

# SPATIAL AND FISCAL DIMENSIONS OF THE DONUT EFFECT IN THE CZECH REPUBLIC

Hana Černá Silovská<sup>1</sup> , Martin Lukavec<sup>1</sup>

<sup>1</sup> Prague University of Economics and Business, Department of Regional Studies, nám. W. Churchilla 1938/4, 130 67 Prague, Czech Republic

## Abstract

This paper investigates the donut (doughnut) effect in the Czech Republic during the COVID-19 pandemic, focusing on municipalities with authorized municipal offices in Bohemia. We examine shifts in population and housing demand between the years 2019 and 2021, a period significantly marked by pandemic-related disruptions. As migration data were unavailable, property price dynamics served as a proxy, based on 114,620 residential purchase transactions received from the Reas (real estate portal). Average price changes were calculated for 273 municipalities, ensuring sufficient observations while preserving geographic detail. The findings suggest spatial redistribution consistent with the donut effect: municipalities surrounding major urban cores such as Prague, Pilsen, Mladá Boleslav, and České Budějovice recorded stronger demand growth than the cores themselves. Regression analysis confirms the significance of labor market conditions, particularly unemployment, while population density effects appear less robust. Beyond demographic and housing dynamics, the study highlights potential fiscal implications for municipal budgets, infrastructure, and service provision. These aspects, however, are not analyzed in depth here and will be pursued in future research. This paper thus represents a first step toward a broader investigation of the donut effect in the Czech settlement system, laying the groundwork for understanding both its spatial and fiscal dimensions.

Keywords: Donut Effect, Czech Republic, Housing Demand, COVID-19, Municipalities, Fiscal Impact

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JEL Code: R23, R11, H72

## Introduction

The COVID-19 pandemic has brought unprecedented social, economic, and spatial changes to urban environments worldwide. Among the phenomena that have emerged or accelerated during this period is the so-called donut effect, characterized by population shifts from urban cores toward surrounding suburban or peri-urban areas. It is potentially connected with degradation of cities, and this urban degradation in general, places high demands on urban planning, requiring comprehensive strategies to address social, economic, and spatial challenges (Araki, 2018).

This process, extensively documented in North America and Western Europe, reflects broader transformations in residential preferences, labor market dynamics, and mobility patterns, often driven by remote work opportunities, changing housing demands, and public health considerations.

While the donut effect has been the subject of empirical investigation in several international contexts, no particular study has yet addressed its occurrence in the Czech Republic. This represents a significant research gap, given the country's distinct administrative and settlement structure, in which municipalities with authorized municipal offices play a central role in governance, service provision, and fiscal management. Understanding whether, and to what extent, the pandemic has altered the spatial distribution of population within these territories is critical for assessing the long-term implications for local public finances and housing policy.

Population redistribution can have profound fiscal consequences for municipalities. A declining core population may lead to reduced local tax revenues, underutilized infrastructure, and increased per capita costs of service provision, while surrounding areas may face pressure to expand infrastructure and housing supply to accommodate incoming residents. These dynamics are particularly relevant in the Czech context, where municipal budgets depend heavily on per-capita revenue sharing, and where housing policy remains a complex interplay between national strategies and local implementation (e.g. Radvan, 2021 or Sobotovičová and Janoušková, 2017).

This study aims to fill the existing gap by providing the first empirical analysis of the donut effect in the Czech Republic during the initial phase of the COVID-19 pandemic. Focusing on the period between 2019 and 2020, we analyze population change within the territories of municipalities with authorized municipal

office and apply regression models incorporating unemployment data to explore the relationship between demographic shifts and local labor market conditions. In doing so, we contribute to both the international literature on pandemic-induced spatial change and the domestic debate on sustainable urban development, municipal finance, and other related issues.

## Theoretical Framework

The concept of the donut effect<sup>1</sup> emerged prominently in urban economics and geography during the COVID-19 pandemic, building on earlier literature on suburbanization, counter-urbanization, and the “hollowing-out” of city centers. Some evidence from the United States (Ramani and Bloom, 2021 or Ramani, Alcedo and Bloom, 2024) demonstrated that the pandemic triggered a measurable outflow of residents from dense urban cores to lower-density peripheral areas, a trend facilitated by the rapid adoption of remote work and the search for larger, more affordable housing. In their following work, the authors confirm that the donut effect has proven to be relatively persistent, with the initial pandemic-driven population shifts showing signs of stabilization rather than reversal. This trend is strongly linked to the widespread adoption of remote work, which has reduced the necessity for daily commuting and increased the attractiveness of suburban and peri-urban living. Studies examining the phenomenon of working from home are quite frequent in relation to the donut effect, as the expansion of remote work is undoubtedly a direct driver of this process (Bond-Smith and McCann, 2025 or Waters and Clower, 2025).

