

Firms' Innovation Behaviour Under Constraints in Central and Eastern Europe

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Abstract: Innovation is widely recognised as a key driver of productivity growth and long-term economic development, yet firms' ability to innovate is strongly shaped by the quality of the business environment in which they operate. This paper investigates how perceived business constraints are associated with firms' innovation behaviour in Central and Eastern Europe (CEE). Using firm-level data from the sixth round of the Business Environment and Enterprise Performance Survey (BEEPS), we analyse whether innovative and non-innovative firms differ in their perception of obstacles related to financial conditions, institutional quality, regulation and infrastructure. The analysis employs non-parametric Wilcoxon–Mann–Whitney tests to compare the distribution of perceived constraints across firms and explores heterogeneity between EU and non-EU economies. The results show that innovative firms tend to be more sensitive to financial, taxation and infrastructure-related constraints, while non-innovative firms more frequently report barriers associated with human capital limitations and organisational capabilities. Significant differences also emerge between EU and non-EU economies, reflecting the role of institutional development and market conditions in shaping innovation dynamics. Overall, the findings highlight the importance of an enabling business environment for fostering firm-level innovation and provide policy-relevant insights for strengthening innovation capacity in the CEE region.

Keywords: Business Environment, Innovation Behaviour, Firm-Level Analysis, Institutional Constraints, Wilcoxon–Mann–Whitney Test.

1. Introduction

Innovation is widely recognised as a key driver of economic growth, productivity and long-term development (Schumpeter, 1934; Romer, 1990; Aghion and Howitt, 1990; Acemoglu and Robinson, 2012). In knowledge-based economies, firms' ability to introduce new products, processes and organisational practices is crucial for competitiveness and structural transformation. Innovation, however, does not occur in isolation. It is a complex socio-economic process involving firms, research institutions, governments and markets (Corsaro, Cantù and Tunisini, 2012). In this sense, innovation can be understood as the transformation of knowledge into economic and social value through interactive processes linking firms with their broader institutional and economic environment.

The literature highlights that contextual factors strongly shape firms' innovative behaviour. Firms operate within territorial and institutional settings that may either support or constrain their capacity to generate and absorb knowledge. As organisations are embedded in their surrounding environment, they may benefit from knowledge spillovers, networks and institutional support mechanisms that foster innovation (Cooke, 2001; Hall and Lerner, 2010). Conversely, weaknesses in the business environment, such as financial constraints, regulatory burdens, inadequate infrastructure or limited human capital, may hinder innovation activities and reduce productivity potential (Gao and Li, 2025).

Public institutions also play an important role. The state can stimulate innovation through public investment in universities and research centres (Pinto, Fernandez-Esquinas and Uyarra, 2015; Pinto, 2024), regulatory frameworks and standards shaping technological trajectories (Blind, 2023), and intellectual property protection that encourages knowledge creation and diffusion (Moser, 2013). Consequently, the quality of institutions and regulation may significantly influence firms' innovation incentives and capabilities.

These issues are particularly relevant for countries in Central and Eastern Europe (CEE), where firms operate in heterogeneous institutional contexts characterised by different levels of development, institutional quality and market integration. In such environments, business constraints may affect firms' innovation behaviour differently depending on firm characteristics and the broader institutional setting.

Against this background, this paper investigates whether innovative and non-innovative firms differ in their

perception of business environment constraints and whether these patterns vary across EU and non-EU economies in the CEE region. Using firm-level data from the sixth round of the Business Environment and Enterprise Performance Survey (BEEPS) of EBRD and World Bank, we examine the distribution of perceived obstacles across firms and assess whether these constraints are systematically associated with firms' innovation activities.

The remainder of the paper is organised as follows. Section 2 reviews the theoretical background and relevant literature. Section 3 presents the data and methodology. Section 4 reports the empirical results. Section 5 discusses the findings and policy implications. Section 6 concludes.

2. Theoretical Overview and Hypothesis Development

2.1 Literature Review

Theoretical and empirical research has consistently shown that innovation does not occur in isolation but is strongly influenced by the institutional, economic and organisational environment in which firms operate (Pinto, Guerreiro and Fernández-Esquinas, 2023). In this perspective, the business environment may either facilitate or constrain firms' innovative activities through channels such as financial conditions, regulation, human capital availability and infrastructure quality.

The relationship between innovation and economic performance has been widely studied since the seminal work of Schumpeter (1934), who identified innovation as the key mechanism of economic development and creative destruction. Firms introducing new products, processes or organisational practices disrupt markets and generate productivity gains. Later contributions further stressed the role of firm heterogeneity and market dynamics in innovation processes (Nelson and Winter, 1985).

