Examination of factors contributing to SMEs Innovation outcomes in the Visegrad Countries

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Doctoral Thesis Summary

Tomas Bata University in Zlín

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Faculty of Management and Economics

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Zkoumání faktorů přispívajících k výsledkům inovací malých a středních podniků v zemích V4

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ABSTRACT

Innovation has become a major factor affecting firms' competitiveness and growth. Firms have over the years' emphasis on introducing new ideas to support their growth and position itself on the market for higher profit. Small and Medium Scale Enterprises (SMEs) account for the bulk of businesses globally and are key contributors to job creation, poverty reduction and global economic development. Despite their growing importance in the national and global economy, they are face with varied challenges such as access to finance, increased competition, capacity limitations related to innovation, knowledge, and creativity. The visegrad group of countries are considered less innovative in the European Union, meaning that SMEs in these countries have weak innovation potentials because of their ecosystem. Until now, less studies especially in visegrad countries have focused on how firms especially SMEs can optimise innovative ideas to withstand the intense market competitions and staying profitable. This thesis examined the various factors contributing to SMEs innovation outcomes in these countries. The thesis examined the role played by both the internal and external environment of these SMEs and how it can influence their innovation outcomes. This study used the doubly robust estimation models, which helped overcome issues of confounding and endogeneity. Data for the empirical study was from the Business Environment and Enterprise Performance Survey (BEEPS V), conducted by the World Bank and the European Bank for Reconstruction and Development (EBRD) between 2017 to 2019. The final combined sample included 2494 SMEs pooled from Poland (1101), Czech Republic (380), Slovakia (338) and Hungary (675). The logit model results have shown positive and significant results that internal factors such as internal R&D, machinery, lines of credit and internet security aided in product and process innovation outcomes in the Visegrad countries. The results on the external factors demonstrate that government contract, financial services, external R&D and informal competition positively impacted technological innovation outcomes. The research further obtained a qualitative data of 15 respondents who are lecturers and academic researchers through interview guide (unstructured instrument) and found similar variables to examine innovation outcomes. They asserted that financial obstacle deterred SMEs in their quest to adopt product innovation and technology license acquisition. The study also finds that tax rates, inadequate labour, financial obstacle, and loss due to theft impeded SMEs innovation outcomes in Visegrad Countries. The study offers theoretical and practical implications on how SMEs in these transition countries can overcome and improve their low innovation.

ABSTRAKT

Inovace se staly hlavním faktorem ovlivňujícím konkurenceschopnost a růst firem. Firmy v průběhu let kladou důraz na zavádění nových nápadů, které podpoří jejich růst a pozici na trhu za účelem zvyšování zisku. Malé a střední podniky (SMEs) představují většinu podniků na celém světě a jsou klíčovými přispěvateli k vytváření pracovních míst, snižování chudoby a globálnímu hospodářskému rozvoji. Navzdory jejich rostoucímu významu v národní a globální ekonomice čelí různým výzvám, jako je přístup k financím, zvýšená konkurence, kapacitní omezení související s inovacemi, znalostmi a kreativitou. Země visegrádské skupiny jsou v Evropské unii považovány za méně inovativní, což znamená, že malé a střední podniky v těchto zemích mají kvůli svému ekosystému slabý inovační potenciál. Až dosud se méně studií, zejména v zemích visegrádské čtyřky, zaměřovalo na to, jak mohou být firmy, zejména malé a střední podniky, inovativní, aby obstály v intenzivním konkurenčním prostředí na trhu a zůstaly ziskové. Tato práce zkoumala různé faktory přispívající k výsledkům inovací MSP v těchto zemích. Autor zkoumal, jakou roli hraje vnitřní i vnější prostředí MSP a jak může ovlivnit jejich inovační výsledky. Tato studie používala probit regresi a model logistické regrese. Data pro empirickou studii pocházela z průzkumu podnikatelského prostředí a výkonnosti podniků (BEEPS V), který provedla Světová banka a Evropská banka pro obnovu a rozvoj (EBRD), v letech 2017 až 2019 s 2494 respondenatmi - SME z Polska, ČR republiky, Slovenska a Maďarska. Výsledky průměrného dopadu opatření ukázaly pozitivní a významné výsledky, že vnitřní faktory, jako jsou výkonnostní pobídky poskytované zaměstnancům, využití kapacit zdrojů / vstupů, efektivní strategie obchodních operací, pomohly při výsledcích inovací produktů, procesů a patentů v zemích Visegrádu. Výsledky studie ukázaly pozitivní a významné výsledky, že interní faktory, jako jsou výkonnostní pobídky poskytované zaměstnancům, kapacitní využití zdrojů/vstupů, efektivní obchodní operační strategie napomáhající výsledkům inovací produktů a procesů v zemích Visegrádu. Výsledky naší studie externích faktorů opět ukázaly, že technologie, licencované od zahraničních firem, externí spolupráce v oblasti výzkumu a vývoje, nehmotná aktiva, jako jsou ochranné známky a autorská práva, pozitivně ovlivnily výsledky inovací procesů a produktů. Výsledky logistické regrese však ukázaly, že daňové sazby, politická nestabilita, kriminalita, krádeže a nepořádek bránily malým a středním podnikům v procesech, produktech a výsledcích získávání patentů v zemích Visegrádu. Studie nabídne teoretické a praktické důsledky toho, jak mohou malé a střední podniky v těchto transformujících se zemích překonat a zlepšit svou nízkou míru inovací.

