied to retain only those records that included key variables influencing the price level. This procedure is essential to ensure data consistency and minimize estimation bias that could arise from missing values. The final dataset primarily included listings containing the asking rental price and the basic property characteristics that have a direct impact on these prices, i.e.,

1. Total area of the offered apartment in square meters (*area_net*),
2. Average square meters per room (*sqm_room*),
3. Calculated asking rent price in CZK per square meter (*price*),
4. Apartment technical condition(*state*),
5. Apartment location (*location*),
6. Energy performance class (*epc*),
7. Information on whether the apartment has a separate kitchen (*sep_kitch*).

Supplementary attributes such as floor level, balcony, parking options, or interior furnishings were not included in the dataset due to their frequent incompleteness and inconsistent reporting. Including these variables would have significantly reduced the sample size and increased data heterogeneity, which could negatively affect the stability and interpretability of the results. This approach is consistent with standard practice in empirical real estate market studies, where the use of a homogeneous set of key variables is preferred over striving for maximum detail at the expense of representativeness (Hill 2013).

Apartment technical condition is a zero-one variable. The following apartments are marked as "0": good, under reconstruction, very good, before reconstruction. The following apartments are marked as "1": after reconstruction, in the state of a development project under sales, under construction, new construction. The apartment location is a categorical variable with values 1, 2, 3, 4, 5, and 6 according to the attractiveness of urban districts for residential purposes (see Table 2). The level of district attractiveness was assigned based on several factors, such as price level, reputation, availability of public amenities, access to public transport–especially the metro–architectural and urban quality, and the extent of green spaces. To reduce subjectivity in assigning data to a specific level, three researchers carried out the classification independently, and in cases of discrepancies, further analysis and discussion were conducted to reach unanimous agreement.

It might seem reasonable to objectify the classification of apartment locations by including measurable variables such as distance to the city center, metro accessibility, or neighborhood fixed effects. However, this would not actually provide a more objective control over location quality, because district attractiveness results from a complex combination of factors–not only physical accessibility but also socioeconomic status, reputation, level of public amenities, architectural quality, and green space availability. Individual indicators, such as distance to the city center, can be misleading, as a peripheral district may be highly valued due to infrastructure, low crime rates, or its prestigious character. Similarly, metro accessibility is a binary or limited variable that ignores other forms of transport and overall urban quality. Moreover, neighborhood fixed effects require detailed data at the level of individual apartments, which are not available, and assume a homogeneous character of districts, which is not the case in practice. Therefore, using a comprehensive categorical variable validated through expert consensus is methodologically more appropriate and minimizes the risk of bias that would arise from relying on partial indicators that fail to capture the full variability of location quality.

Energy performance class has a scale from A to G, which has been transformed into numerical values from 1 to 6 i.e. "1"=A most energy efficient, "2"=B, "3"=C, "4"=D, "5"=E, "6"=F least energy efficient.

In cases where an energy performance assessment is not available when offering an apartment for sale or rent, legal regulations require declaring class G. For this reason, this category may be assigned to apartments across all actual energy efficiency classes, making it a highly unreliable indicator of the least efficient properties. Including it in the model could lead to significant distortion of the results. In the original dataset, approximately 20% of records were classified as EPC class G. To verify potential bias, the observable characteristics of properties labeled as class G were compared with those of the remaining sample. The analysis showed that these properties are, on average, older; however, their geographical and structural parameters are essentially comparable to the rest, confirming that class G may in fact include apartments from any energy category. For this reason, class G was excluded from the dataset, which is a standard procedure commonly applied in empirical studies. For example, the scoping review by Ou et al. (2025) states that in most analyzed studies, class G is excluded from models for the above reasons, in order to minimize the risk of misinterpretation and improve the accuracy of price premium estimates.

Information on whether the apartment has a separate kitchen is binary – in case there is no separate kitchen it takes the value "0", otherwise, it takes the value "1".

This data selection ensures that the retained sample captures active market offerings while minimizing classification bias, yielding a robust foundation for the econometric estimation.

After the data cleaning and processing the dataset includes 1,118 observations of the apartment rental advertisements in Prague.

Table 2. Summary Statistics of Key Variables

	Mean	Median	Max	Min	Std. Dev.	Skew	Kurt
price	423.771	401.639	961.539	160.772	121.607	1.027	4.369
area_net	74.045	61.000	378.000	14.000	43.711	2.273	11.029
sep_kitch	0.137	0.000	1.000	0.000	0.344	2.116	5.476
sqm_room	31.166	29.000	92.500	4.667	8.913	1.728	8.774
state	0.596	1.000	1.000	0.000	0.491	-0.392	1.153
location	3.040	3.000	6.000	1.000	1.431	0.218	2.130
epc	2.847	3.000	6.000	1.000	1.010	0.799	3.543

Source: Authors' computations.

