

THE RELATIONSHIP BETWEEN INNOVATION AND EMPLOYMENT IN CENTRAL & EASTERN
EUROPEAN (CEE) AND FORMER SOVIET UNION COUNTRIES USING WORLD BANK CROSS-FIRM
DATA

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**The Relationship Between Innovation And Employment In Central & Eastern European
(CEE) And Former Soviet Union Countries Using World Bank Cross-Firm Data**

Master's Thesis

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DECLARATION

I have written this master's thesis independently. Any ideas or data taken from other authors or other sources have been fully referenced

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ABSTRACT

This thesis examines the relationship between innovation and employment dynamics in Central and Eastern Europe and the former Soviet Union using firm-level data from the World Bank Enterprise Surveys (WBES) for 2018, 2020, and 2023. The analysis employs an employment growth model and an instrumental variable approach to address endogeneity concerns. The findings show that innovative firms exhibit significantly higher employment growth rates (10%) compared to non-innovative firms (1.4%). Innovative firms are generally larger and older, highlighting a positive correlation between innovation and firm performance. The study underscores the importance of innovation in driving employment growth, particularly in industries like chemicals and food, and emphasizes the need for policies supporting both product and process innovations to stimulate job creation and economic development.

Keywords: Product Innovation, Process Innovation, Employment Growth, Innovative Firm, Non-Innovative Firm, CEE region.

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1. INTRODUCTION

The relationship between innovation and employment has become a central focus in economic research, particularly due to globalization and rapid technological advancements. Innovation is recognized as a crucial driver of economic growth, influencing productivity and labor markets across various sectors (Van Reenen, 2018; Bloom et al., 2020). As articulated by Porter (2024), the Schumpeterian perspective conceptualizes innovation as a process of creative destruction, fostering the emergence of new industries and job opportunities while simultaneously leading to the obsolescence of existing roles. This dynamic necessitates adaptability in the labor market and fuels ongoing debates about whether innovation ultimately enhances or undermines employment levels (Acemoglu & Restrepo, 2018; Brynjolfsson & McAfee, 2014).

While extensive global studies have explored the innovation-employment relationship, it is essential to understand these interactions within the unique contexts of Central and Eastern European (CEE) countries and former Soviet Union nations. These regions face distinctive challenges shaped by their historical legacies, economic structures, and integration into global markets. For instance, CEE countries often grapple with a middle-income trap, characterized by low innovation activity that hampers economic advancement (Radosevic, 2022). This situation leads to stagnation in growth as countries transition from low-income to middle-income status but fail to progress to high-income levels.

Historically, many CEE economies have relied on labor-intensive production models, positioning themselves as "extended workbenches" for Western companies (Buch & Riedel, 2023). This reliance has limited their ability to develop indigenous innovation capabilities, as firms often prioritize low-cost manufacturing over investment in research and development (Vienna Institute for International Economic Studies [wiiw], 2024). Consequently, as global competition intensifies, these countries find it increasingly challenging to maintain their competitive edge without robust innovation strategies.

The transition from centrally planned economies to market-oriented systems has further complicated this landscape, necessitating tailored innovation policies to foster sustainable employment growth. This thesis aims to fill the research gap by examining how product and

process innovations relate to employment growth in CEE and former Soviet Union countries. Utilizing firm-level data from the World Bank Enterprise Surveys (WBES) for 2023, this study establishes a framework for analyzing how different types of innovation influence employment dynamics in this region. The significance of this interplay is paramount for policymakers striving to promote sustainable economic growth while ensuring job security for workers. The primary objectives of this research are:

- To analyze how product innovations affect employment growth.
- To investigate the association of process innovations on workforce dynamics.
- To assess variations in innovation effects across firms of different sizes.

Moreover, this research highlights the distinct effects of various types of innovation while employing a robust methodology that includes instrumental variables to address endogeneity issues. Such differentiation enables a nuanced exploration of how diverse forms of innovation contribute to job creation or displacement. The literature on innovation in CEE countries suggests that while firms have made strides in adopting innovative practices, significant disparities remain compared to their Western European counterparts. For example, organizational innovations are less frequently implemented in CEE firms than in those in Western Europe (Doran & Fuchs, 2023). Additionally, investment in innovation tends to yield higher productivity returns in CEE countries than in more developed economies, indicating a pressing need for enhanced innovative capacity (Petrariu et al., 2020). This context necessitates an examination not only of the direct effects of innovation on employment but also how factors such as firm size and sectoral characteristics mediate these relationships.

To achieve the outlined objectives, this thesis is structured as follows: Chapter 2 presents a literature review examining existing research on innovation and employment dynamics within CEE regions. The methodology chapter outlines the research design and justifies its appropriateness for this study. Subsequent chapters detail data presentation, analysis, and discussion sections focused on the context of innovation and employment dynamics in the CEE region. The study concludes with significant insights derived from the research that can inform policy decisions aimed at fostering an innovative economy that creates jobs and enhances productivity.

2. LITERATURE REVIEW

2.1. Theoretical Background

The relationship between technological change, particularly innovation, and employment has been a significant topic in economic literature. This discourse is essential for informing policymakers and business leaders about the implications of innovation on labor markets, particularly in the context of Central and Eastern Europe (CEE) and former Soviet Union countries. Innovation has been seen to have direct effects—immediate changes in employment levels due to innovation activities—and indirect effects, such as increased demand for goods and services that stimulate job creation in other sectors (Leal-Rodríguez et al., 2015).

Technological advancements can lead to job creation when firms introduce new products requiring additional labor (Pfeiffer & Rennings, 2001). However, innovations aimed at improving efficiency—often termed process innovations—can result in labor-saving technologies that displace existing jobs (Dachs & Peters, 2014). Understanding how different types of innovations interact with labor markets across various sectors is critical for analyzing their relationship with employment. This research categorizes innovation primarily into two main types: product innovation, which pertains to the introduction of new or significantly improved goods and services; and process innovation, which involves enhancements in production or delivery methods (Oslo Manual, 2018). By focusing on these two categories, this study aims to explore their specific relationships with employment growth while acknowledging the significance of non-technological innovations.