Other evidence from the United States suggests that many residents are reluctant to return to dense urban cores, even as pandemic-related restrictions have eased (Ramani, Alcedo and Bloom, 2024). Similar patterns have since been documented in Canada (Schnurr, 2021), the United Kingdom (Ramani and Bloom, 2021) or parts of Western Europe such as Germany (Stawarz *et al.*, 2022), though the magnitude and persistence of these shifts vary by region and institutional context. Studies on the donut effect can also be found in Spain, where researchers have examined how the pandemic reshaped residential patterns and housing demand between urban cores and surrounding areas (e.g. González-Leonardo *et al.*, 2023 or García-Coll and López Villanueva, 2024).

From a theoretical perspective, the donut effect can be understood as an accelerated form of urban spatial restructuring driven by both push and pull factors. Push factors include perceived health risks in densely populated areas, high housing costs, and declining amenity access during lockdowns. Pull factors encompass improved digital connectivity, availability of suburban or rural housing, and lifestyle changes prioritizing space and access to nature. The interplay of these forces alters the traditional urban hierarchy and redistributes population in ways that have potential long-term implications for urban form, service provision, and fiscal sustainability (Ahrend *et al.*, 2023).

## Donut Effect and Shrinking Cities

The concept of the donut effect is closely related to earlier theoretical frameworks describing spatial and demographic changes in urban areas. It shares similarities with the hollowing-out effect, which traditionally refers to the decline of central urban areas accompanied by economic stagnation and outmigration toward the periphery. Likewise, it intersects with the notion of shrinking cities, a term used to describe urban centers experiencing sustained population loss, the proliferation of brownfields, social disparities, and the deterioration of infrastructure. The phenomenon of shrinking cities is relatively widespread, affecting a significant number of urban areas across Europe and beyond. Nearly 20% of European cities have at some point experienced a shrinking period, characterized by population loss, economic restructuring, and urban decline (Wolff and Wiechmann, 2018). In the case of the Czech Republic, studies on shrinking cities often focus on the Ostrava region, which has been significantly affected by deindustrialization and population decline (Krejčí, Martinat and Klusáček, 2011; Šerý, Svobodová, Šilhan and Szczyrba, 2018 or Slach, Bosák, Krtička, Nováček and Rumpel, 2019). While the donut effect specifically emphasizes population redistribution during the COVID-19 era, particularly toward suburban and peri-urban zones, it can be seen as a contemporary manifestation of these longer-standing urban processes.

International research also points to the fiscal dimension of the donut effect. Shrinking populations in central areas may lead to revenue losses from property taxes, local business activity, and shared national taxes, while fixed costs for infrastructure and public services remain largely unchanged (Slack and Bird, 2014). Conversely, municipalities experiencing rapid in-migration may face budgetary strain from the need to expand infrastructure and housing supply. These shifts can exacerbate spatial inequalities, particularly in governance systems where municipal finances are strongly tied to population counts, as in the Czech Republic (Tomášková and Radvan, 2024).