Table 3. Prague Locations

Grade of the Location	Description
1 (most attractive)	Dejvice, Hradčany, Malá Strana, Nové Město, Staré Město, Troja, Vinohrady
2	Břevnov, Bubeneč, Karlín, Podolí, Smíchov, Vyšehrad
3	Braník, Ďáblice, Holešovice, Kobylisy, Libeň, Michle, Nusle, Strašnice, Střešovice, Vršovice, Záběhlice, Žižkov
4	Bohnice, Čimice, Hloubětín, Hodkovičky, Hostivař, Kamýk, Košíře, Krč, Malešice, Motol, Prosek, Radlice, Řepy, Stodůlky, Střížkov, Štěrboholy, Veleslavín, Vokovice, Vysočany, Zličín
5	Běchovice, Čakovice, Černý Most, Dolní Chabry, Dolní Měcholupy, Dolní Počernice, Háje, Hlubočepy, Horní Měcholupy, Horní Počernice, Hostavice, Hrdlořezy, Chodov, Klánovice, Koloděje, Kolovraty, Kunratice, Kyje, Letňany, Lhotka, Modřany, Radotín, Ruzyně, Řeporyje, Slivenec, Suchdol, Šeberov, Velká Chuchle, Vinoř, Zbraslav
6 (least attractive)	Dubeč, Cholupice, Jinonice, Kbely, Královice, Křeslice, Liboc, Libuš, Lipence, Lipenice, Lysolaje, Miškovice, Petrovice, Písnice, Pitkovice, Satalice, Sedlec, Sobín, Točná, Třebonice, Třeboradice, Uhříněves, Újezd nad Lesy, Újezd u Průhonic

Source: Authors.

3.2. *Methodology and Model Specification*

From a methodological standpoint, the literature predominantly employs hedonic regression models estimated via Ordinary Least Squares (OLS). The dependent variable is typically the logarithm of price or rent per square meter, ensuring elasticity-type interpretations and approximate normality. Key debates concern the functional form and the appropriate treatment of qualitative or ordinal variables, such as EPC ratings. Halvorsen and Pollakowski (1981) and Malpezzi (2003) emphasized the importance of model parsimony and interpretability when introducing categorical controls; unnecessary parameter proliferation can inflate standard errors and obscure core effects.

Accordingly, many authors represent ordinal scales as continuous variables when empirical evidence suggests monotonicity (Hyland, Lyons, and Lyons 2013 and Fuerst and Warren-Myers 2018). This approach assumes that each step in the rating represents an approximately constant change in the underlying latent efficiency measure–a defensible assumption when categories are equidistant by construction, as in EPC standards defined by EU regulation.

In summary, existing literature establishes two points relevant to this study:

1. Energy efficiency generally commands a measurable price or rental premium.
2. Hedonic regression remains the dominant empirical approach for isolating that effect.

By explicitly addressing this trade-off, the present paper advances the methodological discussion while providing novel evidence from a CEE context.

To evaluate how the energy performance class influences the asking rent price of apartments in Prague, we follow the standard hedonic pricing framework (Rosen 1974 and Malpezzi 2003). We model the logarithm of asking rent per square meter as a function of observable apartment attributes. The hedonic regression model is expressed as:

$$\ln p_i = c + \sum_{j=1}^{k} \beta_j x_{ij} + \delta epc_i + \varepsilon_i.\ i = 1, \dots, N \qquad (1)$$

where the dependent variable p_i, indexed by the apartment (*i*), denotes the asking rent price per square meter. The independent variables x_{ij} represent *area_net*, *sep_kitchen*, *sqm_room, state*, *location*. The variable epc_i represents the energy performance class scale from A to G in the numerical transformation from 1 to 6 (i.e, "1"=A, most energy efficient, "2"=B, "3"=C, "4"=D, "5"=E, "6"=F, least energy efficient). The parameter c is the intercept, and parameters β_j, $j = 1, \dots, k$, and δ are the partial regression parameters. In this model, for a unit increase in the epc_i, the dependent variable increases on average by the percentage$100(\varepsilon^{\delta} - 1)$. When $|\delta| < 0.1$, this percentage approaches to 100δ. The same applies to the parameters β_j, $j = 1, \dots, k$. The ε_i are observation-specific zero-mean random error terms, a set of equally distributed independent random variables, i.e. $\varepsilon_i \sim IID(0, \sigma_{\varepsilon}^2$. The hypothesis $H_0\ \delta = 0$ is tested to answer the research question.

3.3. Justification of Model Choice

A central methodological decision concerns how the *epc* variable should enter the regression. The alternative model specification has the following form

$$\ln p_i = c + \sum_{j=1}^{k} \beta_j x_{ij} + \sum_{l=1}^{5} \delta_l\, epc_{il} + \varepsilon_i. \qquad (2)$$

The variables epc_{il} represent the energy performance classes from A to E in the form of five zeroone dummy variables (binary indicators), where one represents the class of interest and zero represents other classes. The $100\delta_l$ parameter, when $|\delta_l| < 0.1$, can be interpreted as the average percentage increase/decrease in price due to the class of interest compared to the price due to the reference class, in this case, class F, i.e., the least energy efficient. The hypothesis $H_0\ \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$ is tested, to answer the research question of the article.

3.3.1. Theoretical Rationale

From a theoretical perspective, EPC ratings represent a structured, ordinal scale directly derived from measured energy consumption levels standardized across the EU. The classes (A–F) correspond to predefined thresholds of primary energy demand, forming an approximately linear progression. Thus, the *epc* variable can be viewed as an ordered proxy for a latent continuous attribute–energy efficiency quality.