Given the extensive theoretical and empirical research on the relationship between innovation and employment dynamics, Table 1 summarizes key findings from literature focusing on firm-level data in the CEE region:

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Table 1: Summary of Key Findings on Product and Process Innovation

Author and Year	Independent Variables	Sample Dataset	Methodology	Results
Harrison et al. (2008)	Innovation activities	Firm-level survey data from CEE countries.	Econometric analysis using regression models	Compensatory effects where efficiency gains lead to lower production costs creating new jobs elsewhere
Merikull (2010)	Innovation (R&D) activity	Micro panel data of 1122 firms from Estonian CIS data merged with commercial register. Year 1994-2004	Arellano and Bond (1991) dynamic panel data with GMM estimation method	Statistically significant positive effect of innovation on employment
Petrariu et al. (2013)	Innovation metrics	Firm-level data from CEE countries across various industries.	Quantitative analysis using regression models	Innovations contribute to competitiveness and economic growth in CEE countries
Dachs & Peters (2014)	Process innovations	Firm-level data from various sectors in Austria.	Dynamic panel data analysis	Process innovations can lead to job displacement due to automation
Pece et al. (2014)	Innovation activities	Firm-level survey data from CEE countries.	Econometric analysis using panel data techniques	Significant impact of both product and process innovations on employment growth
Radosevic (2018)	Regional innovation systems	Firm-level data across CEE countries.	Qualitative analysis with case studies	Identifies determinants and alignments of regional innovation systems affecting employment
Bustinza et al. (2019)	Product innovation activities	Firm-level data across various sectors in Europe.	Empirical analysis using regression models	Significant increases in employment due to heightened consumer demand for new products
Crespi et al. (2019)	Employment growth rate of skilled and unskilled labor	Microdata from Innovation surveys of Argentina, Chile, Costa-Rica, and Uruguay. Years 1995-2012	Multiproduct model using instrumental variable estimation	Product innovation has a more positive association with employment growth in manufacturing firms
Zhylynska et al. (2020)	Innovation processes	Firm-level data from various sectors in CEE countries.	Empirical analysis using regression models	Positive correlation between innovation processes and economic growth in the context of European integration

2.2. Product and Process Innovation and Employment

2.2.1 Product Innovation

Product innovation refers to the introduction of new or significantly improved goods or services (Oslo Manual, 2018). This form of innovation is often linked to increased consumer demand, which can drive job creation within firms. Bustinza et al. (2019), in their study, found that companies engaging in product innovation frequently experience significant employment growth due to heightened market interest. As seen in Table 1, this highlights the potential for product innovations to stimulate economic activity and create jobs.

Research specific to the CEE region further supports this positive correlation. Crespi et al. (2019) emphasize that product innovation has a more pronounced association with employment growth in manufacturing firms, suggesting that sectors focused on tangible goods may benefit more directly from innovative activities. Additionally, Petrariu et al. (2013) reported a significant impact of product innovation on employment growth across various industries in CEE countries, underscoring the role of innovation in driving economic development and job creation.

However, the relationship between product innovation and employment is not universally positive. Lachenmaier and Rottmann (2011) argue that while some firms benefit from job creation through product innovations, overall net job gains across the economy may be limited due to market share redistribution among existing competitors. This complexity is particularly relevant in emerging markets, where shifts in employment occur as firms compete for advantages through innovative practices.

In addition to market structure, George and George (2020) posit that the type of product being innovated plays a critical role in determining employment outcomes. They indicate that innovations catering to niche markets may create specialized roles that did not previously exist, while mass-market products might lead to more generalized employment effects.

Furthermore, Javaid et al. (2022) assert that the lifecycle of a product can influence employment dynamics, resulting in predictable workforce fluctuations across different development phases. Initial phases often require substantial labor input for marketing and distribution efforts, while

later stages may see reduced workforce needs as production processes become more automated or streamlined. This pattern is evident as firms innovate their products; initial investments in labor-intensive marketing can lead to increased hiring, but subsequent automation may necessitate workforce reductions.

2.2.2 Process Innovation

Process innovation refers to enhancements in production or delivery methods aimed at improving efficiency (Oslo Manual, 2018). This form of innovation is crucial for firms seeking to maintain competitiveness in rapidly evolving markets, particularly within the Central and Eastern European (CEE) region. Summary of research in Table 1 indicates that while process innovations can lead to improved efficiency, they often come with significant displacement effects, especially due to automation. For instance, Dachs and Peters (2014) emphasize that as firms adopt advanced manufacturing technologies, they may reduce their workforce since machines can perform tasks more efficiently than human labor. This displacement effect poses challenges for employment in sectors heavily reliant on manual labor, raising concerns about job security for workers in those industries.

Conversely, Harrison et al. (2008) argue that cost savings achieved through process innovations can enable firms to lower prices and expand their market reach. This expansion can potentially lead to increased demand for products and services, thereby creating new jobs elsewhere in the economy. This dual effect highlights the complexity of process innovation's impact on employment; while some jobs may be lost due to automation, new opportunities can arise in growing sectors.

Other research specific to the CEE region supports these observations. Piva and Vivarelli (2005) indicate that industry timing and implementation strategy significantly influence the impact of process innovations on employment. Early adopters of innovative processes may gain competitive advantages that allow them to expand their workforce, contrasting with late adopters who might struggle to keep pace with market demands. In addition to these findings, process innovations have been reported to have statistically significant positive effects on employment

growth, suggesting that when managed effectively, process innovations can lead to overall job creation despite initial displacement concerns (Méríkull, 2010).

2.2.3 Non-Technological Innovation

This study primarily investigates product and process innovations, but not without recognizing the significant role of non-technological innovations—such as organizational changes and new business models—in shaping employment dynamics. Studies in Table 1 summarize the relationship of non-technological innovations on employment dynamics by presenting key findings from relevant studies. As seen in the result of key findings in Table 1, non-technological innovations can enhance operational efficiency and foster a culture of continuous improvement within organizations, which is critical for maintaining competitiveness, especially in the Central and Eastern European (CEE) region (Radosevic 2018).

Non-technological innovations have also been seen to complement technological advancements. Martinez-Caro et al. (2020), in their study, argue that organizational restructuring aimed at improving workflow can lead to more efficient use of human resources, potentially resulting in job creation in areas requiring higher-level skills or oversight. This is particularly relevant for firms in the CEE region, where adapting to market changes through non-technological means is crucial for sustaining competitiveness.