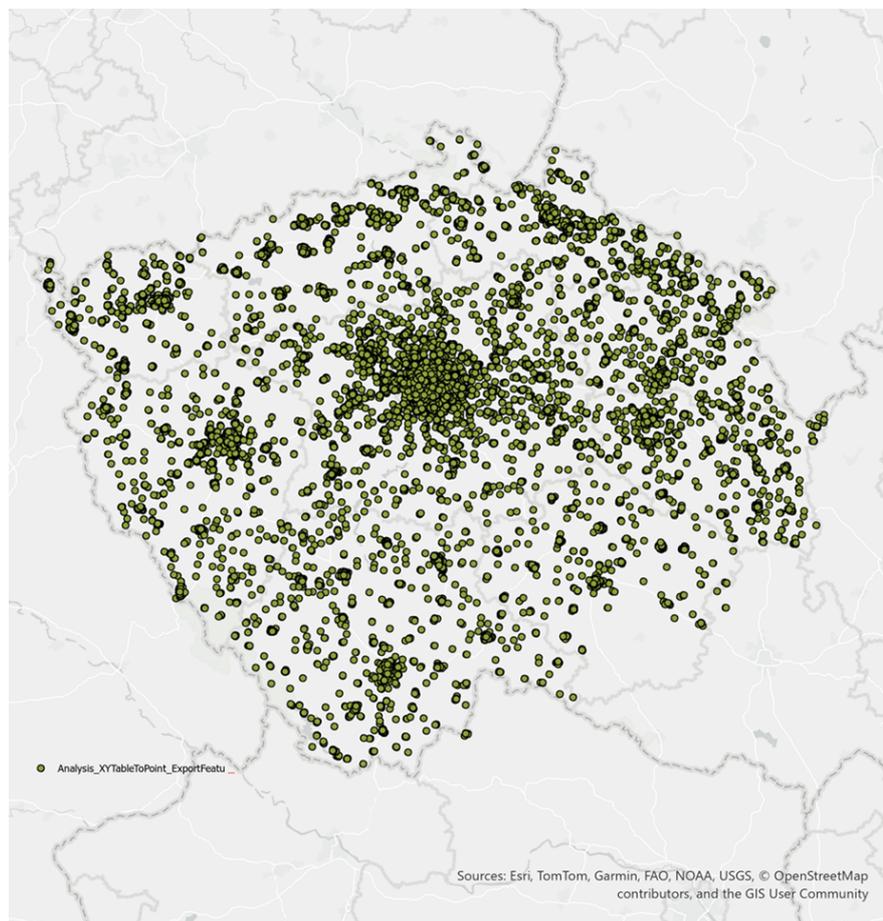
<sup>1</sup> In the literature, the term “doughnut effect” can be also found, carrying the same meaning (e.g. Ahrend *et al.*, 2023; Schnurr, 2021 or Hubbard and Maginn, 2020).

Despite the growing body of international literature, studies on the donut effect remain scarce in Central and Eastern Europe, where post-socialist urban development trajectories differ substantially from those of Western countries. The Czech Republic, with its unique administrative system of municipalities with extended powers and municipalities with authorized municipal offices, offers a distinct case for exploring how pandemic-related population redistribution interacts with local fiscal capacity and housing policy. This research builds on established theories of urban spatial change while addressing a notable empirical gap in the regional context.

## Methodology

We set out to explore whether the area of Bohemia (the Western part of the Czech Republic) experienced a so-called donut effect, that is, depopulation of dense urban cores. As population movement at a sufficient detail wasn't available at the time of writing of this paper, we relied on a proxy variable showing increased or decreased demand for housing, as shown in property prices. For this, we have used a very robust dataset of 114,620 purchase transactions for residential properties as recorded by Reas real estate portal for the period February 2019 to February 2022 (Reas, n.d.) as shown in Fig. 1.