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1 INRODUCTION

1.1 Research background

Small and medium enterprises (SMEs) are considered to play major roles in countries' economic growth and well-being (Odei & Novak, 2020; Dey et al., 2022). Small businesses are seen as the most vibrant business sector for most start-ups and create jobs for the populace. In terms of innovation, SMEs undergo several innovation activities which help to transform the business through the provision of improved service deliveries and adoption of new product development. Small businesses are known to be the most functioning and vibrant business sector for start-ups and new job creation. In terms of innovations, they undertake several innovation activities which meaningfully help to advance their businesses in terms of improved service deliveries and new product development. Small firms constitute a pulsating of the European countries' main type of businesses, forming about 99 per cent of firms (Bassi & Guidolin, 2021). SMEs constitute about 90% of businesses in transition and developing countries (Srebalová & Vojtech, 2021). SMEs with fewer than ten employees and yearly profit of less than € 2 million are classified as micro-enterprises. Small enterprises have less than 50 employees and make an annual profit below €10 million. Medium-sized enterprises comprise less than 250 employees with yearly profits not exceeding € 50 million (European Commission, 2016; Nugent, 2016).

The relevance of studying SMEs innovation outcomes can be elaborated from different perspectives (Agostini & Nosella, A2019). First, SMEs have a huge impact on unemployment and gross domestic product (GDP). As described above, SMEs have reduced unemployment and contributed their share in GDP worldwide (Del Giudice et al., 2021). Secondly, in the context of the world's economy, there has been rapid growth in national economies due to globalisation and has adapted to the rapid changes in the innovation-friendly environment (The Dey et al., 2022). Thirdly, SMEs have encouraged entrepreneurship leading to competition (Afshari et al., 2020). Finally, they engage in research and development activities and the commercialization of economically viable research and innovations which can have positive externalities on economic growth. Although SMEs operate in different geographic regions, some authors discovered that SMEs play key roles in technological innovation development which is fundamental for achieving and sustaining economic growth (Piwowar-Sulej & Kołodziej, 2022: Zygmunt, 2018).

In recent times, knowledge, research, and development are driving the firm's growth. Innovation is very important to firms in new European Union countries, considering there is increased competition due to the fast pace of globalization. Innovation is seen as the vital resource that can enhance and position firms competitively in the tensed global markets (European commission, 2016). Although it cannot be disputed that innovation helps firms to be very competitive, it has been highly beneficial to the European regions (Stejskal & Hajek, 2015).

Studies on innovations in the Visegrad group of countries have overly focused on large firms at the expense of small businesses albeit the constitute the bult of businesses. This bias means that our understanding of firm-level innovations in these countries is not balanced. A comprehensive understanding of innovation will warrant a focus on small businesses. This thesis therefore fills in this gap by focusing on understanding the factors driving small businesses innovations. This thesis focused on the empirical analysis of the internal and external factors capable of driving small businesses innovation performances. The analysis also focused on examining the business environment in these countries to see which aspect of it can impede small businesses quest for innovation. The nexus between the businesses environment and small businesses innovation has not received ample scholarly attention although it can buttress and sustain firm-level innovation process.

This thesis is structured as follows; chapter one introduces the subject and current state of small businesses innovations. Chapter two outlines the motivations of this dissertation, the research methodology, aims of the dissertation. Chapter three focused on the theoretical background, and reviews of recent literature on factors driving small businesses innovations. The conceptual framework, research hypotheses and definitions of all constructs used are also elaborated. Chapter four outlines the methodologies and research design comprising sample, data collection tools, and analytic techniques. Chapter five presents the empirical findings of the dissertation and presents a general discussion of the results of the research in relation to recent existing literature. Chapter six concludes the thesis and provides contributions to theory and practice, limitations and suggestions for future research.

2. LITERATURE REVIEW

2.1 Theoretical underpinnings of the research (knowledge spill overs and endogenous growth)

Innovation economists primarily believe that drivers of economic growth in a recent knowledge-based economy are not the accumulation of wealth as neoclassical economics believes, but with innovative ideas coupled with knowledge and technology (Braunerhjelm et al., 2018). Economic development in innovation economics factors knowledge, policies, technological spillovers, collaboration and creating innovative environments (Fromhold-Eisebith et al., 2021).

The endogenous growth theory is very prominent, considering its role in knowledge spillovers and the economic development processes (Romer, 1990; Grossman & Helpman, 1994). However, other growth theories are considered to be among the role of knowledge in the economic growth process (see Aghion & Howitt, 1998). According to Solow (1957), the level of development can be attributed to the role played by technological advancement but needs to use

consultants and external collaborators in the scientific processes irrespective of the economic factors. But according to strong proponents of endogenous growth theories, knowledge occurrence is not a coincidence when it comes to economic and social development; it takes conscientious effort and the availability of resources to be efficient. Policymakers invest heavily in utilizing resources through effective collaboration with research institutions to produce novel knowledge. Mazzucato & Li (2021) also emphasize that a public good that possesses spill resources over with zero marginal cost is knowledge. The spillover effect is heavily connected with diverse knowledge, which forms the basis of increasing revenues, which helps long-term economic development. Knowledge spillovers happen when knowledge and information concerning an innovative activity are used to generate new ideas that can transform the business setting. Due to innovation, new services and product development have been attributed to knowledge spillovers (Stejskal & Hajek, 2015). The relevance of knowledge spillover is that the rate at which development increases is equivalent to the total number of labours engaged in collaboration with research and development. The policy implies that both public and private sectors increase the number of labourers for research to increase the growth rate in knowledge stock, increasing per capita growth in the long run.