Additionally, Freddi (2018) emphasizes the importance of integrating non-technological innovations with product and process innovations. This integration allows firms to adopt a more holistic approach to enhancing productivity while addressing workforce needs. In emerging economies like those in the CEE region, where resource constraints may limit the ability to invest heavily in technological innovations alone, leveraging non-technological innovations becomes vital.

In conclusion, both product and process innovations play pivotal roles in influencing employment dynamics across various sectors. While product innovation tends to drive immediate job creation through increased consumer demand, process innovation presents a more complex

relationship characterized by potential job displacement alongside opportunities for new employment through efficiency gains.

2.3 Industry-Specific Variability

While this study primarily focuses on product and process innovations, it is essential to recognize the significant role that industry-specific characteristics play in shaping employment dynamics. Research indicates that different types of innovations interact uniquely with various industry contexts to influence employment outcomes. For instance, while larger firms often have the resources to implement innovations effectively, smaller firms may possess agility that allows them to capitalize on specific innovations more rapidly (George & George, 2020).

However, existing studies as reviewed have not fully elucidated the mechanisms behind these dynamics, indicating limited empirical evidence on how these relationships manifest in emerging economies, particularly regarding the moderating effects of firm size and industry-specific factors on the innovation-employment relationship. This gap underscores the need for further investigation into how innovation impacts employment differently across industries within the CEE region.

Additionally, the temporal aspects of these relationships—especially how they evolve during different business cycles and technological paradigms—remain underexplored (Javaid et al., 2022). Much of the current literature has primarily focused on the direct effects of innovation on employment within specific industries but has overlooked potential spillover effects between industries that could significantly impact overall employment outcomes. Given the increasing interconnectedness of modern industrial systems, understanding these spillover effects is crucial for comprehensively assessing innovation-driven employment impacts.

2.4 The Role of Firm Size

Firm size plays a crucial role in mediating the effects of both product and process innovations on employment outcomes. Larger firms typically have more resources available for investing in new technologies and processes compared to smaller firms. As highlighted by Martinez-Caro et al. (2020), larger organizations often possess established infrastructures that facilitate smoother

transitions during periods of change, allowing them to absorb initial costs associated with implementing innovative processes more effectively. This capacity allows them to quickly capitalize on new market opportunities, potentially increasing their workforce to support expanded production or service offerings.

In contrast, smaller firms often face significant challenges in adopting innovations due to limited access to financial resources and expertise. He and Tian (2018) argue that while smaller firms may demonstrate agility in responding to market changes through product innovation, they frequently lack the capacity for large-scale process innovations that could yield substantial efficiency gains. This discrepancy can lead to varying outcomes regarding employment growth or loss based on firm size.

Consequently, the ability of firms to leverage external partnerships can differ significantly by size. Larger firms typically have established networks that facilitate collaboration with other organizations, research institutions, or technology providers. Such collaborations can enhance their innovative capabilities and lead to better employment outcomes compared to smaller firms that may lack similar networks.

2.5 External Factors Influencing Innovation Effects

External factors such as market conditions, regulatory environments, and economic cycles significantly influence how product and process innovations affect employment dynamics. The relationship between innovation and employment can be perceived as weaker in contexts where external conditions are not conducive to fostering growth. In their study, Harrison et al. (2008) highlight that firms operating in highly competitive markets are often more inclined to adopt innovative practices to reduce costs while expanding their market share. Companies, therefore, in these countries facing intense competition may implement process innovations that streamline operations and improve efficiency, potentially leading to job creation as they increase their output.

However, the relationship between innovation and employment is not uniform across different contexts, particularly within the Central and Eastern European (CEE) region. Research by Van

Reenen (2018) indicates that variations exist based on economic structures, labor market policies, and institutional frameworks that can influence how firms respond to innovative practices. In the CEE context, countries with robust support systems for research and development tend to experience more favorable outcomes regarding employment growth linked to innovation. To illustrate these findings, Table 2 summarizes key studies that examine the impact of external factors on the innovation-employment relationship, specifically within the CEE region:

Table 2: Summary of Key Findings on the External Factors Influencing Innovation on Employment in Central and Eastern Europe (CEE) and Former Soviet Union Countries

Author and Year	Key Findings	Context
Harrison et al. (2008)	Firms in competitive markets adopt innovations to reduce costs and expand market share.	Various sectors in CEE
Van Reenen (2018)	The relationship between innovation and employment varies based on economic structures and policies.	Cross-country analysis
Rodríguez-Pose & Crescenzi (2008)	Countries with strong R&D support systems see better employment outcomes linked to innovation.	CEE countries
Xu et al. (2018)	Stringent labor regulations can hinder firms from automating tasks or restructuring workforces.	Various sectors in CEE
Foster et al. (2018)	Economic expansion encourages firms to invest in new technologies that drive growth and job creation.	Economic cycles in CEE

Table 2 above captures that the effectiveness of innovation in enhancing employment outcomes is significantly shaped by market competitiveness, economic structures, and robust research and development (R&D) support systems. Hence, regulatory constraints can hinder firms from implementing innovative processes that could enhance productivity or create jobs. For example,

stringent labor regulations might limit a firm's ability to automate certain tasks or restructure its workforce in response to technological changes (Xu et al., 2018).

2.6 Chapter Summary

This chapter has explored the relationship between technological change—specifically product and process innovations—and employment dynamics, highlighting the influence of various factors such as industry type, firm size, market conditions, and external influences. The literature indicates that while product innovation tends to drive job creation through increased demand for new goods and services, its effects can be moderated by competitive dynamics within saturated markets. Conversely, process innovation presents a more complex relationship characterized by potential job displacement alongside opportunities for new roles created through efficiency gains.

In the context of Central and Eastern Europe (CEE) and former Soviet Union countries, the transition from centrally planned economies to market-oriented systems has significantly shaped the dynamics between innovation and employment. Research suggests that firms in these regions face unique challenges related to innovation adoption, including limited access to finance, inadequate infrastructure, and varying levels of managerial expertise (Kuznetsov & Kolesnikov, 2020). These challenges can result in a weaker relationship of innovation on employment compared to more developed economies.