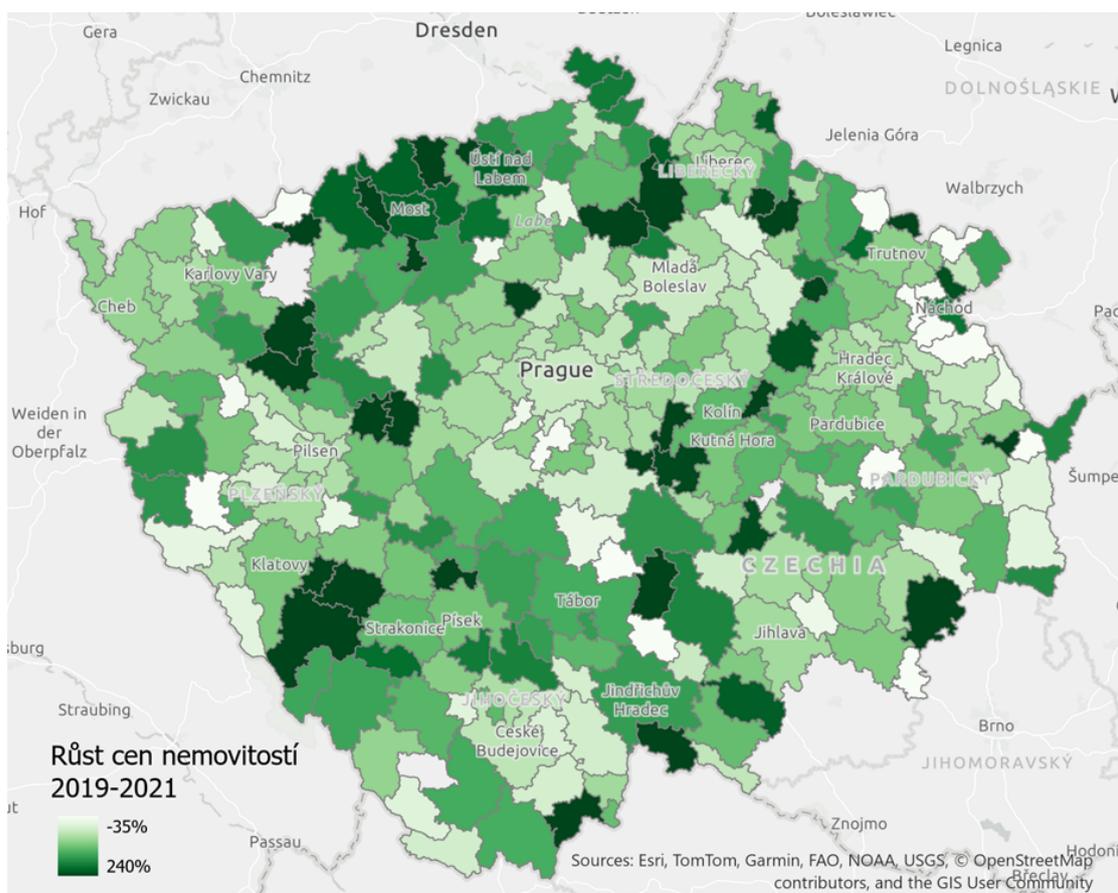
We have calculated per square meter averages for both 2019 and 2021 (as real estate prices demonstrate log-normal distribution, we have log-transformed the prices, averaged them and reversed the process for the averages) for 273 municipalities with an authorised municipal office<sup>2</sup> located in Bohemia. This level of aggregation gives us a sufficient number of observations, while the geographical detail is not lost. The averages can be seen on the following Fig. 1.



1: Real estate transaction sample  
Source: Own processing

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<sup>2</sup> For this reason, municipalities with extended powers were not employed in the analysis, as the number of available observations at this level of aggregation would not have been sufficient for robust empirical inference.



2: Change in property prices between 2019–2021  
Source: Own processing

Graphically, the doughnut effect seems to be present. The locations around dense urban cores of Prague, Pilsen, Mladá Boleslav or České Budějovice all saw only moderate demand, while municipalities without dominant cities saw very dynamic growth in property prices.

To further confirm or disprove this intuition, we have decided to test this hypothesis via regression, where population density and unemployment during the period were included as variables. The graphical distributions of these variables can be seen on the following Fig. 3 and 4.

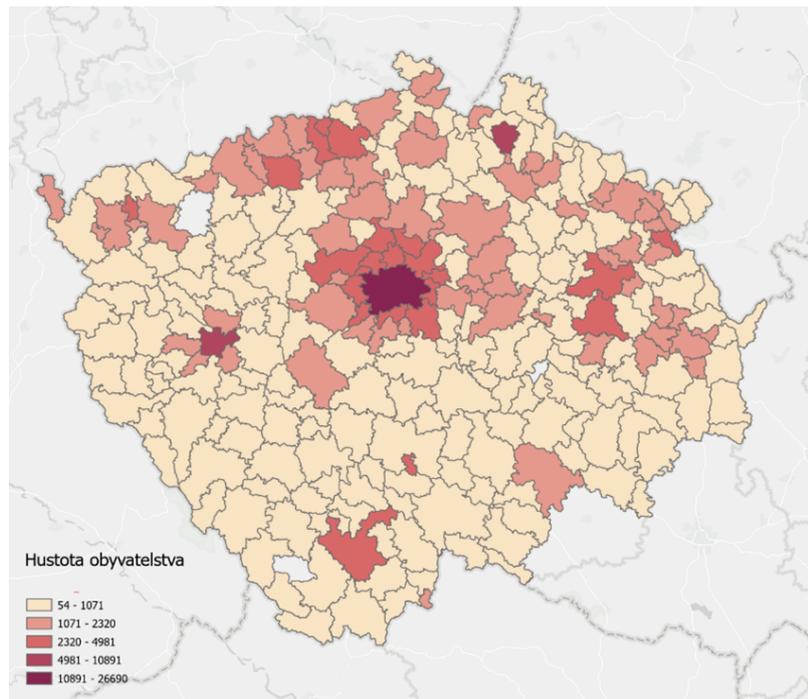
As all 3 variables displayed positive skew, we have log-transformed them, and the regression was defined as follows:

$$\log \text{Property prices change}_i = \log \text{Unemployment}_i + \log \text{Density}_i + \varepsilon \quad (1)$$