Treating ordinal variables as continuous is well-established in econometric literature where the scale reflects consistent rank ordering (Greene 2018 and Wooldridge 2020). The practice is particularly defensible when categories are limited and equidistant, as in the EPC framework (Maddala and Lahiri 2009). Each downgrade from one EPC class to the next implies a roughly proportional increase in expected energy cost and environmental inefficiency, which should be mirrored in a proportionate change in rent.

Additionally, the primary research objective is to test the direction and significance of the relationship between *epc* and rent, rather than to estimate separate coefficients for each *epc* level. An ordinal specification provides a clear, interpretable elasticity: the percentage change in rent associated with a one-class deterioration in energy performance. This approach preserves parsimony–a key principle in econometric modeling (Akaike 1974; Halvorsen and Pollakowski 1981)–and avoids unnecessary loss of degrees of freedom.

3.3.2. Empirical Rationale and Comparative Testing

Table 4 contains the correlation coefficients of the explanatory variables and the explained variables that enter both Model (1) and Model (2). The variable *sqm_room* is relatively strongly correlated with *area_net* (0.5394), while other correlations are weak. This result is logical, and the risk of multicollinearity will be eliminated by excluding the explanatory variable *sqm_room* from the models. This refinement improved models' precision and ensured stability of coefficient estimates.

To validate the chosen specification, both models were estimated using identical data and control variables. Table 5 presents the OLS estimates of Model (1), in which the *epc* variable is entered as an ordinal numeric scale and Table 8 in Appendix reports results for Model (2), in which EPC classes are represented by dummy variables.

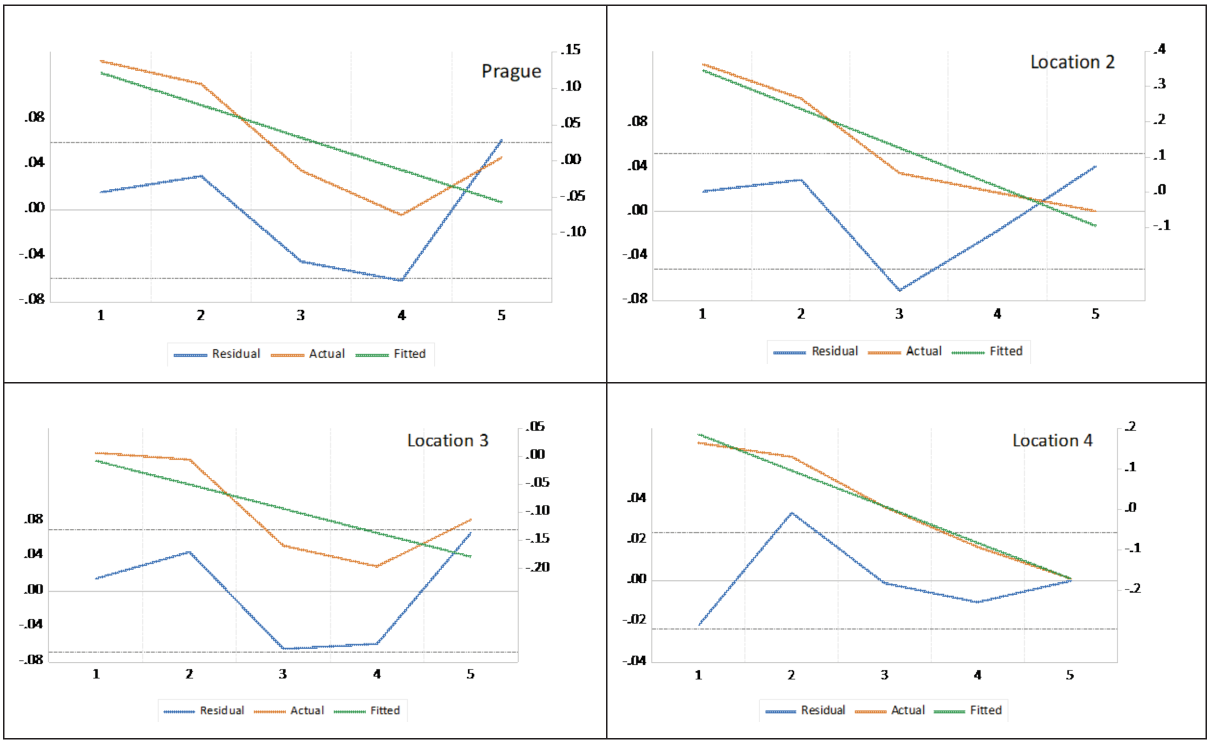
Figure 1 plots the *epc* dummy coefficients from Model (2) against their respective categories, alongside fitted values from the linear regression reported

Table 4. Correlation Matrix of Explanatory Variables

	price	area net	sep kitch	sqm room	state	location	epc
price	1.0000						
area net	-0.1846	1.0000					
sep kitch	-0.1906	0.0811	1.0000				
sqm room	-0.1098	0.5394	0.1042	1.0000			
state	0.2228	-0.0377	-0.1654	0.0125	1.0000		
location	-0.3576	-0.2035	-0.0657	-0.2002	-0.0122	1.0000	
epc	-0.1660	0.0234	0.2687	-0.0277	-0.2550	-0.2347	1.0000

Source: Authors' computations.