More recent theoretical work has highlighted the importance of the broader institutional and competitive environment. Aghion and Howitt (1990) developed endogenous growth models showing that innovation incentives depend on market structure, competition and expected returns from technological progress. Similarly, Audretsch and Feldman (1996) and Audretsch and Keilbach (2004) emphasised knowledge spillovers, regional ecosystems and entrepreneurial activity. Innovation is therefore embedded in networks linking firms, research institutions and policy frameworks.

One of the most studied barriers is access to finance. Innovation activities involve high uncertainty and long payback periods, limiting firms' ability to obtain external financing. Hall and Lerner (2010) and Brown, Martinsson and Petersen (2012) show that financial constraints significantly reduce R&D investment and innovation outputs, especially for SMEs. In emerging and transition economies, underdeveloped financial markets intensify these problems (Gao and Li, 2025).

Regulatory and institutional factors also matter. Excessive bureaucracy, complex licensing procedures and inefficient legal systems may increase transaction costs and discourage risky innovative activities (Djankov et al., 2002; Aghion et al., 2005). Weak institutions, corruption, poor contract enforcement and political instability increase uncertainty and reduce incentives for long-term innovation investment (Acemoglu and Robinson, 2012; Aidt, 2009). The availability of skilled human capital is another key determinant of innovation capacity, since innovation requires specialised knowledge and absorptive capability (Acemoglu, 1998; D'Este et al., 2008). Shortages of qualified labour are frequently reported as a major innovation constraint, particularly in transition and developing economies.

Additionally, Infrastructure quality, including reliable electricity, efficient transport and communication networks, also supports productivity and technological upgrading by lowering operational costs and facilitating participation in global value chains (Calderón and Servén, 2010; Gorodnichenko and Schnitzer, 2013; Bergantino, Capozza and Spiru, 2023; Bergantino and Spiru, 2020). Evidence based on BEEPS data shows that electricity, transport and customs constraints can significantly affect innovation outcomes (Gorodnichenko and Schnitzer, 2013; Hein and Männasoo, 2017).

Market competition and informality may generate further obstacles. Informal competitors can distort incentives to innovate when formal firms face higher tax and regulatory burdens. Ayyagari, Demirgüç-Kunt and Maksimovic (2011) find that informal competition significantly affects firms' investment and innovation decisions. Similarly, labour regulations and customs procedures may reduce flexibility and limit access to external markets and technologies.

The impact of these obstacles differs across countries. EU firms generally benefit from stronger institutions, deeper financial markets and better infrastructure, supported by programmes such as Horizon Europe and cohesion policy instruments. By contrast, firms in non-EU and transition economies are more likely to face political instability, corruption, weak legal systems and limited access to finance, which may hinder innovation and productivity growth.

Despite these constraints, innovation may also emerge as a strategic response to adverse conditions. Firms facing labour shortages may invest in automation, while financially constrained firms may adopt incremental or cost-saving innovations. This perspective is consistent with “constraint-induced innovation” and with the literature on frugal innovation, where scarcity stimulates simplified and efficient solutions (Baker and Nelson, 2005; George, McGahan and Prabhu, 2012; Zeschky, Widenmayer and Gassmann, 2011; Weyrauch and Herstatt, 2019). Empirical evidence suggests that firms often respond to financial, regulatory or market barriers through process improvements, organisational change and incremental innovation rather than large-scale R&D investments (Ayyagari, Demirgüç-Kunt and Maksimovic, 2011; D’Este, Rentocchini and Vega-Jurado, 2014). In this sense, constraints may not suppress innovation entirely, but reshape its direction, intensity and form.

2.2 Hypothesis Development

The literature suggests that innovation is shaped by the interaction between firm-level capabilities and contextual factors. Financial constraints, regulatory burdens, infrastructure limitations, labour market conditions and institutional quality are key determinants of firms’ innovation behaviour. Understanding how these factors affect innovative and non-innovative firms differently, particularly across EU and non-EU economies, is essential for designing policies that foster innovation and productivity growth.

Based on these considerations, innovative and non-innovative firms are expected to differ in the obstacles they identify as the most significant barriers to business activity. Innovative firms, due to their engagement in technological upgrading and market expansion, may be more exposed to constraints related to finance, skills, regulation or infrastructure. Conversely, non-innovative firms may be more affected by traditional cost-related barriers such as taxation or informal competition. This leads to the following hypothesis:

H1: The distribution of perceived business obstacles differs between innovative and non-innovative firms.