The endogenous growth model seeks to address the production function on knowledge which is schematic to the advancement of knowledge creation. This means the number of new ideas from academic research depends on the labour input for R&D activities. Romer (1990) believes that knowledge spillover in a country would heavily depends on the stock of knowledge.

The Romer model assumes that economic knowledge comes first when it comes to innovation activities, but we should note that knowledge can spill over. Knowledge spillovers can result in inter-temporal spillovers, which would result in endogenous growth in the long run. The firm heavily investing in R&D would generate huge sums of revenue in future. Mazzucato & Li (2021) also pointed out that knowledge inherently differs from all the old factors of production. New ideas depend on the ''intertemporal spillover knowledge'' of future researchers. The efficient application of technology and knowledge production is made possible due to historical growth such as stock of scientific, technological know-how'' (Fromhold-Eisebith et al., 2021).

Innovation has come to be part of human existence. Therefore, there is a need for all firms to adopt systematic advancement of products, processes, and organizational work methods to embrace it. This is why Joseph Schumpeter's work on innovation in 1934 has widely been accepted, contributing to the field. Schumpeter (1934) defined innovation as new ways of producing things and exploiting new markets in an organized business. This definition to date is being used, and Eurostat's Community Innovation Surveys and Oslo Manual (OECD, 2005) affirms it. The Oslo Manual emphasizes that ideas with insufficient novelty

can be classified as something other than innovation. Conversely, those significant improvements to organizational performance are acknowledged as innovative (OECD, 2005; Reçica, 2016).

Firms could develop a model for new processes or products through innovation activities. According to González-Fernández & González-Velasco (2018), a newly developed framework may represent inventions, but not necessarily innovations. To become innovative, conceptual models must meet commercial standards. Stefko et al. (2020), asserts that coming up with an idea may not be necessary if it cannot be implemented. A new innovative model could be of economic value if it has the potential to be commercialized. Innovation does not necessarily mean an invention but depends on the inputs and the research, which may lead to inventions and innovation even though it may fail to generate output (Schumpeter, 1934).

Companies engage in innovation processes to increase their competitiveness, productivity, and market share, ultimately increasing turnovers (Odei et al., 2020). Various innovation theories and firm performance have changed drastically during the era of Schumpeter. While the neoclassical school of thought affirms that all markets always tend towards an equilibrium, the Schumpeterian theory posits technologies create a continuous market disequilibrium. One limitation of the neoclassical theory is that it does not factor in technological change as a significant factor. This has been pointed out in the new growth theory (Romer, 1990; Grossman & Helpman, 1994), which emphasizes that growth and technology development must be simultaneous. Alternative theories are more of an evolutionary view which assumes that if the human environment continuously evolves, then the way humans perceive innovation could also change (Bubak, 2021).

According to Penrose & Penrose (2009), the resource-based view (RBV) suggests that employees are crucial to innovation development and growth. The RBV accentuates that owning strategic resources offer firms golden opportunities to build and sustain competitive advantages over other market rivals as firms can take advantage of these strategic resources to innovate (Lundvall, 1998; Barney et al. 2011). Strategic resources encompass both capital and physical assets such as land, human and social capital, new knowledge, organizational processes, firm features, capabilities, and coordinative structures. New knowledge is widely accepted as a valuable strategic resource which can propel sustainable firm performance leading to improved competitiveness. The challenge of firms having limited internal resources, which would help in their innovation outcomes, was suggested in the 'open innovation' approach, where R&D collaboration for external knowledge and resources are considered viable for firm's innovation outcomes (Weissenberger-Eibl & Hampel, 2021).

In line with various literature and the effect of innovation on economic development, innovation can be seen as the major driver for change at micro and macro levels. The European Union sees innovation as an avenue for growth and to be more competitive with other world economies, so the EU is heavily increasing its R&D investments. For the EU to exceed this target, the private sector enterprises would have to play a major role as the generators and owners of the innovation processes. This is very important for transition economies seeking full EU integration and those new EU member countries that still need to catch up to other advanced economies regarding innovation activities and firm growth. In addition to developmental issues, transition economies (TE) face some form of reforms, and their market environment targets industrialized economies to reach their targets. While the literature on innovation activities and firm performance has mainly focused on advanced economies which has classified them as technological innovation leaders, research in transition economies has attracted less attention.

2.2 Firm innovation theories

Research on the impact of firm performance and innovation outcomes has attracted many studies. According to Kline & Rosenborg (1986), profits earned from first-mover innovators face a threat from competitors who imitate the products to take a share of the market and turnover.