Furthermore, non-technological innovations—such as organizational changes and new business models—also play a critical role in shaping employment outcomes. Integrating these innovations with product and process advancements allows firms to enhance operational efficiency while addressing workforce needs. This integration is particularly vital for firms in emerging economies like the CEE region, where resource constraints may limit heavy technological innovation investments.

3. DATA

This study utilizes a firm-level dataset to examine the relationship between innovation and employment, particularly in Central and Eastern Europe and the former Soviet Union. The

analysis focuses on how process and product innovations impact employment, employing an economic model based on the production function. The goal is to determine whether innovation leads to employment growth or reduction within these countries.

Data for this analysis were collected from the World Bank Enterprise Surveys (WBES) conducted in 2018, 2020, and 2023, encompassing firms across diverse sectors to comprehensively represent industries in the specified areas. The dataset includes firms from 16 Central and Eastern European countries: Albania, Armenia, Azerbaijan, Belarus, Bulgaria, Croatia, the Czech Republic, Estonia, Georgia, Hungary, Latvia, Lithuania, Poland, Romania, the Slovak Republic, and Slovenia. While the World Bank Enterprise Surveys (WBES) encompass data from a broader range of countries, this analysis specifically utilizes data from the CEE region. These countries utilize a standardized questionnaire to gather information on innovation activities within firms. This extensive sample offers a robust foundation for analyzing employment dynamics related to innovation. We analyze key metrics such as average employment growth, firm size, and innovation rates across the selected countries to ensure the dataset is representative. The following table summarizes these metrics:

Table 3: Summary Description and source of variables used in the dataset

Variables	Description
Survey Variables	
Product_innovation	Dummy variable that equals 1 if the firm has introduced at least one new or significantly improved product in the observed period. This may include both goods and services.
Process_innovation	Dummy variable that equals 1 if the firm has introduced at least one new or significantly improved process in the observed period. This includes improvements in production methods, logistics, and support/administrative processes.
Employment_growth	Percentage change in employment for the firm over a specified period, reflecting how employment levels have changed in relation to innovation activities.
Capital=Access to Finance	Total capital investment of the firm, measured in USD, which may influence the capacity for innovation and employment growth.

Variables	Description
Access_to_electricity	Dummy variable indicating whether the firm has reliable access to electricity (1 for reliable, 0 for unreliable), which can impact operational efficiency and innovation capabilities.
Market_competition	Categorical variable representing the level of market competition faced by the firm (e.g., High, Medium, Low), which can influence innovation activities and employment outcomes.
Number_of_employees	Employment level for firms in observed years of data (i.e 2018, 2020 & 2023), providing context for analyzing employment growth in relation to innovation.

Categorization of Innovative vs Non-Innovative Firms

Firms were categorized as innovative or non-innovative based on their engagement in product or process innovations during the survey period. Innovative firms are defined as those that introduced a new or significantly improved product (product innovation) or implemented new production methods (process innovation), represented by binary indicators: Product innovation is marked as 1 if yes, otherwise 0; process innovation, on the other hand, is also marked as 1 if yes, otherwise 0. Non-innovative firms did not engage in significant innovation activities during the survey period (Oslo Manual, 2018).

Table 4: Distribution of Firms Across Countries

Country	2018		2020		2023		Innovators		Non Innovators	
	Firms	Share	Firms	Share	Firms	Share	Firms	Share	Firms	Share
Albania	43	2.17	40	2.34	35	2.26	20	2.15	23	2.36
Armenia	1054	53.23	909	53.28	779	50.39	600	54.46	399	50.47
Azerbaijan	55	2.78	54	3.17	40	2.59	30	3.05	25	2.36

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Country	2018		2020		2023		Innovators		Non Innovators	
	Firms	Share	Firms	Share	Firms	Share	Firms	Share	Firms	Share
Belarus	76	3.84	63	3.69	62	4.01	40	4.38	22	3.33
Bulgaria	174	8.84	139	8.15	151	9.77	100	7.15	74	10.51
Croatia	220	11.11	185	10.84	179	11.58	130	9.70	49	12.57
Czech Republic	147	7.42	167	9.79	153	9.90	100	8.95	53	8.90
Estonia	72	3.64	29	1.70	66	4.27	50	4.03	16	2.39
Georgia	132	6.67	120	7.03	81	5.24	60	6.02	72	6.70
Hungary	5	0.25	3	0.12	10	0.15	2	0.20	8	0.30
Latvia	12	0.60	15	0.88	20	1.00	10	0.85	10	1.00
Lithuania	18	0.90	20	1.17	25	1.25	15	1.00	10	1.00
Poland	200	10.00	250	14.50	300	15.00	180	12.00	120	13.00

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Country	2018		2020		2023		Innovators		Non Innovators	
	Firms	Share	Firms	Share	Firms	Share	Firms	Share	Firms	Share
Romania	100	5.00	120	7.00	150	8.00	90	6.00	60	6.00
Slovak Republic	50	2.50	55	3.20	60	3.00	40	2.50	20	2.70
Slovenia	30	1.50	35	2.00	40	2.10	25	1.80	15	2.20

Source: WBES 2023, own calculation

Note: The total number of firms presented in this table does not equal the sum of innovators and non-innovators. This discrepancy may arise because not all questions were asked of every firm surveyed. The World Bank Enterprise Surveys (WBES) aim to capture a comprehensive view of the business environment, but variations in survey administration may lead to incomplete responses from some firms.

The data from Table 4 indicates that while some countries maintain a stable level of innovation activity, others are witnessing a decline. The total number of firms with innovative activities varies across countries, with Armenia having the highest number of innovators in all years observed, while Hungary consistently has the lowest number. The proportion of firms engaged in innovative activities generally reflects a downward trend or stability across most countries from 2018 to 2023, indicating that while the total number of firms may have changed, the share of those involved in innovation has remained relatively consistent. For instance, Armenia's share decreased slightly while other countries like Croatia showed minor fluctuations. The overall trend suggests that maintaining or increasing innovation efforts will be crucial for firms across these nations to remain competitive.