Testing this hypothesis allows us to assess whether firms engaged in technological innovation perceive the business environment differently from those that do not innovate.

The institutional context may also shape the relationship between innovation and business constraints (Acemoglu and Robinson, 2012; EBRD, 2020). Firms in European Union countries generally benefit from stronger institutions, more developed financial markets and better infrastructure than those in non-EU economies. These differences may affect both innovation behaviour and the constraints firms face. Previous studies on transition economies show that institutional quality, access to finance and regulatory stability are important determinants of innovation activity (Hein and Männasoo, 2017; Gorodnichenko, Svejnar and Terrell, 2010).

To capture these differences, we examine whether the relationship between innovation and perceived obstacles varies across EU and non-EU countries. This leads to the second hypothesis:

H2: The relationship between innovation and perceived business obstacles differs between EU and non-EU firms.

Together, these hypotheses allow us to investigate whether innovative firms face different business environment constraints and whether these relationships vary across institutional contexts. The empirical analysis compares the distribution of perceived obstacles between innovative and non-innovative firms using non-parametric methods and examines heterogeneity across EU and non-EU economies.

3. Methodological Framework

The analysis of perceived obstacles to innovation using firm-level survey data is well established in the literature. Studies based on the Community Innovation Survey (CIS) and similar datasets examine how institutional, financial and knowledge barriers affect firms’ innovative activity and performance. For example, D’Este et al. (2008) analyse deterring and revealed barriers to innovation, while Strobel and Kratzer (2017) and Arza (2018) explore how obstacles shape firms’ innovation strategies and investment decisions. Similarly, research using

Business Environment and Enterprise Performance Survey (BEEPS) data investigates the relationship between institutional constraints, business environment conditions and firm performance or innovation outcomes (Hein and Männasoo, 2017; Gorodnichenko, Svejnar and Terrell, 2010).

To test our hypothesis, we use the sixth round of BEEPS, conducted by the EBRD and World Bank across 23 countries in Central and Eastern Europe (CEE) during 2018–2020. Towards the interview respondents are shown a card with a list of 15 potential obstacles and are asked:

Can you tell me which of the elements of the business environment included in the list, if any, currently represents the biggest obstacle faced by this establishment?

We indicate the 15 predefined categories with C_{ij} (e.g., access to finance, electricity, tax rates, transport) for firm i and j each specific obstacle.

Since product and process innovations are complementary activities, the technological innovation indicator is a dummy variable I_{ij} equal to 1 if the firm introduced a new or improved product, service and/or process within the last three years. Specifically, respondents asked the following questions:

During the last three years, has this establishment introduced new or improved products or services?

During the last three years, has this establishment introduced any new or improved process?

We also consider stratification by country group, such as EU membership as a heterogeneous analysis.

Because each obstacle is represented by a binary variable C_{ij} , the comparison between innovative and non-innovative firms can be interpreted as testing whether the distribution of C_{ij} differs across the two groups.

To examine whether innovative and non-innovative firms differ in their perception of business constraints, we apply the two-sample Wilcoxon rank-sum test, also known as the Mann–Whitney U test. Originally proposed by Wilcoxon (1945) and extended by Mann and Whitney (1947), the test compares two independent samples using ranked observations rather than raw values. Unlike parametric tests such as the independent samples t-test, it is robust to outliers and distributional irregularities.

For a given obstacle j , we test within the whole sample and within each subsample the null hypothesis:

$$H_0: F_{C_{ij}|I=1}(d) = F_{C_{ij}|I=0}(d) \quad (1)$$

against the alternative that the distributions differ (H_1). After assigning ranks among the biggest obstacles as R_i , we define the sum of ranks in the innovative group as follows:

$$U_1 = W_1 - \frac{n_1(n_1 + 1)}{2} \quad (2)$$

The Mann–Whitney (U) statistic can be written as:

$$U_1 = W_1 - \frac{n_1(n_1 + 1)}{2} \quad (3)$$

where n_1 is the number of innovative and n_0 is the number of non-innovative firms, with $n = n_1 + n_0$ and the expected value under H_0 is $E[U_1] = \frac{n_1 n_0}{2}$ while the standardized z-statistic is $z = \frac{U_1 - E[U_1]}{\sqrt{\text{Var}(U_1)}}$.

To explore institutional differences, the analysis is also conducted separately for firms located in EU and non-EU countries. Firms operate within business environments shaped by institutional and market constraints, which affect the obstacles they perceive as most binding. We hypothesise that innovative and non-innovative firms differ in their perception of these obstacles (H1), and that this relationship varies across institutional contexts (EU vs non-EU) (H2). Fig. 1 summarises the conceptual framework guiding the empirical analysis.