Therefore, too many firms will eventually be in the market, bringing down the average profit of firms into the expected profit. This effect will drive subsequent innovation by some firms as whoever makes the bold decision to invest in innovation gains more competitive advantage. This process of adopting innovation eventually changes the economy. An OECD (2005) report has affirmed that innovation has no economic impact without diffusion. Again Schumpeter (1934) affirms that innovation theory has had massive modification throughout the 20th and 21st Centuries since he published his first work on innovation. Improved data availability significantly affected some research methodologies and theoretical views, which evolved mainly in the last thirty years.

2.3 Innovation and types of innovation

Globalization has heightened the competitive pressure in markets in recent, the adoption of technological changes in new product and process development for small and medium enterprises (SMEs) could be the solution to withstanding these intense market competitions. Innovation plays a key role for SMEs in building firms' competitive advantage (Anwar, 2018). According to Bayarçelik et al. (2014). The Organisation for Economic Co-operation and Development (OECD) classifies innovation into four types, namely: process, product, marketing and organizational innovation (European commission, 2016). Other researchers, classify these four innovation types into two groups thus technological innovation which broadly consist of products and processes while

non-technological innovation also broadly comprises of both marketing and organizational innovations. Technological innovation involves several activities like utilizing and adopting new technologies, production techniques, management strategies, improving existing production techniques, exploring new markets, and reaping profits. It can be inferred that technological innovation necessitates R&D, improving production processes, efficient organisation decision, which when done effectively could contribute to greater sales turnover (Yigitcanlar et al, 2019; Afshari et al., 2020). Non-technological innovation refers to innovation activities that do not have technological motives (Hervas-Oliver et al., 2021). Non-technological innovation is pertinent for firms' innovation and its related activities as it balances technological innovation, and it can be described as introducing improvements into firms' new marketing systems and organizational structure. Non-technological innovation is exemplified in the application of improved management practices, the implementation of appropriate organizational structures and new corporate strategies.

2.4 Internal factors influencing innovations

A company's internal and external conditions affect their aptitude to innovation as a result of changes in the business milieu, competition, short product cycle, and technological advancement (Saunila & Ukko, 2013). Innovation ensures that firms meet consumer needs and capitalize on new marketing opportunities, making firms more competitive to retain the market or obtain a new set of clients (Tian et al., 2018). Firm-level factors such as the availability of resources, competent skilled personnel, and the firm's ability to conduct research and development significantly impact technological innovation outcomes (Mikalef & Krogstie, 2020). Inconsistencies by SME managers in determining the causes of their failure to adopt technological innovation have been a major setback to SMEs in Europe (Győri et al., 2019).

2.5 External factors influencing innovations

According to Yoruk (2019), the macro-environment is defined as exogenous factors around companies that facilitate technological innovation during start-up and SME lifecycle across Europe. Some authors assert that external factors present threats, opportunities and all the necessary information affecting SME external environment, regardless of the firm's business concept and background (Odei et al., 2021).

Some authors list external factors such as socio-demographics, cultural, political, economic, markets (local, international, emerging and well-established markets), legal, infrastructure and other physical factors found in an environment (Yoruk, 2019; Sobakinova et al., 2019). According to Tian et al. (2018), the macro-environmental factors are not easily controlled. The success of SMEs depends on management's ability to blend these factors with their internal activities. However, Rustin & Poynter (2020) argued that for newly established firms across the European region to be successful depends on the state of specific factors within the European boundaries with a stable political, economic, and social factor.

2.6 Innovation inputs

The literature usually measures innovation input with R&D expenditure devoted to innovation and its related activities. Odei & Novak (2020) also used employees and research scientists as an input to analyse overall innovations, while Rossi et al. (2012) also used the number of hours employees commit to the role. Some authors consider only internal R&D expenditures as the measure to the firm's innovation input (Bartelsman et al., 2019; López-Fernández et al., 2021). Alternatively, Benavente & Bravo (2009) measured innovation intensity using the firm's turnover.

2.7 Innovation outputs

Innovation output processes have been identified and measured in different ways. According to Hall (1987), patents are used to measure innovation activities. Some authors also use product, process or another type of innovation to measure innovation outputs (Haar, 2018), whiles others used the proportion of sales outputs to measure general innovation outcomes.

2.8 Overview of SMEs in the Visegrad Countries

Recently, SMEs have evolved as the fundamental source of positive business development in the Visegrad Group (Pasnicu, 2018). SMEs need more capital and human resource personnel to enable business operations (Watkins, 2012). Thus, SMEs are more vulnerable to business risks than larger firms (Falkner & Hiebl, 2015). In taking business risks regarding innovation activities, SMEs incur losses and damages due to their negligence in business operations. SMEs mostly encounter challenges during business operations' early or final stages (Wang et al., 2016; Ghenţa & Matei, 2018). However, SMEs are exposed to different forms of risk, such as taking operational, financial, strategic, and hazardous risk assessments (Cepel et al., 2019). The variant literature shows how firms handle risk to achieve their goals in the long-run (Ferreira de Araújo Lima et al., 2020). SMEs are therefore encouraged to embrace calculated and uncalculated risk in their strategic plans.