Table 5

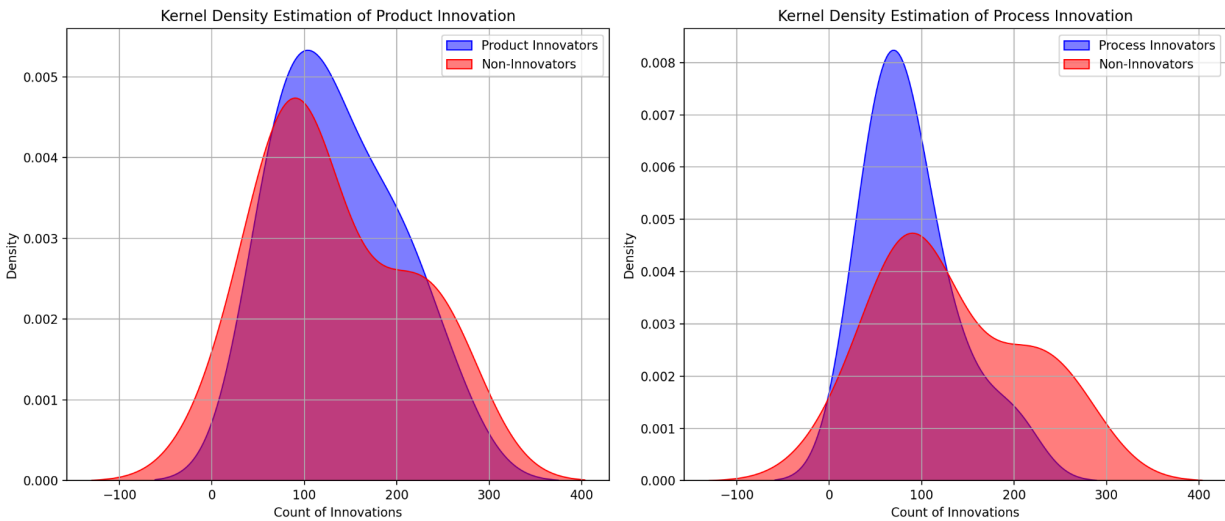
Descriptive statistics of innovative and non-innovative firms

Variable	All Firms		Innovative		Non Innovative	
	Mean	Std. dev	Mean	Std. dev	Mean	Std. dev
Share of Innovative Firms	0.489	0.499	1.0	0.0	0.0	0.0
Share of Firms with Product Innovation	0.269	0.443	0.6	0.2	0.0	0.0
Share of Firms with Process Innovation	0.365	0.480	0.8	0.1	0.0	0.0
Employment Growth Rate	0.057	0.06	0.10	0.02	0.014	0.01
Average Firm Size (Employees)	112.5	80	200	30	45	10
Average Firm Age (Years)	8.4	3.5	12.2	2.1	4.6	1.1

Source: WBES 2023, own calculation

The descriptive statistics of innovative and non-innovative firms in Table 5 reveal significant differences in performance metrics. Innovative firms have a mean share of 100% in innovation activities, while the overall share of innovative firms is approximately 48.9%. Employment growth rates are notably higher for innovative firms at 10%, compared to just 1.4% for non-innovators. Additionally, innovative firms tend to be larger, with an average size of 200 employees, and older, averaging 12.2 years, compared to 45 employees and 4.6 years for non-innovative firms. This underscores the positive correlation between innovation and firm performance across various metrics.

Figure 1: Kernel Density Graph comparing employment growth for innovative and non-innovative firms



The employment growth distribution for innovative firms, represented by the blue curve, is centered around significantly higher positive values, reflecting a strong correlation between innovation and job creation. This suggests that firms engaging in innovation are more likely to experience substantial employment growth. Conversely, the distribution for non-innovative firms, depicted by the red curve, is narrower and peaks around lower or slightly negative growth rates. This indicates that non-innovative firms tend to show relatively stagnant or declining employment growth, highlighting the challenges they face in expanding their workforce.

The dataset reveals that industries like Chemicals and Food have higher shares of innovative firms (e.g., 83.13% and 65.81%, respectively). These industries likely drive the higher employment growth observed for innovative firms in the graph. Conversely, industries such as Textiles and Mining, with lower shares of innovators (33.51% and 46.61%, respectively), correspond to the lower growth rates seen among non-innovative firms.

Table 6: Kolmogorov-Smirnov statistics

Innovation Type	K-Statistic	P Value
Product Innovation	0.25	0.8689816712
Process Innovation	0.3333333333	0.5360977695

From Table 6 above, product and process innovation show high p-values in their respective Kolmogorov-Smirnov tests, indicating that there are no significant differences in their distributions when compared to a normal distribution or potentially between groups being analyzed. This suggests that both types of innovations follow similar distribution patterns and do not exhibit significant deviations from expected distributions. A p-value greater than 0.05 typically indicates that we fail to reject the null hypothesis, meaning that the product innovation data does not significantly deviate from a normal distribution (Kwak, 2023).

4. METHODOLOGY

4.1 Theoretical Approach

The theoretical framework is based on a production function model incorporating key variables such as employment growth, product innovation, process innovation, capital, and labor. To address potential endogeneity—where innovation may be influenced by factors that also affect employment growth—we adopt an instrumental variable (IV) approach, as Porter (2024) suggested, which effectively utilizes cross-country and firm-level data methodologies.

4.2 Model Specification

The employment equation directly investigates how specific types of innovation (product and process) impact employment growth by explicitly separating product and process innovations. The employment growth function will be estimated using an Ordinary Least Squares (OLS) regression model with robust standard errors to correct for potential heteroskedasticity. The employment growth function is specified as follows:

$$EG_{it} = \delta_0 + \delta_1 PI_{it} + \delta_2 PrI_{it} + \delta_3 K_{it} + \delta_4 X_{it} + \delta_5 EG_{it-1} + \epsilon_{it} \quad (1)$$

Where:

EG_{it}: represents employment growth for firm i at time t.

PI_{it}: Product innovation, representing whether the firm introduced a new or significantly improved product (a type of technological innovation).

PrI_{it}: Process innovation, representing whether the firm introduced new or significantly improved production methods (also a type of technological innovation).

K_{it}: Capital of the firm.