4. Data Analysis and Results

First, we present descriptive statistics for the main variables of interest. Table 1 reports the sample composition by country and the share of firms introducing different types of innovation. The dataset includes 11,142 firms operating in manufacturing and services across 23 Central and Eastern European (CEE) countries. Among them, 11 are members of the European Union (EU), while 12 are non-EU economies, offering a useful setting to

compare innovation behaviour across different institutional environments.

Overall, technological innovation is relatively widespread, although with substantial cross-country heterogeneity. On average, around 34% of firms report product innovation, 20% process innovation, and 41% technological innovation (product and/or process). Several non-EU economies display relatively high shares of innovative firms compared with some EU countries. This may reflect catch-up dynamics and technological upgrading processes typical of transition economies, where firms innovate to reduce productivity and technology gaps (Fagerberg and Verspagen, 2002; Radosevic et al., 2019). By contrast, firms in more advanced economies may rely more on incremental innovation and established capabilities. The literature also emphasises that innovation behaviour is strongly shaped by the surrounding institutional and economic environment (Audretsch and Feldman, 1996; Radosevic and Yoruk, 2012).

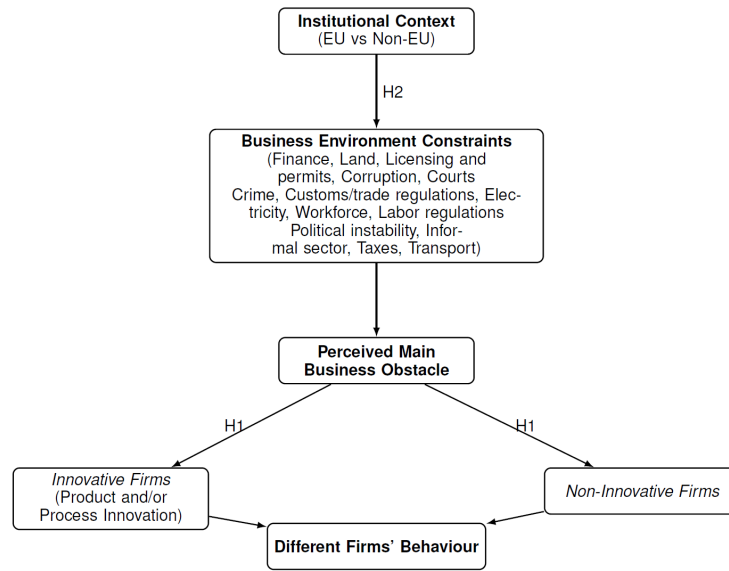


Figure 1: Conceptual framework linking business environment constraints and firms' innovation behaviour.

Table 1: Innovation indicator statistics and sample composition by country.

	Product innovation		Process innovation		Technological innovation		
Country Code	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.	Obs.
<i>EU countries</i>							
Poland	0.20	0.40	0.08	0.27	0.23	0.42	1,248
Romania	0.27	0.44	0.20	0.40	0.37	0.48	804
Estonia	0.41	0.49	0.25	0.43	0.53	0.50	303
Czech Rep.	0.40	0.49	0.29	0.46	0.53	0.50	494
Hungary	0.19	0.39	0.13	0.34	0.27	0.45	770
Latvia	0.52	0.50	0.49	0.50	0.70	0.46	344
Lithuania	0.33	0.47	0.22	0.41	0.45	0.50	350
Slovak Rep.	0.16	0.37	0.09	0.28	0.21	0.41	420
Slovenia	0.68	0.47	0.55	0.50	0.77	0.42	321
Bulgaria	0.20	0.40	0.13	0.33	0.25	0.44	739
Croatia	0.35	0.48	0.16	0.36	0.41	0.49	404
<i>Non-EU countries</i>							
Albania	0.39	0.49	0.25	0.43	0.51	0.50	369
Belarus	0.42	0.49	0.25	0.43	0.51	0.50	504
Georgia	0.44	0.50	0.17	0.38	0.48	0.50	482
Ukraine	0.37	0.48	0.22	0.41	0.41	0.49	1,284
Serbia	0.41	0.49	0.27	0.45	0.48	0.50	326
Moldova	0.33	0.47	0.22	0.41	0.45	0.50	350
Bosnia and Herz.	0.52	0.50	0.31	0.46	0.57	0.50	342
Azerbaijan	0.32	0.47	0.12	0.32	0.37	0.48	172
North Macedonia	0.50	0.50	0.29	0.45	0.57	0.50	316
Armenia	0.40	0.49	0.13	0.34	0.43	0.50	497
Kosovo	0.33	0.47	0.15	0.36	0.37	0.48	222
Montenegro	0.29	0.46	0.13	0.34	0.34	0.48	123
Total	0.34	0.47	0.20	0.40	0.41	0.49	11,142

Notes: Technological innovation is defined as firms introducing either product or process innovation within the last three years.