Figure 1. Straight Line Fitting of the Estimated Parameters of Individual Classes *epc* - Model (2)



Source: Authors' computations.

Table 5. Straight Line Fitting of the Estimated Parameters of Individual Classes *epc* - Model (2)

	Prague	Location					
		1	2	3	4	5	6
c	0.1649*		0.4552***	0.0349	0.2741***		
l	**-0.0443**		**-0.1100*****	**-0.0428**	**-0.0891*****		
R^2	0.6461		0.9363	0.5579	0.9789		
N	5		5	5	5		

Notes: 1) The point estimates of parameters of regression model $\hat{\delta}_l = c+\beta_l + \varepsilon_l$, $l = 1, 2, \ldots 5$. 2) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1.

Source: Authors' computations.

in Table 5. The results show an almost perfectly linear pattern for Locations 2 and 4, and a near-linear pattern for Prague and Location 3. All coefficients of determination are very high, and the estimated slopes closely match the *epc* parameter estimates from Model (1). These findings confirm that treating EPC as an ordinal variable in Model (1) introduces no significant bias. Naturally, with only five data points, detecting a non-linear trend would be difficult, even if the observations deviated more from the straight line.

Furthermore, Model (1) demonstrated smaller standard errors and greater parameter stability, indicating a higher level of precision in its estimates. This suggests that the model is less sensitive to sampling variability and provides more reliable results across different conditions.

Models (2) for smaller locations 1, 5, and 6 were not created because the regressors are likely perfectly or nearly perfectly collinear, which leads to a near singular matrix error. This issue typically occurs when there is a relatively small number of observations combined with a larger number of zero-one (dummy) variables in the model. In such a situation, the risk of linear dependence among predictors increases significantly, as the combination of many binary variables in a small sample often creates redundant information.

Considering the above findings and adhering to the principle of model parsimony, we selected the ordinal specification as the preferred empirical approach. This choice effectively captures the underlying monotonic relationship, enhances estimation efficiency, and eliminates the interpretational challenges associated with multiple dummy variables.

This reasoning aligns our modeling strategy with prior literature that adopts ordinal or quasi-continuous treatments of energy labels (Hyland, Lyons, and Lyons 2013; Cajias and Piazolo 2013; Fuerst and Warren-Myers 2018).

3.3.3. Diagnostic Control

In most subsamples the goodness-of-fit metrics, i.e. adjusted R^2, Akaike Information Criterion [AIC], and Schwarz Criterion [SC]) indicated only marginal differences between the two models.

The Jarque–Bera test in Models (1) and (2) for Prague and Locations 3 and 4 rejected normality in residuals (Lumley et al. 2002), while the Breusch–Pagan–Godfrey and Glejser tests simultaneously rejected homoskedasticity. These results are closely related, as inspection of the residuals showed that both deviations were caused by the presence of outliers. In the case of Prague, with more than 1,100 observations, it is unlikely that the standard errors of the estimates are significantly biased. In contrast, for Locations 3 and 4 with 290 and 202 observations, the bias may be more pronounced. Therefore, the degree of bias was assessed by comparing classical standard errors with robust MacKinnon–White heteroskedasticity-consistent standard errors HC2 (White 1980). In Table 6 (Model 1) and Table 8 in the Appendix (Model 2), robust standard errors are reflected in the statistical significance of parameter estimates, which is shown next the standard significance in the form of asterisks in parentheses. For Prague and Model 1, the statistical significance of estimates was not affected by heteroskedasticity and related non-normality, while in other cases the impact was minor and does not change the interpretation of results. The Breusch–Godfrey LM test and the Durbin–Watson test did not detect autocorrelation in any model (in some locations, a negative value of the test criterion ($n \times R^2$) appeared, which is due to a negative coefficient of determination in the auxiliary regression. This technical phenomenon corresponds to a zero statistic and confirms the absence of autocorrelation). Based on the above, the diagnostic check results are nearly identical for both model types, indicating that specifying *epc* through individual zero-one variables does not enhance the model's quality.

In summary, the chosen model specification is supported by both theoretical and empirical evidence. EPC classes form an ordinal scale, allowing for clear and meaningful interpretation. Comparative analysis confirmed a nearly linear relationship, greater precision, and stable estimates for the ordinal model. Diagnostic tests showed that this choice does not reduce model quality, making it the optimal specification.

4. Results

Across both specifications, the coefficients of control variables behave as expected and are consistent with economic intuition. Larger apartments are associated with lower rent per square meter, confirming the standard negative elasticity of size due to scale economies. Apartments with a separate kitchen command slightly lower rents, reflecting the predominance of smaller studio or one-bedroom units in the high-price segment. Apartments in better physical condition yield significant rent premiums, ranging between 5 and 10 percent, depending on the locational subsample. Location coefficients show the strongest effect, decreasing monotonically from central to peripheral zones.