2.9 Indicators and measurement of innovation outcomes

This section carefully assesses the characteristics of different indicators of innovation used in the economic literature and discusses their limitations and

strengths. According to Paredes-Frigolett et al. (2021), one of the major challenges has been emphasized in the literature, with input and output being measurement indicators. The last stage in the innovation process could be seen in the product outcome. To achieve sustainable innovation, firms must actively recruit and engage competent employees and heavily invest in technological innovation. Research and development (R&D) expenditure and employee headcount in relation to R&D are commonly used in the economic literature to determine innovation inputs. All input indicators could be R&D expenditure which would help assess the financial costs can help check the return on innovation activities at the micro and macro levels. The R&D indicator helps to set innovation targets at the country level. However, R&D expenditure can be used to determine the input intensity of the innovation process, but its commercial output can be used to check its successful factor. As defined by the Oslo Manual (OECD, 2005), no innovation occurs if innovation outcomes do not lead to a commercialisation.

2.10 Barriers to value creation for innovation

Obstacles to innovation may arise from internal or external threats to the firm, which may also be categorized according to how firms see them, which could be endogenous or exogenous. Internal barriers may result from human-related risk from top managers, inadequate personnel (researchers), or poor record-keeping on the SME operators. Conversely, it could also be assessed based on external environment which could be affected by legal institutions, economic institutions, policy stability and cost of telecommunication among others.

Inadequate human capital is an obstacle that could hinder innovations within SMEs. Although we can recognize the impact of highly skilled resource personnel as the key factor to innovation, the demand for these resource personnel has been hindered by low wages, quality of education (Nugent, 2016). From a different dimension of human capital problems, the intent of SMEs to collaborate is deeply affected by the innovative tendencies as a result of the competent employees in the field with high absorptive capacities (Birgit et al., 2018). This is usually measured with the percentage of the population with university degrees. It is assumed that university graduates will be able to absorb and assimilate new knowledge vital for innovation production and sustaining. When this cannot be guaranteed it could serve as a barrier for firms' innovation search.

3. RESEARCH PROBLEM, QUESTIONS, OBJECTIVES AND SCOPE OF THE STUDY

3.1 Research gap

SMEs significantly influence the European economy (Mura et al., 2017). For SMEs to thrive and ensure continuous growth in the business environment, they must adopt and implement new policies to promote their activities. SMEs' innovation outcomes within the business field have contributed to economic growth and regional development. This study asserts such positive impact on

SME innovation outcomes to both internal and external factors within SMEs firms (Fernández-Olmos & Ramírez-Alesón, 2017; Lašáková et al., 2017). This thesis attentively examines contributing factors to SMEs innovation outcomes in Europe in some selected countries. Both organizational learning and external factors allow firms to blend their assets and capabilities into specific economic advantages (Tu & Wu, 2021).

The latest innovation performance report on the Visegrad countries paints a mixed picture of innovation in these countries (Hudec, 2015). SMEs are displaying few signs of innovation less collaboration with academic institutions, and thus, innovation remains weak, with inadequate skilled personnel and lack of funds (Skala & Beauchamp, 2017). However, gross innovation product has increased in these countries and thus has improved entrepreneurship and business environment. Although SMEs in the Visegrad are noted for economic growth and regional development (Odei & Novak, 2020), SMEs are intermittently faced with challenges such as inadequate capital and less collaboration with academic institutions (Gyimesi, 2021). Again, despite the assistance of the European Union, members of the Visegrad Group from the socialist backgrounds need to recover their economies by upgrading their technological capabilities and their technology transfer practices because of their slow growth (Švarc & Dabić, 2019). Thus, innovation outcomes occur as a highly contextual phenomenon, dependent not only on the support from the European but also on the structure of the SMEs (internal factors such as management decisions on the business operation strategies, internal R&D, etc.) and external environmental factors such as external R&D activities, competition from unregistered firms, etc.). Limited research has been conducted in this area which is a driver for this current study.

More efforts need to be made to improve the coordination between strategic documents and policies. Having noted the effective role that EU funds in driving innovations in the strong EU countries such as UK, Germany and the Netherland. The national government can direct some of these funds towards a long-term project on innovation rather than short term projects which are not beneficial to SME's innovation performance across the Visegrad countries. These long-term projects can be run with other EU programmes such as Seventh Framework Programme (FP7) for technological advancement and competitiveness and innovation framework (CIP). However, despite various studies on this theme, less attention has been paid to examining the internal, external and barriers to SME's innovation outcomes across different sectors in the Visegrad Countries. The need for this dissertation is to reinforce constant growth and regional development by the SME sector in Europe.

3.2 Research objectives and research questions

The main aim of this dissertation is to examine the factors influencing SMEs' innovation performance across Visegrad countries.
Specific objectives of this study

The first specific objective of this thesis is to examine the internal factors that can drive small businesses innovation performance. The focus will be on assessing whether overdraft facility, internal R&D, membership organisation, machinery, lines of credit, internet security and training given to employees could impact on product and process innovation outcomes using the logit (ATE) model.

The second specific objective is a follow up of the previous objective stated above. Besides the above-mentioned internal factors, it is expected that SMEs search for innovations will be affected by several obstacles beyond their control. The logistic model was used to estimate the probability that SMEs innovations would be dependent on certain external factors (determinants) such as government contract, technology license, external R&D, International quality certificate, informal competition and financial services would influence SMEs technological innovation outcomes within the Visegrad Group.