Table 2: Main business obstacles by country (%).

Obstacles	Non-EU countries											
	Western Balkan						Other Non-EU					
	AL	BI	KS	ME	MK	RS	AM	AZ	BY	GEO	MM	UA
Inadequate workforce	11.4%	10.2%	5.9%	13.8%	16.8%	21.8%	13.1%	13.4%	15.3%	13.5%	22.0%	5.0%
Tax rates	22.8%	19.3%	7.2%	14.6%	4.4%	16.6%	12.5%	2.3%	16.7%	6.4%	14.9%	13.9%
Political instability	8.4%	19.3%	10.4%	1.6%	24.4%	13.8%	12.1%	2.9%	5.4%	29.0%	19.7%	25.3%
Competitors in informal sector	10.8%	7.3%	24.8%	31.7%	14.6%	14.4%	13.1%	25.0%	7.9%	3.5%	8.6%	7.8%
Access to finance	3.0%	2.3%	7.2%	7.3%	9.2%	5.5%	29.8%	25.6%	21.8%	25.7%	10.6%	13.2%
Corruption	9.2%	7.3%	9.9%	4.9%	4.4%	3.1%	2.4%	5.8%	3.0%	1.0%	7.4%	15.6%
Transport	7.9%	4.7%	5.9%	10.6%	6.6%	2.8%	2.2%	0.6%	7.3%	2.9%	0.6%	5.7%
Labor regulations	1.9%	2.6%	1.4%	0.8%	4.1%	2.8%	0.8%	0.6%	2.8%	2.1%	1.1%	2.3%
Tax administration	3.3%	7.6%	6.3%	1.6%	2.2%	0.3%	2.6%	2.3%	0.8%	1.9%	1.4%	2.7%
Electricity	8.7%	3.5%	14.9%	3.3%	3.5%	3.1%	1.6%	5.2%	3.0%	5.8%	3.1%	1.5%
Business licensing and permits	1.6%	3.2%	1.8%	2.4%	2.2%	4.0%	1.2%	1.2%	4.2%	1.5%	0.9%	1.7%
Customs and trade regulations	4.1%	5.0%	3.2%	4.1%	1.3%	4.6%	4.0%	8.7%	4.2%	2.1%	3.4%	1.6%
Courts	2.4%	3.2%	0.0%	0.8%	1.9%	2.8%	0.4%	2.9%	3.2%	0.4%	4.9%	1.5%
Crime, theft and disorder	2.7%	3.5%	1.4%	0.0%	2.5%	3.4%	1.2%	2.3%	1.2%	2.3%	0.9%	1.3%
Access to land	1.9%	0.9%	0.0%	2.4%	1.9%	1.2%	3.0%	1.2%	3.4%	1.9%	0.6%	0.9%

Obstacles	EU countries											Total
	BG	HR	CZ	EE	HU	LV	LT	PL	RO	SK	SI	
Inadequate workforce	26,3%	22,3%	40,1%	37,0%	43,2%	28,8%	24,3%	17,1%	24,3%	18,6%	20,6%	20,3%
Tax rates	13,5%	41,8%	12,3%	21,1%	17,7%	28,8%	37,7%	32,7%	15,0%	17,9%	13,7%	18,5%
Political instability	5,0%	5,7%	5,5%	7,6%	0,8%	4,7%	7,1%	6,1%	8,2%	3,3%	3,1%	10,7%
Competitors in informal sector	15,8%	3,0%	6,7%	12,2%	10,0%	10,2%	11,1%	4,7%	5,2%	8,1%	10,6%	9,5%
Access to finance	4,7%	2,2%	3,4%	4,3%	2,7%	4,9%	4,9%	4,0%	7,1%	3,3%	7,8%	8,9%
Corruption	6,4%	2,0%	0,8%	0,3%	0,6%	1,5%	0,6%	1,8%	7,5%	6,7%	1,9%	5,1%
Transport	3,2%	3,0%	6,1%	5,0%	9,5%	2,0%	1,7%	3,8%	5,7%	5,7%	4,7%	4,8%
Labor regulations	6,8%	4,2%	9,7%	4,0%	5,7%	5,5%	2,6%	6,7%	4,7%	10,7%	16,5%	4,7%
Tax administration	2,3%	9,9%	5,7%	1,7%	6,2%	3,5%	3,4%	9,6%	6,5%	4,0%	8,4%	4,6%
Electricity	2,4%	0,0%	3,0%	2,3%	0,9%	2,9%	2,3%	4,9%	2,6%	6,7%	2,2%	3,3%
Business licensing and permits	6,2%	1,7%	1,4%	0,7%	1,2%	3,2%	1,7%	1,5%	5,2%	8,8%	1,9%	2,7%
Customs and trade regulations	1,2%	0,5%	2,4%	1,3%	0,9%	1,2%	1,1%	2,9%	1,6%	1,9%	2,5%	2,4%
Courts	2,8%	2,5%	1,0%	0,3%	0,1%	0,6%	0,3%	1,6%	2,4%	1,7%	1,6%	1,7%
Crime, theft and disorder	2,6%	1,0%	1,0%	2,0%	0,1%	1,2%	0,6%	1,2%	2,9%	1,7%	0,6%	1,6%
Access to land	0,7%	0,2%	0,8%	0,3%	0,3%	1,2%	0,6%	1,3%	1,1%	1,0%	4,0%	1,3%