The parameter estimates of the *epc* variable in Model (1) are negative and statistically significant both in the full sample and in most subsample models. This implies that each downgrade in energy performance class corresponds to an average rent decrease of approximately 5%. This interpretation follows from the structure of Model (1), where *epc* is represented as an ordinal variable taking values from 1 to 6 for classes

Table 6. Regression Results of Log Asking Rent Price per Square Meter in Czech Crowns in Prague – Model (1)

	Prague	Location					
		1	2	3	4	5	6
c	6.5519***	6.3031***	6.5919***	6.2062***	6.3303***	6.1662***	5.9984***
area_net	-0.0020***	-0.0012***(**)	-0.0019***	-0.0015***	-0.0031***	-0.0037***	-0.0020**(*)
sep_kitch	-0.1138***	-0.1814***	-0.0976**	-0.0747*( )	-0.0475	-0.1684***	0.1046
state	0.0760***	0.0714*	0.0558	0.1022***	0.0676**	0.0405	0.0741
location	-0.0882***						
epc	-0.0553***	-0.0171	-0.1263***	-0.0558***	-0.0867***	-0.0294*	-0.0014
Mean dep	6.0134	6.1449	6.1103	6.0045	5.9388	5.8598	5.9124
SD dep	0.2726	0.2922	0.2905	0.2411	0.2417	0.2025	0.1990
R^2	0.3213	0.1581	0.3927	0.2010	0.3399	0.3703	0.1499
R^2 adj	0.312	0.1403	0.3815	0.1898	0.3265	0.3539	0.0743
F-stat	105.2844***	8.8742***	35.2394***	17.9266***	25.3621***	22.6401***	1.9830
JB	25.4910***	0.0038	0.8244	10.8208***	72.9987***	1.1230	0.2426
BPG	63.2425***	10.5279**	3.7631	12.6509**	18.0535***	7.3683	15.8610***
G	65.5939***	12.8916**	4.6974	14.1455***	13.5636***	5.0881	10.1459**
BG	0.0253	-3.5675	0.0183	3.8965	0.2528	-2.2332	-1.7859
D-W	2.0098	2.0052	2.1926	1.7614	1.4241	2.1516	0.6676
AIC	-0.13391	0.2512	-0.0930	-0.2007	-0.3733	-0.7616	-0.3735
SC	-0.1122	0.3355	-0.0166	-0.1374	-0.2915	-0.6651	-0.1823
HQC	-0.1289	0.2853	-0.0622	-0.1754	-0.3402	-0.7224	-0.3006
N	1118	194	223	290	202	159	50

Notes: 1) The point estimates of parameters of regression model $\ln p_i = c + \sum_{j=1}^{k} \beta_j x_{ij} + \delta epc_i + \varepsilon_i$.
2) JB – Jarque-Bera normality test, BPG – Breusch-Pagan-Godfrey heteroscedasticity test (χ^2-form), G – Glejser heteroscedasticity test (χ^2-form), BG – Breusch-Godfrey autocorrelation LM test (χ^2-form), D-W – Durbin-Watson autocorrelation test. 3) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1, MacKinnon-White (HC2) heteroscedasticity consistent standard errors: $^{(***)}$ p < 0.01, $^{(**)}$ p < 0.05, $^{(*)}$ p < 0.1. 4) *state*: after reconstruction, project, under construction, new construction.

Source: Authors' computations.

A–F. This approach assumes a linear effect of energy efficiency on rental prices, which may not fully reflect reality. The alternative Model (2) employs binary indicators for individual classes, allowing for the capture of potential nonlinearities. However, as shown in the section "Empirical Rationale and Comparative Testing," the parameter estimates for dummy variables exhibit an almost perfectly linear pattern, particularly in Locations 2 and 4. Table 8 in the Appendix indicates that models for Locations 1, 5, and 6 could not be estimated due to multicollinearity, while in Locations 2, 3, and 4 the estimates follow the expected trend–higher rents for better-rated apartments–but with substantially larger standard errors. Consequently, most of them are statistically insignificant, making it impossible to reliably determine any nonlinear effect of EPC on rental prices. Nevertheless, some degree of caution is required when interpreting the parameter estimate for the *epc* variable in Model (1).

The above findings are confirmed by the results of the review study by Ou et al. (2025). While the study focuses on the impact of EPC on apartment prices, the following insights are directly applicable to the effect of EPC on rental values as well. The study states that most European research relies on the hedonic framework for the two specifications mentioned above, and these specifications are also the most frequently compared. The findings indicate that dummy variables typically exhibit an almost linear trend across classes, which supports the suitability of the ordinal approach, while at the same time highlighting the need for caution in interpretation and the potential use of advanced methods to identify nonlinearities.

Table 7 contains point and interval estimates of the parameters for the *epc* variable. For example, the values -0.0842 and -0.0273 in the 7th row and 5th and 6th columns say that in Location 3, when the EPC rating worsens by one level, the asking rent of one square meter of an apartment decreases on average by a maximum of 8.4% and a minimum of 2.7% with a 95% probability.