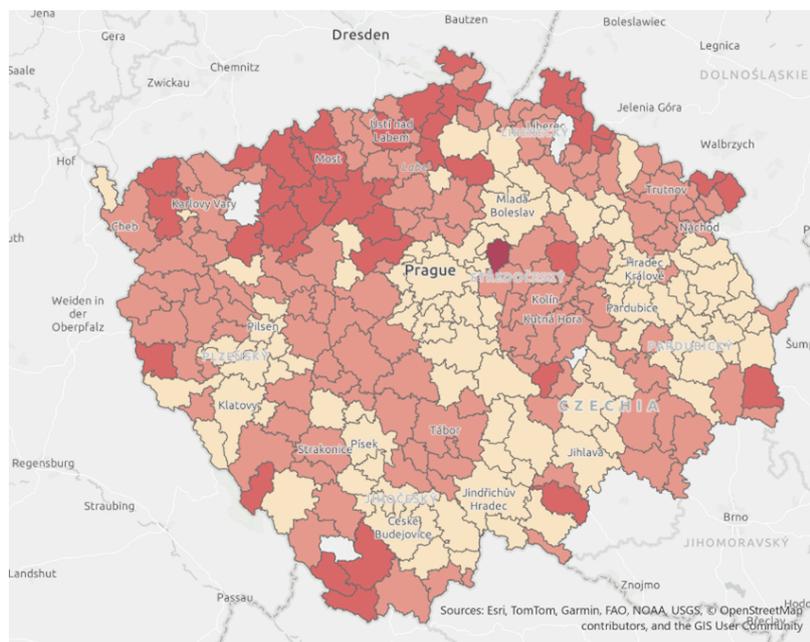
## Results

The map of 2019–2021 price changes exhibits a spatial pattern that is consistent with a “ring” dynamic around the largest cores. Around Prague, Pilsen, Mladá Boleslav, and České Budějovice, many surrounding municipalities registered stronger price growth than the core jurisdictions. This pattern aligns with a growing literature documenting pandemic-era decentralization of housing demand toward lower-density belts within, or even outside metropolitan commuting zones. Internationally, these “donut-like” reallocations have been linked to the rapid adoption of remote work and changing residential preferences for space and local amenities (Ahrend *et al.*, 2023).

The regression results confirm a statistically robust association between local labour market conditions and price dynamics: during 2019–2021, municipalities with tighter labour markets (lower unemployment) tended to experience faster growth in transaction prices. This is consistent with demand-side channels in which employment expectations and income security support households’ willingness to bid for housing in accessible peripheral locations. By contrast, the density coefficient is negative but unstable and not statistically significant in the preferred specification. This lack of precision is unsurprising in



3: Population density  
Source: Own processing



4: Unemployment  
Source: Own processing

a setting where “density” conflates multiple forces—urban amenities that create demand in some cores, versus perceived health risks or workplace decentralization that depress demand in others. Furthermore, dense post-industrial areas with relatively affordable stock (especially in northern Bohemia) can attract substitution from more expensive cores. These offsetting mechanisms, well-documented in cross-country evidence, can wash out an average density effect.

Regression was first run on the whole dataset, but some observations demonstrated excessive leverage on the regression curve and altogether 6 observations out of 273 were removed as outliers.

The results of the regression, prior to and after outlier removal, can be seen in the following Tab. I.

I: Regression table

	Log Property price change		Log Property price change (after outlier removal)	
Log Unemployment	0.0834	**	0.0994	***
	(0.0298)		(0.0253)	
Log Density	-0.0202		-0.0190	
	(0.0167)		(0.0161)	
Intercept	0.20	***	0.19	***
	(0.0544)		(0.0529)	
Observations	273		267	
R-squared	0.0320		0.0553	

robust st. errors in parentheses

\* p < 0.1, \*\* p < 0.01, \*\*\* p < 0.001

Source: Own processing

Removing six high-leverage municipalities reduces noise without altering the qualitative picture: unemployment retains its sign and statistical significance, while density remains weakly identified. The stability of the unemployment effect across samples suggests the result is not driven by a handful of atypical local markets.