Notes: Albania: AL; Bosnia and Herzegovina: BI; Kosovo: KS; Montenegro: ME; North Macedonia: MK; Serbia: RS; Armenia: AM, Azerbaijan: AZ; Belarus: BY; Georgia: GEO; Moldova: MM; Ukraine: UA; Bulgaria: BG; Croatia: HR; Czech Republic: CZ; Estonia: EE; Hungary: HU; Latvia: LV; Lithuania: LT; Poland: PL; Romania: RO; Slovakia: SK; Slovenia: SI.

Table 2 reports firms' perceived main business obstacles across countries. The most frequently reported constraints in the CEE region include inadequately educated workforce, tax rates, political instability and competition from the informal sector, although their relative importance varies substantially. In many Western Balkan and Eastern Partnership economies, firms more often identify access to finance, institutional instability and informal competition as key barriers, whereas in EU member states firms more frequently report human capital shortages and taxation-related constraints. These patterns are consistent with studies stressing the role of institutional quality, regulation and human capital in shaping firms' innovation capacity (Hall and Lerner, 2010; Aghion et al., 2005; Gorodnichenko and Schnitzer, 2013).

Table 3 presents the results of two-sample Wilcoxon rank-sum (Mann-Whitney) tests comparing the distribution of perceived business obstacles across groups of firms. This non-parametric approach is suitable for survey data characterised by categorical responses and heterogeneous firm populations (Wilcoxon, 1945; Mann and Whitney, 1947; Conover, 1999).

The first part of Table 3 compares innovative and non-innovative firms across the full CEE sample. Significant differences emerge for several constraints, suggesting that the business environment affects firms differently depending on their innovation status. Innovative firms are more likely to identify access to finance, tax rates, tax administration and transport infrastructure as major obstacles. This is consistent with the literature showing that innovation requires substantial resources, involves uncertainty and depends on expected returns (Hai et al., 2022; Hall and Lerner, 2010; Aghion, Akcigit and Fernández-Villaverde, 2013). Infrastructure quality also matters by facilitating knowledge diffusion, market access and participation in global value chains (Audretsch and Feldman, 1996; Bergantino, Capozza and Spiru, 2023; Bergantino and Spiru, 2020).

Conversely, non-innovative firms are more likely to report obstacles related to human capital constraints, particularly the availability of an adequately educated workforce. This supports the concept of absorptive capacity, according to which firms need sufficient human capital to recognise, assimilate and exploit external

knowledge (Cohen and Levinthal, 1990; Lepak, Takeuchi and Swart, 2011). Firms with weaker internal capabilities may therefore perceive labour quality as a more binding constraint.

Table 3: Summary of statistically significant differences in perceived obstacles using the Two-sample Wilcoxon rank-sum (Mann–Whitney) test.