Table 6 and 7 show that the results are statistically significant for the Prague region as a whole. Individual areas were grouped into six locations according to their attractiveness. For Prague and Locations 2, 3, 4, the *epc* variable significantly influences the asking rents at the 1% level, and for location 5 at the 10% significance level. Table 7 shows that the *epc* variable exerts the strongest effect on asking rents in Location 2, where a deterioration in *epc* by one level leads to a price reduction of up to 16% and a minimum of 9% (with a 95% probability). In location 5, the price reduction is a maximum of only 6% (with a 95% probability). Overall, in Prague, a one-level deterioration in *epc* leads to a price reduction maximum of 7% and a minimum of 4%.

Table 7. Confidence Intervals for Parameters of *epc* Variable

	epc						
		90%		95%		99%	
	Coefficient	Low	High	Low	High	Low	High
Prague	-0.0553*** (0.0076)	-0.0678	-0.0428	-0.0702	-0.0404	-0.0749	-0.0357
Location 1	-0.0171 (0.0182)	-0.0472	0.0129	-0.0530	0.0187	-0.0644	0.0302
Location 2	-0.1263*** (0.0185)	-0.1569	-0.0957	-0.1629	-0.0898	-0.1745	-0.0781
Location 3	-0.0558*** (0.0145)	-0.0797	-0.0319	-0.0842	-0.0273	-0.0933	-0.0183
Location 4	-0.0867*** (0.0175)	-0.1157	-0.0577	-0.1213	-0.0521	-0.1324	-0.0411
Location 5	-0.0294* (0.0175)	-0.0583	-0.0005	-0.0639	0.0051	-0.0750	0.0161
Location 6	-0.0014 (0.0332)	-0.0572	0.0543	-0.0683	0.0654	-0.0907	0.0878

Notes: 1) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1. 2) Standard errors are given in parentheses, Prague, Locations 3 and 4 - MacKinnon-White (HC2) heteroscedasticity consistent standard errors are given in parentheses.

Source: Authors' computations.

5. Discussion

In terms of methodological reflection, the comparative evidence between Model (1) and (2) underscores three main findings. First, the plot of EPC dummy parameter estimates from Model (2) shows an almost perfectly linear pattern for Locations 2 and 4 and a near-linear pattern for Prague and Location 3. High R^2 values and slopes of the regression of these estimates and the ordinal scale, closely match parameter estimates for the variable *epc* in Model (1) and confirm that treating EPC as an ordinal variable introduces no significant bias. With only five data points, detecting nonlinearity would be difficult even with deviations.

Second, statistical efficiency strongly favors the ordinal specification. The standard error of the single *epc* coefficient in Model (1) is up to ten times smaller than those of individual dummy coefficients in Model (2). This higher precision allows clear inference about the overall relationship between energy performance and rent, whereas Model (2) fails to identify class-specific effects reliably.

Third, model quality indicators–adjusted R^2, AIC, SC, and HQC–show only negligible differences between the two specifications. Model (2) occasionally performs slightly better in some submarkets, but these differences are statistically and practically insignificant. Diagnostic tests of Model (1) revealed deviations from normality and homoskedasticity (Jarque–Bera, Breusch–Pagan–Godfrey, Glejser), caused by outliers. For Prague, with more than 1,100 observations, the impact is negligible, while for smaller samples (Locations 3 and 4) the bias may be more pronounced. Therefore, classical standard errors were compared with robust MacKinnon–White heteroskedasticity-consistent errors (HC2); differences were minimal and did not affect interpretation. Breusch–Godfrey and Durbin–Watson tests confirmed the absence of autocorrelation. Model (2) shows nearly the same results, indicating that specifying EPC through dummy variables does not improve model quality and amplify model explanatory power.

The comparative exercise between Model (1) and Model (2) also provides an opportunity to reflect on broader methodological principles. In hedonic modeling, researchers often face a trade-off between model flexibility and statistical precision. Treating ordered categorical variables as numeric imposes structure but gains efficiency; treating them as dummies allows flexibility but risks collinearity and interpretational complexity. The findings of this study confirm that when categories represent an inherently ordered economic attribute–such as energy performance–an ordinal specification is not only theoretically defensible but also empirically optimal. This approach provides unbiased and statistically more precise estimates without compromising the explanatory power of the model. Treating EPC as an ordinal variable aligns with the principles of parsimony (Akaike 1974) and with econometric literature recommending ordinal treatment of categories that reflect a latent continuous dimension (Maddala and Lahiri 2009), as it eliminates excessive parameterization and the risk of collinearity associated with dummy variables. Empirical tests further demonstrate an almost perfectly linear structure of estimates across EPC classes, confirming the validity of this methodological choice.

In terms of economic interpretation, the results of the study indicate a meaningful but moderate energy-efficiency premium on the asking rent in Prague. A one-class improvement in *epc* variable corresponds to a rent increase of roughly 5 percent, implying that moving from Class F to Class A could yield up to a 25 percent rent differential, ceteris paribus. This magnitude is consistent with prior studies from other European markets (e.g.: Hyland, Lyons, and Lyons 2013; Fuerst and Warren-Myers 2018; Cajias and Piazolo 2013; Kholodilin, Mense, and Michelsen 2017; Cajias, Fuerst, and Bienert 2019; März et al. 2022). But also studies outside Europe by Gabe and Rehm (2014) and Fuerst and Warren-Myers (2018) have proven energy performance rental price premium existence. However, this result should be interpreted with caution, because even though the nonlinearity of the relationship between *epc* and rent has not been empirically demonstrated, this does not necessarily mean that it does not exist in reality.