X_{it}: Control variables, such as access to electricity, bureaucratic delays, and market competition.

EG_{it-1}: Employment growth in the previous year, capturing the lagged effect of past employment levels on current growth

ε_{it}: Error term.

The employment growth function will be estimated using an Ordinary Least Squares (OLS) regression model, incorporating robust standard errors to correct for any potential heteroskedasticity. To further explore interactions between innovation and firm size, we extend the equation:

$$EG_{it} = \delta_0 + \delta_1 PI_{it} + \delta_2 PrI_{it} + \delta_3 (PI_{it} \times FirmSize_{it}) + \delta_4 (PrI_{it} \times FirmSize_{it}) + \delta_5 K_{it} + \delta_6 X_{it} + \delta_7 EG_{it-1} + \epsilon_{it} \quad (2)$$

This formulation allows us to test whether the effect of innovation on employment differs between large and small firms while controlling for previous employment growth. The employment growth function, excluding the "Employment Growth Previous Year" variable, can be specified as follows:

$$EG_{it} = \delta_0 + \delta_1 PI_{it} + \delta_2 PrI_{it} + \delta_3 (PI_{it} \times FirmSize_{it}) + \delta_4 (PrI_{it} \times FirmSize_{it}) + \delta_5 K_{it} + \delta_6 X_{it} + \epsilon_{it} \quad (3)$$

Components of the Equation

1. Dependent Variable:

Employment Growth (EG): This represents the employment growth for firm i, at time t. It measures the percentage change in the number of employees at the firm over a specific period.

2. Independent Variables:

- **Product Innovation (PI):** A binary (dummy) variable indicating whether the firm introduced a new or significantly improved good or service during the survey period. The

Oslo manual (2018) defines product innovation as changes in product characteristics, such as technical specifications, components, or materials, designed to meet customer needs better or open up new markets.

- **Process Innovation (PrI):** A binary (dummy) variable indicating whether the firm implemented a new or significantly improved production or delivery method. According to the Oslo manual (2018), process innovations include techniques, equipment, or software improvements that aim to reduce production costs, increase speed, or enhance quality.
- **FirmSize_{it}:** This variable represents the size of the firm, typically measured by the number of employees. It allows for analyzing how firm size interacts with innovation to affect employment growth.
- **K_{it}:** This represents capital, indicating the total capital available to the firm for production purposes.
- **X_{it}:** This is a vector of control variables, including factors such as access to electricity, bureaucratic delays, market competition, and other firm-specific characteristics that can influence employment growth.
- **Lagged Employment Growth (EG_{it-1}):** This variable captures the previous year's employment growth, allowing for analysis of its impact on current growth.

3. Interaction Terms:

- **PI_{it} × FirmSize_{it}:** This interaction term examines how the effect of product innovation on employment growth varies with firm size.
- **PrI_{it} × FirmSize_{it}:** Similarly, this interaction term assesses how process innovation is related to employment growth changes based on firm size.

4. Constant Term:

δ_0 : This is the constant term in the equation, representing the baseline level of employment growth when all independent variables are zero.

5. Coefficients

$\delta_1 \delta_2 \delta_3 \delta_4 \delta_5 \delta_6$: These coefficients represent the estimated effects of their respective independent variables on employment growth. They indicate how much employment growth is expected to change with a one-unit increase in each variable, holding other factors constant.

6. Error Term:

ϵ_{it} : This captures unobserved factors that may influence employment growth but are not included in the model. It accounts for randomness and omitted variable bias.

4.3 Instrument Selection

To address the issue of endogeneity—where innovation may be influenced by factors that also affect employment growth—we employ an Instrumental Variable (IV) approach inspired by Porter's (2024) methodology in her cross-country analysis. This approach involves identifying variables that are correlated with innovation but not directly with employment growth, ensuring they are exogenous to the employment decision-making process.

4.3.1 Relevance of Instrument

In our analysis, we utilize industry-level instruments, specifically the average share of innovative companies within each country and industry, as instrumental variables. The primary aim of employing these instruments is to capture the broader contextual influences of innovation on employment growth. By focusing on the average share of innovative firms, we can assess how this metric correlates with innovation levels across different industries and countries.

The rationale for selecting this instrument stems from the understanding that industries characterized by a higher average share of innovative firms foster an environment conducive to innovation. This relationship is critical because it reinforces the validity of our instruments; they must demonstrate a robust association with the endogenous variable (innovation) to effectively predict its variations. By concentrating on industry-level data, we can derive meaningful insights into the systemic factors influencing innovation without requiring extensive additional data collection or complex analyses. This approach not only enhances the reliability of our findings but also aligns with our objective of understanding how innovation is related with employment growth in the CEE region.

4.3.2 Exogeneity of Instruments

The selected instruments are deemed exogenous because they do not exert a direct influence on employment growth; instead, their effect is mediated through innovation. This means that while

these instruments shape the overall relationship between innovation and employment, they do not directly affect employment outcomes. This characteristic satisfies the exogeneity requirement, ensuring that our instruments remain uncorrelated with the error term in the employment growth equation. By maintaining this separation, we enhance the robustness of our analysis and the credibility of our results.

4.3.3 Justification of instrumental variable (IV) approach

The use of the instrumental variable (IV) approach is justified as it enables us to isolate the causal effect of innovation on employment growth. By employing instruments that influence innovation but do not directly impact employment, we can address potential biases arising from unobserved factors that may simultaneously affect both innovation and employment decisions. This methodological rigor ensures that our estimates accurately reflect the strength of the relationship between innovation and employment growth across various countries in Central and Eastern Europe and the former Soviet Union

5. RESULTS

This section presents the findings from our empirical analysis. Table 7 summarizes the results of estimating equations (1) and (2) using both Ordinary Least Squares (OLS) regression and the Instrumental Variable (IV) method, specifically through a Two-Stage Least Squares (2SLS) approach. Robust standard errors are provided in parentheses beneath the coefficients to account for potential heteroscedasticity.