The third objective is to examine the barriers that possibly affect SMEs in their search for innovations. It is expected that SMEs search for innovations will not be without obstacles. We analyse the barriers which are usually embedded in the business environment that negatively affect cost of operations. Within the business environment obstacles such as tax license, tax rates, labor regulations, inadequate labour, losses due to theft and financial obstacle, etc., impeding SMEs product innovations and technology license acquisition outcomes in the Visegrád countries.

4. METHODOLOGY

4.1 Research design

The study commences with theoretical research on examination of factors contributing to SMEs innovation outcome in the Visegrad Countries. The qualitative results were used to support the quantitative results to give it more detailed discussion.

4.2 Methods

When conducting research, two different methods are available for use: qualitative or quantitative. The two different methods possess various abilities depending on the aim of the research. The quantitative research approach focuses on quantifying data, and it's built on the deductive reasoning, whilst the qualitative approach mainly focuses on the verbal description and interpretations of responses. Qualitative research follows the inductive perspective between provided theories that factors the continuous flexibility of modern society and tend to be more open-ended than the quantitative approach (Peterson, 2019). The inductive approach of qualitative research design helps strengthens research, thereby assisting in gaining access to rich information. However, the qualitative method enables researchers to collect further in-depth data from respondents (Bryman, 2016).

This dissertation used both quantitative and qualitative research design since it conforms to the study's objective (Stockemer, 2018). The quantitative research design's main aim is to establish the causal relationship between an independent variable and a dependent variable. It can involve any type of empirical research about social issues that starts by testing theories that involve descriptive study that establishes the only relationship between variables or an experiment that measure variables likely to explain the mechanism of treatment (Bryman, 2016). Quantitative research helps respond to questions about how an event occurred over a period or the rate at which a sampled population is affected by a phenomenon. According to Tu & Wu, (2021), as researchers seek answers to a series of research questions in a study, the quantitative research approach is useful in formulating and testing hypotheses. Furthermore, the basis of research can be generally grouped into four categories: descriptive, explanatory, emancipatory and exploratory (Stockemer, 2018). This dissertation is empirical in nature. Thus, it strictly employed all scientific methods, enabling its outcomes to be generalized to cover the Visegrad countries where the samples are taken from.

Qualitatively, this involves collecting and assessing non-numerical data such as text to understand opinions (Belotto, 2018). This approach was adopted to get an in-depth understanding of the research problem to generate new ideas for the research method. This can be conducted by interviewing people who are mostly experts (researchers, lecturers, or professors with some renowned publications in Scopus, web of science, Google scholar, etc.). It is important to remind readers that both approaches were tailored toward getting a clear picture of the actual situation from the expert point of view to compare to what the quantitative data affirmed.

By virtue of the thesis' primarily aims, particularly establishing the empirical links among the study constructs within the proposed framework; thus, it makes sense to say that both positivism and interpretivism approach fits the overall scope of the current work (Elkatawneh, 2016).

The qualitative method was also used to solicit opinions from experts and researchers from the Visegrad countries. These carefully selected experts are those whose research focus on innovations in the Visegrad countries. They were randomly selected from Google Scholar based on their research with key words such as innovations, small businesses and Visegrad countries. As expected, the search provided the researcher with numerous results. The researcher then narrowed the search to those that have researched on the topic for the last five to ten years, this allowed me to get people who have experienced researchers who were mainly academics with detailed knowledge about the subject matter from the Visegrad Group. They were randomly chosen based on their research background as they have experiences with the innovation ecosystem in these countries. Once the experts were identified, they were first contacted through emails to invite them. The questionnaires were sent to them through emails,

Skype and zoom across the Visegrad countries. The interview helped to obtain relevant answers from practitioners and academic researchers on SMEs innovation outcomes in the Visegrad countries. A virtual interview with an open-ended questionnaire was used by the researcher and practitioners well vexed in this field. The virtual interview has become relevant due to the coronavirus pandemic, and travel costs to these countries. According to Gray et al. (2020), this approach is a data collection tool that has been widely used to improve response rates. Respondents background information including job experience, educational status, and other details are obtained from these experts and summarized in our discussion.

Two research methods widely used for similar analysis was used. The following studies have used these methods for similar analysis so this dissertation will apply them, i.e., Probit regression (Hayden et al., 2020) and logistic regression (Arbolino et al., 2019). Also, the treatment effect analysis was employed to control for confounding and endogeneity. Their doubly robust nature, allowed to correct any selection biases when using binary variables (Hayden et al., 2020).

The statistical software used for the empirical analysis includes Statistical Package for the Social Sciences (SPSS 20). Again, STATA was used for the logistic and probit regression models. Numerous authors have used this statistical software for similar analysis (see Purwanto et al., 2021; Galán-Muros & Plewa, 2016). Excel was also used to organise the data for the empirical research.