We include added variable charts, q-q plots and kernel density plots in the appendix (both prior to and after outlier removal), to show the regression's sufficient fit.

## Discussion and Conclusion

Findings resonate with studies from North America and OECD economies that document persistent, post-2020 reweighting of housing demand toward suburban belts and accessible hinterlands—especially where remote work became entrenched. Recent global evidence shows that remote work durably dispersed spending, commuting, migration, and housing activity away from the most central neighbourhoods, with the strongest shifts in high-telework cities. Yet cross-national heterogeneity is substantial: for example, Spain's housing-transactions data show no national-scale donut effect once activity rebounded in 2021–2022. In that light, the Czech pattern appears closer to the U.S./OECD “suburbanization within metros” than to the Spanish case of broad-based recovery across the urban–rural spectrum (Ramani *et al.*, 2024).

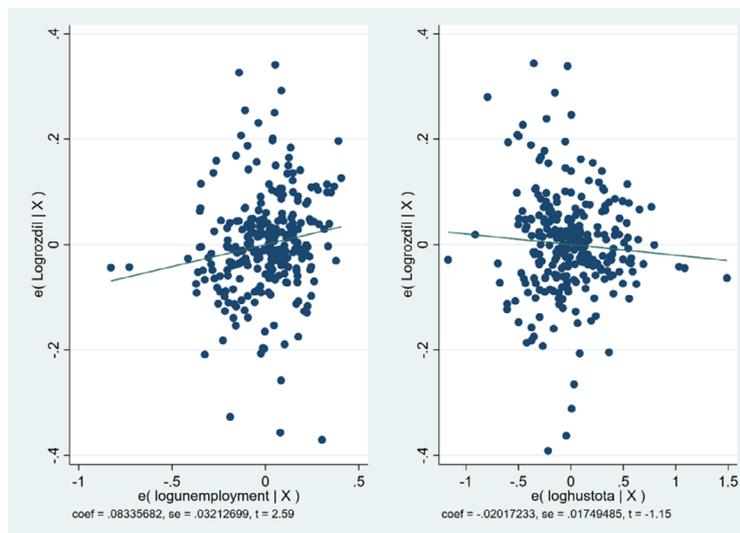
In the Czech Republic, municipal revenue architecture magnifies the policy relevance of spatial reallocation. Municipal budgets rely heavily on shared national taxes distributed by formula, with recurrent property tax playing only a modest, locally adjustable role (Tomášková and Radvan, 2024). If cores lose residents while suburban municipalities gain them, per-capita-linked transfers and service burdens will shift accordingly—potentially leaving core infrastructure under-utilized (and fiscally rigid) and pushing fast-growing rings to expand housing-adjacent infrastructure (roads, schools, utilities).

The literature review and also findings of this study suggest that the donut effect has the potential to significantly influence the fiscal sustainability of municipalities, particularly within the Czech system of per-capita-based revenue sharing. Population shifts away from urban cores may lead to long-term changes in local tax revenues, service demand, and infrastructure utilization, while surrounding municipalities may experience mounting financial pressures to expand public services and housing capacity. However, a comprehensive evaluation of these fiscal impacts requires more granular data and longitudinal analysis that captures both immediate and delayed effects. This dimension will therefore be the subject of future research, with the aim of providing evidence-based recommendations for municipal finance management and housing policy in the post-pandemic context.