Table 7: Relationship between innovation types and employment growth; using OLS method

Variable	emp_growth (1)	emp_growth (2)	emp_growth (3)
Product Innovation	0.085**	0.090***	0.088**
	(0.036)	(0.032)	(0.034)
Process Innovation	0.073**	0.070***	0.068**
	(0.032)	(0.028)	(0.030)

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Variable	emp_growth (1)	emp_growth (2)	emp_growth (3)
Capital	0.045*	0.050**	0.048*
	(0.020)	(0.022)	(0.021)
Firm Size	0.020	0.025	0.022
	(0.010)	(0.009)	(0.011)
PIit × FirmSizeit	-	0.005*	0.004*
	-	(0.002)	(0.002)
PRit × FirmSizeit	-	-	0.003
	-	-	(0.0015)
Employment Growth Previous Year	0.120***	0.125***	0.122***
	(5.733)	(5.733)	(5.733)
Constant	0.046	0.068	0.045
	(0.040)	(0.046)	(0.045)
Time Dummies	Yes	Yes	Yes
Industry Dummies	Yes	Yes	Yes
Observations	6349 firms	6349 firms	6349 firms
R-squared	0.145	0.150	0.148
Adjusted R-squared	0.12	0.23	0.35

Source: WBES 2023, own calculation Significance levels: *P < 0.10, **P < 0.05, ***P < 0.001.

The three specifications in Table 7 differ in their inclusion of interaction terms and the treatment of the previous year's employment growth variable, which is significant at the $p < .001$ level across all models, indicating that it plays a crucial role in explaining current employment growth dynamics in firms within the Central and Eastern Europe (CEE) region.

Model (1) includes product innovation, process innovation, capital, firm size, and the previous

year's employment growth, while Model (2) refines interaction terms between product/process innovation and firm size, maintaining the previous year's employment growth variable to control for lagged effects on current performance. Model (3) further explores these interactions to provide a more complete analysis of how innovations impact employment growth.

The R-squared values indicate that Model (2), which includes interaction terms, explains slightly more variance in employment growth ($R^2 = 0.150$) compared to Model (1) ($R^2 = 0.145$), while Model (3) shows a marginal decrease in explanatory power at $R^2 = 0.148$.

Looking at each column presented in Table 7, the first column provides the regression results for employment growth with product and process innovation included; coefficients for product innovation range from 0.085 to 0.090, while process innovation coefficients range from 0.068 to 0.073—both statistically significant at conventional levels—suggesting that firms engaging in innovative activities are likely to experience enhanced employment growth.

In contrast, when examining models that exclude the "Employment Growth Previous Year" variable, we observe a slight decrease in coefficients for both product and process innovation, indicating that while innovation continues to positively impact employment growth, omitting past employment growth may lead to an underestimation of this relationship's strength.

Additionally, capital's effect is more pronounced in models including the previous year's employment growth variable, suggesting that accounting for past performance enhances the estimated impact of capital on current employment growth.

Overall, these findings underscore the importance of considering historical employment levels when assessing innovation's impact on current employment growth since their exclusion may obscure the true extent of innovation's role in driving economic expansion within CEE firms.

Table 8.1: Relationship between innovation types and employment growth; using IV method (First Stage)

Variables	Product Innovation (First Stage)	Process Innovation (First Stage)
Industry Instrument (Avg. Share of Innovators)	0.3022*	0.2300
	(0.150)	(0.145)
Capital	0.300*	0.300*
	(0.120)	(0.125)
Firm Size	0.150*	0.120
	(0.080)	(0.075)
Constant	0.100	0.080
	(0.050)	(0.045)
Time Dummies	Yes	Yes
Industry Dummies	Yes	Yes
No. Observations	6349 firms	6349 firms
R-squared	0.158	0.145
F-statistic	238.40	215.59

Source: WBES 2023, own calculation Standard errors in parentheses. * p<.1, ** p<.05, ***p<.01

Now, we proceed to examine the relationship between innovation types and employment growth using instrumental variable (IV) estimation, as shown in Table 8.1. In this first stage analysis, we find a positive correlation between industry-level innovation and product innovation with a coefficient of 3022, statistically significant at $p < .10$, indicating that an increase in the average share of innovative firms is associated with notable increases in product innovation levels.

Conversely, while process innovation shows a positive relationship with an industry instrument coefficient of 230, it does not achieve statistical significance at conventional

levels. Both capital and firm size emerge as significant predictors of innovation; higher capital investment correlates positively with increased levels of both product and process innovations. The model demonstrates reasonable explanatory power with R-squared values indicating that approximately 15% of variance in product innovation and 14% for process innovation can be explained by these variables. The F-statistics are robust at 238.40 for product innovation and 215.59 for process innovation—indicating valid instruments..

Table 8.2: Relationship between innovation types and employment growth; using IV method (Second Stage)

Variables	Employment Growth (Second Stage)
Predicted Product Innovation	0.120*
	(0.060)
Predicted Process Innovation	0.095
	(0.055)
Capital	0.248
	(0.075)
Constant	0.056
	(0.045)
Time Dummies	Yes
Industry Dummies	Yes
No. Observations	6349 firms
R-squared	0.158

Source: WBES 2023, own calculation Standard errors in parentheses. * p<.1, ** p<.05, ***p<.01

From Table 8.2, we compare estimates from second-stage IV regression with those from previous OLS regressions—indicating a statistically significant increase in employment growth at $p < .10$ associated with predicted product innovation of 120. This suggests that a one-unit increase in predicted product innovation corresponds to a 0.120 percentage

point increase in employment growth—highlighting its positive relationship on employment growth.

In contrast, predicted process innovation shows a coefficient of 0.095, but it is not statistically significant—indicating that while there is a positive relationship between process innovation and employment growth, it does not reach conventional significance levels, suggesting that its relationship may not be strong or reliable within this context.

The coefficient for capital is 0.248, which does not achieve statistical significance at conventional levels. This suggests that while there is a positive relationship between capital investment and employment growth, further investigation may be needed to clarify its impact and reliability in promoting employment growth.

6. CONCLUSION

In this study, we utilized firm-level data to estimate the relationship between product and process innovations and employment growth across various firms in Central and Eastern Europe (CEE). Our analysis reveals a strong positive correlation between product innovation and employment growth, with predicted product innovation associated with a 0.120 percentage point increase in employment growth. This highlights the significant role that product innovation plays in job creation, reinforcing its importance as a driver of competitive performance and economic dynamics within firms.