The existence of a premium fee suggests that tenants partially internalize the expected energy savings and appreciate the comfort and quality associated with energy-efficient buildings. The relatively smaller magnitude of EPC influence compared to studies on sales prices, however, reflects the limited investment horizons of tenants, where the fact that this is a highly sought-after location plays a more important role (Gerassimenko et al. 2024). Other determining factors may include proximity to the city center, limited supply and high demand for properties, the prestige and historical significance of the address, the affluent structure of tenants, and restrictions related to historic buildings. Location 1 encompasses some of the most prestigious and desirable districts in Prague, such as Dejvice, Hradčany, Malá Strana, Nové Město, Staré Město, Troja, and Vinohrady. High demand for rental properties in these areas, combined with limited supply driven by culturally rich and architecturally attractive neighborhoods and excellent access to key services, means that tenants are willing to pay premium prices regardless of the property's energy efficiency. Many buildings in Location 1 are also protected landmarks with architectural restrictions that limit improvements in energy performance. Research also show that energy labels often fail to accurately capture thermal comfort and operational behavior in historic buildings, which leads to an underestimation of their actual energy value and a weak influence of EPC on rental valuation in these buildings (Historic England 2022 and Ritson et al. 2025). Historical value and aesthetic appeal therefore often take precedence over modern energy performance standards.

The fact that EPCs and other factors do not affect rents in Location 6 can be explained by peripheral location, specific structure of homes, and lower rent factors. This location comprises apartments on the outskirts of Prague, which are less accessible and less desirable compared to central locations. The housing stock in Location 6 is predominantly single-family homes rather than apartments. These homes are often rented out less frequently, and the rental market is less competitive. The asking rents in Location 6 are generally lower than in more central areas. Therefore, it can cause liquidity to become a significant factor of the price. Moreover, we can attribute the indecisive results for group 6 also to the fact that the tenants in these areas on the very outskirts might consider other or additional factors besides these already involved in the study, like for example garden availability, proximity of highway exit or train station, proximity to school and kinder garden in the location or local traffic. Tenants in these locations are often more price-sensitive and prioritize affordability over energy efficiency, and they may have lower awareness of energy costs.

6. Conclusion

Recently, the focus has been on reducing CO_2 emissions, which are the most significant contributors to greenhouse gases in the context of global warming. The EPC system was introduced to standardize the energy performance of buildings. Other positive effects of EPCs are the reduction of information asymmetry between buyer and seller or owner and tenant.

A literature review revealed that several studies were written on this topic in the past. Some studies focus solely on the effect of EPCs on the selling prices. However, with the growing importance of the rental market, papers on the relationship between EPCs and rentals have also started to be published. Most of the studies conclude that EPC impacts the rental level. In particular, this finding is presented among others by Cajias and Piazolo (2013), Kholodilin, Mense, and Michelsen (2017), März et al. (2022), and Cajias, Fuerst, and Bienert (2019), who studied the German market. Authors outside of Europe also reach the same conclusion. Some authors, such as Kholodilin, Mense, and Michelsen (2017), Gerassimenko, Defau, and De Moor (2024), and Hyland, Lyons, and Lyons (2013), who have analyzed both the sales market and the rental market, believe that the premium for a more energy-efficient property is higher for sales transactions than for rentals. However, the amount of evidence on green premium for apartment rentals remains quite limited and is mostly concentrated in western EU countries. There has been no evidence so far about the rental green premium in CEE countries.

This study contributes to the existing evidence on rental green premium by examining the Prague residential market, the largest real estate market in the Czech Republic. This paper contributes to the already written studies with its comprehensive market analysis using the most commonly used hedonic regression model. The methods that were used control for the most crucial rental value drivers in cities, such as the apartment size, layout, technical condition and location quality. The latter was assessed by dividing Prague into six locations according to several criteria like the reputability, price level, public transportation, civic amenities, green areas and architectonic and urbanistic quality.

According to the results, the EPC significantly affects the asking rent price of apartments in Prague. The models for particular locations did not detect EPC as a statistically significant variable for location 1 (for location 5 only at 10% significance level). It is a prominent area where limited supply and high demand for apartments play a major role. The model yielded inconclusive results for location 6 (the outskirts of Prague) which we explain by the fact that tenants in these areas consider also additional factors to those covered in the study and in general tend to be less sensitive to the EPCs due to their general high price sensitivity. Moreover, the supply and demand for rentals in these areas differ from that in central Prague, which can cause liquidity to become a significant factor.

The limitations of our study lie in the following areas. The data are limited in quality and geographical scope as the accuracy and completeness of the data extracted from the sreality.cz portal only for the Prague region can affect the results. Occasionally, missing or distorted information about key variables such as EPC ratings, property conditions, and asking rents – may occur since leasing agents prepare the advertisements, which can introduce errors. However, the number of observations in the study is so high that we do not suppose there would be a significant bias caused by the possibility of errors.