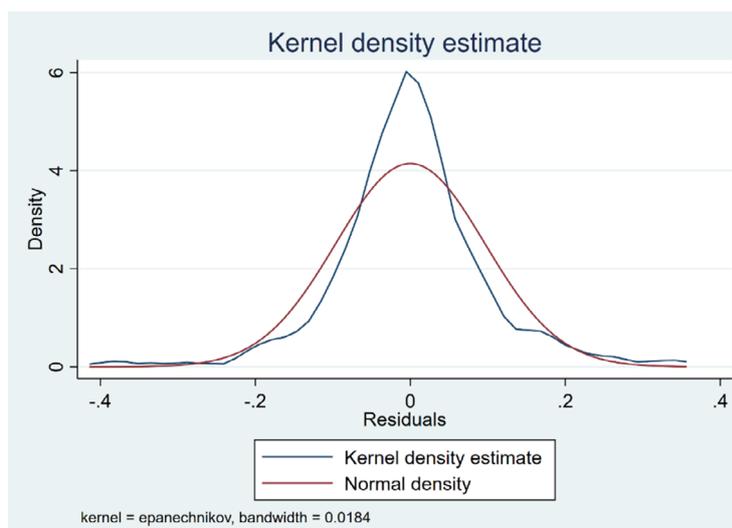
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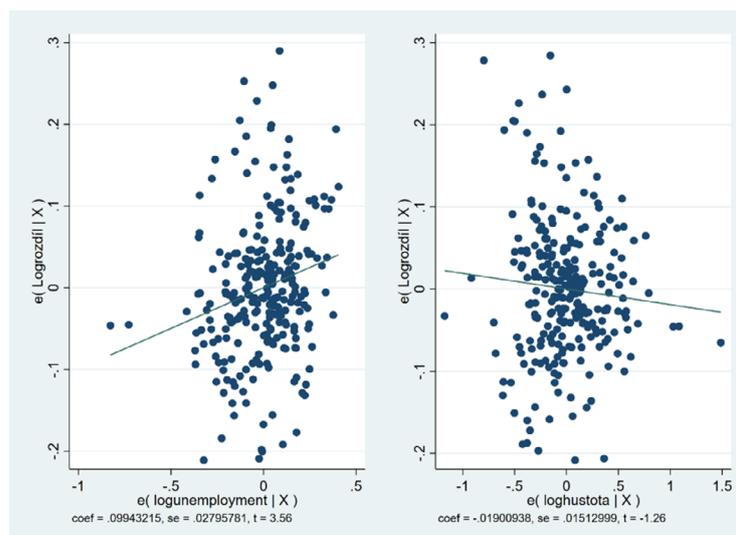
## Appendix



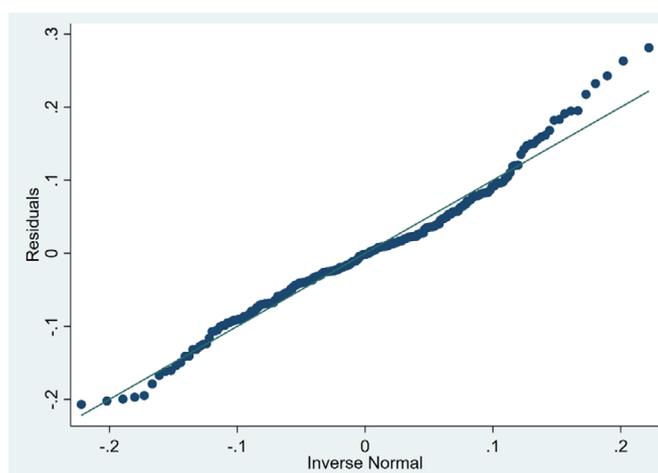
Added-variable plots (prior to outlier removal)



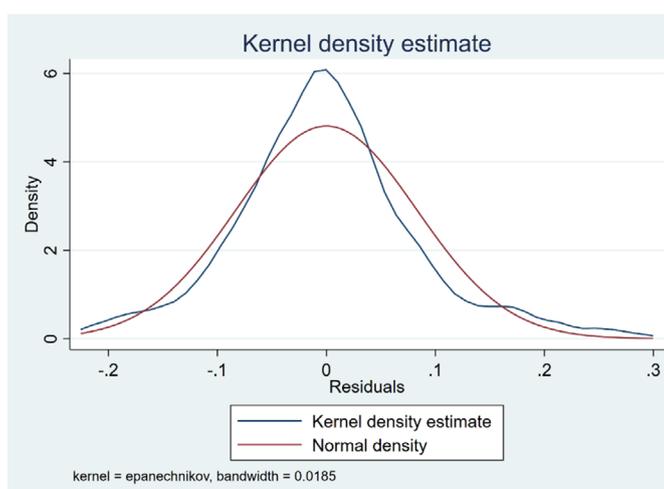
Density of residual compared to (expected) normal distribution (prior to outlier removal)



Added-variable plots (after to outlier removal)



Inverse normal distribution function Q-Q plot (after to outlier removal)



Density of residual compared to (expected) normal distribution (prior to outlier removal)

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### Contact information

Hana Černá Silovská: [hana.silovska@vse.cz](mailto:hana.silovska@vse.cz),  <https://orcid.org/0009-0002-6044-7173>  
 Martin Lukavec: [lukavec@gmail.com](mailto:lukavec@gmail.com)