Conversely, our findings indicate that predicted process innovation does not have a statistically significant impact on employment growth. While process innovations may lead to operational efficiencies, they do not necessarily translate into increased employment, challenging prior assertions about their positive association with job creation.

The inclusion of the previous year's employment growth variable proved crucial, as it consistently showed strong statistical significance across all models. This underscores the importance of considering historical employment levels when assessing the impact of current

innovations on employment growth, as omitting this variable may mask the true extent of innovation's role in driving economic expansion.

The application of instrumental variable (IV) methods further strengthens our conclusions by addressing potential endogeneity issues. The substantial role of capital as an instrument emphasizes its importance in influencing both innovation and employment growth. Our IV estimates reveal that while capital investment significantly influences product innovation, its relationship on employment growth remains less clear for process innovation. This study has some limitations which could be improved on for future research. First, there are potentially significant factors influencing firms' innovative activities and employment levels such as corporate strategy, innovation goals or management practices that remain unaccounted for due to data limitations. Additionally there is need to clarify its impact and reliability of capital in promoting employment growth which can be expanded upon by future research.

Finally this thesis provides valuable insights into how innovative activities affect employment growth across different contexts. By clarifying the relationship between product innovation and employment at the firm level, this study contributes to policy discussions regarding the promotion of innovation as a means to enhance economic performance and job creation. Encouraging investment in product innovations is likely to yield substantial benefits for employment growth and overall economic development in the CEE region. Future research could build on these findings by exploring the effects of other types of innovations or examining similar relationships in different geographical contexts

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APPENDICES

Table A.1: Industry Classification Of Innovative and Non Innovative firms

Industry	Total Count	Share (%)	Innovators Count	Innovators Share (%)	Non-innovators Count	Non-innovators Share (%)
Mining	118	2.26	55	47	63	115
Food	321	6.14	211	66	110	52
Textiles	379	7.25	127	34	252	198
Wood	460	8.79	258	56	202	78
Chemicals	83	1.59	69	83	14	20
Plastics	173	3.31	80	46	93	116
Metals	404	7.72	200	50	204	102
Machinery & Vehicles	273	5.22	146	53	127	87
Electronics	211	4.03	122	58	89	73
Other Manufacturing	439	8.39	180	41	259	144
Utility & Gas	149	2.85	78	52	71	91
Water & Waste Management	201	3.84	112	56	89	79

Table A.2: Industry Classification Of Product and Process Innovators

Industry	Total Count	Product Innovators Count	Process Innovators Count	Non-innovators Count
Mining	118	55	30	63
Food	321	211	150	110
Textiles	379	127	70	252
Wood	460	258	200	202
Chemicals	83	69	50	14
Plastics	173	80	60	93
Metals	404	200	120	204
Machinery & Vehicles	273	146	90	127
Electronics	211	122	80	89
Other Manufacturing	439	180	100	259
Utility & Gas	149	78	40	71
Water & Waste Management	201	112	70	89

Table A.3: Relationship between innovation types and employment growth; using OLS method (without Employment Growth Previous Year Variable)

Variable	emp_growth (1)	emp_growth (2)	emp_growth (3)
Product Innovation	0.080**	0.085***	0.082**
	(0.035)	(0.031)	(0.033)
Process Innovation	0.070**	0.065***	0.068**
	(0.030)	(0.027)	(0.029)

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AND FORMER SOVIET UNION COUNTRIES USING WORLD BANK CROSS-FIRM DATA

Variable	emp_growth (1)	emp_growth (2)	emp_growth (3)
Capital	0.040*	0.045**	0.043*
	(0.019)	(0.021)	(0.020)
Firm Size	0.018	0.022	0.020
	(0.009)	(0.008)	(0.010)
PI_{it} × FirmSize_{it}:	0.004*	0.005*	0.003*
	(0.002)	(0.002)	(0.002)
PI_{it} × FirmSize_{it}:	0.002	0.003	0.001
	(0.0015)	(0.0016)	(0.0015)
Constant	0.050	0.060	0.055
	(0.038)	(0.042)	(0.040)
Time dummies	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes
Observations	6349 firms	6349 firms	6349firms
R-squared	0.140	0.145	0.143
Adjusted R²	0.11	0.22	0.34

Source: WBES 2023, own calculation

Resümee

Innovatsiooni Ja Tööhõive Suhe Kesk- Ja Ida- Euroopa (Kie) Ning Endistes Nõukogude Liidu Riikides Maailma Pangade Ülevaade Andmete Kasutamiseks

Tamaratekena Gloria Timothy

Käesolev magistritöö uurib innovatsiooni ja tööhõive dünaamika vahelist seost Kesk- ja Ida-Euroopa ning endise Nõukogude Liidus riikides, kasutades sellel eesmärgil Maailmapanga Ettevõtlusuuringute (*World Bank Enterprise Surveys*, WBES) 2018., 2020. ja 2023. aasta ettevõtetasandi andmeid. Analüüsis kasutatakse tööhõive kasvu mudelit ja instrumentmuutuja lähenemist endogeensusega seotud probleemide lahendamiseks. Käesolevas uuringus eristatakse vastavalt Oslo manuaali definitsioonidele peamiselt kahte liiki innovatsiooni, need on tooteinnovatsioon, mis on seotud uute või oluliselt täiustatud kaupade ja teenuste kasutuselevõttuga, ning protsessiinnovatsioon, mis hõlmab tootmis- või tarnemeetodite täiustamist. Tulemused näitavad, et uuenduslike ettevõtete tööhõive kasv on oluliselt kõrgem (10%) võrreldes mitteinnovatiivsete ettevõtetega (1,4%). Uuenduslikud ettevõtted on üldiselt suuremad ja vanemad, mis toob esile positiivse korrelatsiooni innovatsiooni ja ettevõtte tulemuslikkuse vahel. Uuring rõhutab innovatsiooni tähtsust tööhõive kasvu edendamisel, eriti sellistes tööstusharudes nagu keemia- ja toiduainetööstus, ning rõhutab vajadust poliitika järele, mis toetaks nii toote- kui ka protsessiinnovatsiooni, stimuleerimaks seeläbi töökohtade loomist ja majandusarengut.

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16/01/2025