More importantly, the data used in this study consist of asking rent prices derived from online rental advertisements rather than actual transaction prices, which is an important consideration for the correct interpretation of the results. While asking rents, measured as the prices advertised by landlords or agents in online rental listings, provide timely and widely accessible market signals, they do not represent actual transaction prices and therefore may not fully capture the final negotiated rental outcomes. For further research we can suggest running the study on a dataset of transaction prices instead in order to get more robust results. However, no dataset that would include the transaction price data as well as other variables used in the model could be collected at the point of this study.

The scope of the study with the focus on the Prague market causes the findings may not be generalizable to other regions or countries with different market dynamics, regulatory environments, or levels of urbanization. Another limitation is the temporal scope, as the data was collected as of September 22, 2023. This snapshot may not capture seasonal variations or long-term trends in asking rents and energy performance impacts.

Beyond the immediate findings, the study contributes methodologically by illustrating how ordinal representations of standardized rating systems can enhance model stability and interpretability without compromising explanatory accuracy. This approach may be useful for similar analyses in other transition or emerging housing markets where data limitations constrain more flexible specifications.

Finally, behavioral factors and climate factors are not considered. The level of awareness and perception of EPCs among tenants can influence their decision-making. If tenants are not well-informed about the benefits of energy efficiency, the impact of EPCs on asking rent prices might be wrongly estimated and potentially underestimated. The effect of energy efficiency on asking rents might vary with climate conditions. In regions with extreme weather, energy-efficient properties might command a higher premium due to greater energy savings.

By acknowledging these limitations, future research can be better designed to address these gaps and provide more robust and comprehensive insights into the impact of EPCs on asking rents and other EPC aspects.

Future research could focus on four main areas. First, examine the long-term effects of energy efficiency improvements on asking rents. Conducting longitudinal studies, i.e., long-term studies to assess the impact of energy performance improvements on rental values over extended periods, can help understand the sustainability of green premiums and the long-term benefits of energy-efficient buildings. Second, explore nonlinearities or threshold effects using semiparametric techniques could test whether certain efficiency classes yield disproportionate premiums. Third, linking rental listings with actual transaction data could validate the magnitude of estimated premiums. Fourth, comparative analyses across Central and Eastern European cities would help generalize the results beyond Prague.

APPENDIX

Table 8. Regression Results of Log Asking Rent Price per Square Meter in Czech Crowns in Prague – Model (2)

	Prague	Location					
		1	2	3	4	5	6
c	6.3710***		6.1099***	6.1543***	6.0665***		
area_net	-0.0020***		-0.0021***	-0.0016***	-0.0032***		
sep_kitch	-0.0969***		-0.0938*	-0.0581	-0.0564		
state	0.0648***		0.0491	0.0876***	0.0533*		
location	-0.0872***						
epc1	0.1365**(***)		0.3633	0.0064	0.1632		
epc2	0.1059**(***)		0.2642	-0.0062	0.1294		
epc3	-0.0132		0.0540	-0.1593	0.0055		
epc4	-0.0741(**)		-0.0022	-0.1963*(**)	-0.0927		
epc5	0.0048		-0.0536	-0.1126	-0.1713		
Mean dep	6.0134		6.1103	6.0045	5.9388		
SD dep	0.2726		0.2905	0.2411	0.2417		
R2	0.3441		0.4126	0.2569	0.3552		
R2adj	0.3388		0.3906	0.2357	0.3284		
F-stat	64.5861***		18.7884***	12.1407***	13.2874***		
Wald F	19.3944***		10.8656***	7.7354***	5.2526***		
JB	24.4177***		0.5540	14.8039***	85.0198***		
BPG	72.1227***		9.9383	17.2142**	18.6204**		
G	72.3708***		12.9128	16.7280**	13.9112*		
BG	0.1532		0.1452	1.9387	0.4571		
D-W	2.0245		2.3122	1.9202	1.3996		
AIC	-0.1661		-0.0905	-0.2456	-0.3571		
SC	-0.1212		0.0470	-0.1317	-0.2097		
HQC	-0.1492		-0.0349	-0.1999	-0.2975		
N	1118		223	290	202		

Notes: 1) The point estimates of parameters of regression model $\ln p_i = c + \sum_{j=1}^{k} \beta_j x_{ij} + \sum_{l=1}^{5} \delta_l \, epc_{il} + \varepsilon_i$.

2) Wald *F* test: $H_0\ \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$, JB – Jarque_Bera normality test, BPG – Breusch-Pagan-Godfrey heteroscedasticity test (χ^2-form), G – Glejser heteroscedasticity test (χ^2-form), BG – Breusch-Godfrey autocorrelation LM test (χ^2-form), D-W – Durbin-Watson autocorrelation test. 3) Asterisks denote statistical significance: *** p < 0.01, ** p < 0.05, * p < 0.1, MacKinnon-White (HC2) heteroscedasticity consistent standard errors: $^{(***)}$ p < 0.01, $^{(**)}$ p < 0.05, $^{(*)}$ p < 0.1. 4) *state*: after reconstruction, project, under construction, new construction. 5) Column 1, 5, 6: Regressors may be perfectly collinear – Near singular matrix error.

Source: Authors' computations.

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