Obstacles	Innovative vs Non-innovative firms						EU vs Non-EU			
	CEE countries (all sample)		EU		Non-EU		Innovative		Non-Innovative	
	Prob.	Sign	Prob.	Sign	Prob.	Sign	Prob.	Sign	Prob.	Sign
Access to finance	***	+			***	+	***	+	***	+
Access to land		-							***	+
Business licensing and permits	**	+			**	-			***	-
Corruption			**	+			***	+	***	+
Courts					***	-	***	+		
Crime, theft and disorder	*	+								
Customs and trade regulations	*	-			***	-	***	+	*	+
Electricity	***	-			***	-	***	+		
Inadequately educated workforce	***	-	***	-	***	-	***	-	***	-
Labor regulations					**	-	***	-	***	-
Political instability			***	-			***	+	***	+
Practices of competitors in the informal sector	***	-					**	+	***	+
Tax administration	***	+	**	+			***	-	***	-
Tax rates	***	+	**	+	***	+	***	-	***	-
Transport	***	+	***	+	***	+				

Notes: “Prob.” reports statistical significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. “Sign” indicates the direction of the difference. In the comparison between innovative and non-innovative firms, “+” means that innovative firms report the obstacle more frequently, while “-” means that non-innovative firms report it more frequently. In the comparison between EU and non-EU countries, the sign indicates which group reports the obstacle more frequently.

The second part of Table 3 separates EU and non-EU economies. This distinction is especially relevant in the CEE context, where institutional development, regulatory quality and financial market maturity differ substantially (D’Este, Rentocchini and Vega-Jurado, 2014). In EU countries, innovative firms differ mainly from non-innovative firms in their perception of corruption, tax administration, tax rates and transport infrastructure. Even in stronger institutional contexts, taxation and administrative procedures remain relevant for innovation incentives (Bloom, Griffith and Van Reenen, 2002; Aghion, Akcigit and Fernández-Villaverde, 2013).

In non-EU countries, innovative firms are significantly more likely to report obstacles related to access to finance, customs and trade regulations, electricity supply and infrastructure. These findings reflect structural weaknesses often observed in transition economies, where firms face multiple barriers simultaneously, including credit constraints, weak institutions and limited infrastructure reliability (Kafourous et al., 2008; Gorodnichenko and Schnitzer, 2013; Radosevic et al., 2019; Radosevic and Yoruk, 2012).

The radar charts complement these results. Figure 2(a) compares EU and non-EU economies, showing that firms in non-EU countries perceive a broader range of structural constraints, especially finance, political instability and infrastructure reliability, while EU firms are relatively more concerned with taxation and regulation (Acemoglu and Robinson, 2012; EBRD, 2020; Hai et al., 2022). Figures 2(b) and 2(c) further distinguish innovative and non-innovative firms, indicating that innovative firms in non-EU economies are particularly exposed to financial and institutional barriers, whereas innovative firms in EU countries face more moderate but still significant fiscal and regulatory constraints. This evidence confirms that innovation strategies are deeply embedded in the broader economic environment and that improvements in institutions, finance and infrastructure remain essential for fostering innovation in transition economies (Hall and Lerner, 2010; Pinto, Fernandez-Esquinas and Uyarra, 2015; Gorodnichenko and Schnitzer, 2013).

5. Conclusions and Recommendations

This paper examined the relationship between firms’ innovation activities and their perception of business environment constraints in Central and Eastern Europe using firm-level data from the BEEPS survey. By comparing innovative and non-innovative firms across EU and non-EU economies, the analysis provides insights into how institutional and structural conditions shape firms’ innovation behaviour in transition and emerging economies.

The empirical results indicate that innovative firms perceive certain obstacles differently from non-innovative firms. In particular, they appear more sensitive to constraints related to financial access, taxation and infrastructure conditions, reflecting the resource-intensive and uncertain nature of innovation investments. By contrast, non-innovative firms more frequently report barriers associated with human capital shortages and institutional inefficiencies, which may limit their ability to adopt new technologies and organisational practices. These findings highlight the importance of firm capabilities and absorptive capacity in shaping interactions with the external environment.