4.3 The Probit regression

The probit regression is like the logistic regression model in which the response in the dependent variable is a dichotomous random variable that only takes two responses (Oudgou, 2021). The probit model estimates the probability that an outcome of characteristics, will be grouped into different categories. This model is preferred for this analysis because the question in the Enterprise Survey used as the dependent variable was binary in nature. The probit model is part of the probability model's group which functions by estimating the model parameters based on the maximum likelihood approach. The maximum likelihood technique estimates parameters by maximising the given data's general outcome, which predicts the probability that an event would occur or not. This makes the maximum likelihood technique one of the best estimators for estimating economic problems (Minasyan et al., 2021). Our empirical analysis used the probit model because of the dependent variable is dichotomous. The probit model assisted in estimating the likelihood of whether these variables will or not influence firms' technological innovations (product, process, R&D and external knowledge). The probit model shows a converse relationship in the standard normal distribution of probability; hence the model assumes there is linear relationship between independent and dependent variables combine (Fox, 2015). We assume the association between firms' internal activities, such as patents, the adoption of sophisticated machinery, performance bonuses to staff

members, etc. technological innovation outcomes are linear. We provide the formula for the probit model as;

$$prob(Y_i = 1|X_i) = \int_{-\infty}^{x\prime\beta} \emptyset(t)dt = \emptyset(X\prime i\beta) \qquad (2)$$

where
β is a vector of parameter estimates
$\emptyset$ is a cumulative distribution function (the normal, logistic, or extreme value)?
X is a vector of explanatory variables
P is the probability of a response
t is the natural (threshold) response rate

4.4 Average Treatment Effect-Inverse Probability Regression

The treatment effect inverse-probability regression (IPR) estimator was used to estimate the additionality effect of how these selected variables will impact firms' technological innovations outcomes. The IPR allowed us to calculate the average causal effect of a dichotomous variable on an outcome variable of scientific interest activities. IPR estimators depend on probability regression coefficients to estimate the intermediate outcomes of predicted treatment levels, where the coefficients represent the projected inverse likelihoods of treatment (Cattaneo, 2010). The doubly robust approach combines both the outcome of the regression model and average treatment scores. Using the outcome regression and the probability estimator enabled us to overcome selection biases from the confounding variable that might affect the results. Again, the doubly robust IPR estimator factors these two main approaches. At least one of the two models used must correctly indicate that it can achieve an unbiased effect estimator. This permitted us to consistently estimate the parameter of the outcome by reducing residual biases, i.e., assume the association between firms' internal activities, such as patents, the adoption of sophisticated machinery, performance bonuses to staff members, etc. and how they lead to technological innovation outcomes.

4.5 Logistic Regression

Logistic regression analysis shows the relationship between a categorical dependent variable and a group of independent variables (Xie et al., 2021). Logistic regression is used when the dependent variables have Yes and NO responses such that they are coded as 0 and 1, respectively. If dependent variables have three or more values, such as widowed, single or married, the multinomial logistic regression is used (Nyarko et al., 2021). However, the type of data used for the dependent variable differs from that of the multiple regression during practical use of data. Logistic regression, which computes discriminant analysis, is also used for analysing categorical-response variables. Some authors assert that logistic regression is more robust for modelling most statistical situations than discriminant analysis (Sujatha & Sridhar, 2021; Sperandei, 2014). Logistic regression does not posit that independent variables are normally distributed as

discriminant analysis performs. This program incorporates binary and multinomial logistic regression on both categorical independent variables. The reports on logistic regression equation as well as the goodness of fit, deviance, confidence intervals and odds ratios. Logistic regression performs a comprehensive residual check, including the plots and residual diagnostic reports. Again, the logistic regression performs an independent variable selection search that seeks to bring the best regressors with few independent variables (Sujatha & Sridhar, 2021).

The set of explanatory variables is used to predict the mean of a continuous variable in multiple regression (Xie et al., 2021). Logistic regression in a mathematical model verifies independent variables used to predict a logit transformed dependent variable. Suppose the binary outcomes are assigned values of 0 and 1. Mostly 0 represents a negative response, and 1 represents a positive response. The outcome of the mean variable would be proportional to positive responses.

If p forms part of the observations with an outcome of 1, then 1-p is the probability of an outcome of 0. The ratio p/(1-p) is called the odds, and the logit is the logarithm of the odds, or just log-odds (Park, 2013). Mathematically, the logit formula is given by (Park, 2013):

$$ln\left[\frac{P_i}{1-P_i}\right] = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_k X_{ki} \qquad (1)$$

where
subscript i represents the *i-th* observation in the sample,
P is the probability of the outcome,
β_0 is the intercept term
β_1, β_2,…,β_k are the coefficients associated with each explanatory variable X_1, X_2, …, X_k.

4.6 Two-step Probit with endogenous variables

Once there is the endogeneity of some of the variables used, the estimation of the model using the logit alone would not be appropriate. Thus, there is a need to conduct a two-step endogeneity test to test for the methodological robustness of the validity of the result (Weisburd & Britt, 2014; Fox, 2015). This approach was used to authenticate the presence of endogeneity in the variables, that can lead to the reverse causality problem which can negatively impacts our results. This approach used the Instrumental Variable (IV) probit regression model applying the Newey's two-step evaluation approach to test for potential endogeneity in our variables. The Wald test of exogeneity evaluates whether the null hypothesis of exogeneity is supported by our data. The Wald test results can help confirm if there is no need for instrumental variable models or not because in the absence of endogeneity, the results from the binary logistic model are considered consistent (Brada & Singh, 2017).