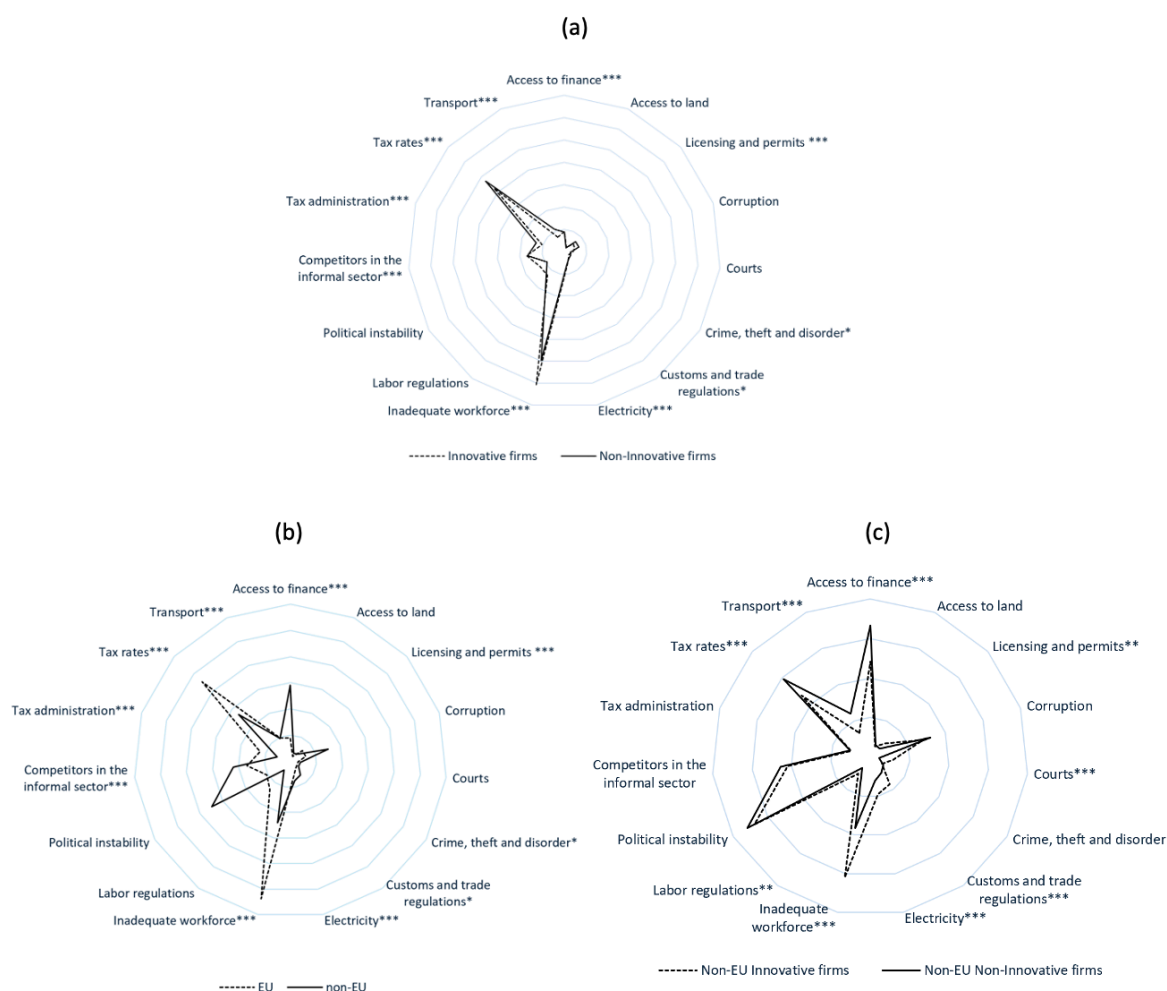


Figure 2: Perceived business environment constraints across firms in Central and Eastern Europe. (a) Innovative vs non-innovative firms; (b) Innovative vs non-innovative firms in EU countries; (c) Innovative vs non-innovative firms in non-EU countries.

Notes: ***, **, * show significance at the 1%, 5% and 10% levels according to the Two-sample Wilcoxon rank-sum (Mann-Whitney) test, indicating whether the difference in the means of the two samples is statistically significant. The circles in the radar charts represent the percentage of firms identifying each factor as the main obstacle. Each concentric circle corresponds to 5% of firms reporting the obstacle.

The analysis also reveals clear differences between EU and non-EU economies. Firms operating in non-EU countries tend to face stronger structural constraints, particularly related to financial markets, institutional stability and infrastructure reliability. In contrast, firms in EU economies more frequently emphasise taxation, regulation and labour market conditions. These patterns reflect the heterogeneous institutional development of the region and underline the importance of stable and efficient frameworks for fostering innovation.

Overall, the findings support the view that innovation is strongly embedded in the broader economic and institutional environment. Policies aimed at strengthening innovation capacity in the CEE region should therefore not focus solely on firm-level incentives but also address structural barriers. Improving access to finance, institutional quality, human capital and infrastructure remains crucial for fostering innovation and productivity growth.

Future research could further explore the causal relationship between innovation and business environment constraints using longitudinal data and econometric approaches capable of addressing potential endogeneity between firms' innovation decisions and their perception of obstacles.

Ethics Declaration

The author did not need ethical clearance for the research referred to in this paper.

AI Declaration

The OpenAI ChatGPT tool was used to assist in refining academic language and organizing the structure of the manuscript. All content generated by AI was critically reviewed, edited, and verified by the author(s) to ensure accuracy, originality, and adherence to scholarly standards.

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