4.7 Data
World Bank dataset

This dissertation uses the Business Environment and Enterprise Surveys (BEEPS) undertaken jointly by the European Bank for Reconstruction and Development (EBRD) and the World Bank in many countries. In particular, the study used the current data conducted in the year 2019 in Visegrad countries. The study within the Visegrad country was conducted with a combined random sample of about 2,494 firms. It contains questions relating to firms' characteristics, innovation activities, and the perceived impact of business environment factors. As explained in the EBRD report, the survey examines the need for a quality business environment that determines various indicators showing firms' interactions and regions. The sample is selected randomly from the population of firms in manufacturing and services (including trade) and designed to represent the population as possible. The sample is distributed across all major industrial regions within each country. The sectoral composition of firms in the survey is based on different sectors' contributions to the GDP in each country. The sample is stratified to ensure that at least ten per cent of firms in each country are in the following categories: small, large, foreign-owned, and exporting. Since BEEPS surveys are conducted with random samples of companies, it is possible to pool them and work with a larger sample, provided that the questionnaires in respective surveys have a common methodology and contain the same set of questions.

The BEEPS survey comprises of questions that would allow us to specify the variables that are described in theoretical framework and utilize the advantage on the number of observations with about 2,002 firms across different sectors. The WBES data source will serve as both innovation variables and control variables at the at the firm level which will replicate the most recent situation of SMEs firms within the study areas. Kaur & Kaur, (2021) used the same database to assess different innovation types among 9,281 SME firms. Lundvall (1998) used this dataset to access knowledge management and innovation outcomes among firms in Albania and Slovenia whose result was showed that learning organization   characteristics have a significant impact on job rotation.

Method and data description

The doubly robust estimation approach was mainly used for the empirical specifications. In the first stage the Probit model was used to analyse the causal relationships. In the second stage the inverse probability regression was used to estimate the Average treatment effect (ATE) to assess the nexus between internal factors and firms' innovations. The ATE helped to control for possible endogeneities in the data leading to consistent results. The logistic regression model was also used to assess external factors contributing to SME's technological innovation outcome. Lastly, the logistic regression was employed in examining the barriers impeding SMEs innovation outcome in the Visegrad

Group. These models were preferred for this analysis because of the dichotomous nature of the dependent variables. The Average treatment effect was used to look out for the additionality effect of how these selected variables will impact firms' R&D activities, patent acquisition, and technological innovations outcomes. To reaffirm objective two and three of this study, we created a two-step probit with endogenous regressors by running a regression analysis using STATA software to test data reliability, robustness, validity, and the presence of common method bias of the data for the study. We used a two-step probit technique incorporating the log of instrumental variables to check for robustness. The null hypothesis of the data is that the two-step probit results are consistent, and the instruments used are valid. Therefore, the probit with endogeneous test of endogeneity results maintains the null hypothesis that $p>0.1353$ is not statistically significant at a 95% confidence interval. Hence, we assert that the data has no endogeneity issues and thus the test strengthens the robustness of the model (Hult et al., 2018). Having confirmed the data's robustness and validity for the study, we then proceed to run the analysis to fulfil the study objectives. (See appendix table 5 for full details of endogeneity test results).

The logistic model was used to estimate the probability that SMEs innovations would be dependent on certain external factors (determinants) such as government grants, technology licensed from a foreign company, competition against unregistered firms, external R&D, intangible assets from foreign firms such as trademarks or licensed would influence SMEs innovation outcomes within the Visegrad Group. For the empirical analysis, we used the combined data from the Business Environment Enterprise Performance Survey (BEEPS) that the World bank conducted between 2017 to 2019. The BEEPS dataset provides relevant information about SMEs' innovation activities. It centres on the various aspects of developing firm-level innovation, providing detailed information on the sources of knowledge and data comprises of annual analysis of SMEs sector across the European region and reveals other factors that drives innovation performance worldwide.

4.8 Distribution of firms in the sample

This part shows a brief overview of the distribution of firms in the sample. About 35% of SMEs in these countries are found in the manufacturing sector and about 40% were found in the service sector. About 25% of SMEs were found in the retail sector. These sectors contributed massively to the economy's health, employment, and driving salaries and wages. For instance, the manufacturing sector alone in Hungary contributes to one-quarter of the country's GDP and attracts foreign direct investment (FDI) of around 71.6 billion (Dvořák et al., 2017). According to Brada & Singh (2017), the Czech automotive industry employs about 120 000 and contribute to 47. 3 % of the country's GDP. Olczyk & Kordalska (2017) have indicated that the manufacturing sector alone accounts for about 20% of GDP and provides over 30% of job opportunities to citizens of

Slovakia. The manufacturing sector in Poland has seen tremendous growth in GDP and has contributed massively to economic growth (Naudé et al., 2019).

5. RESULTS AND DISCUSSION
5.1 Influence of internal factors on SMEs innovations

The specific objective one seeks to find out the internal factors driving SMEs innovations. *To fulfil this objective the research question sought to find out the internal factors driving firm-level innovations.* The logit regression model was employed in the first stage to establish the relationships between internal factors and other firm characteristics. Then we used the marginal effects analysis to help quantify the magnitude of change in the directions of these relationships as described in the methodology section. We begin the results and discussion with the descriptive statistics to provide a brief overview of the sample characteristics.

Table 1 : Descriptive statistics for the combined countries

Variables	N	Mean	Stand. Dev.
Product innovation	2488	0.793	0.406
Process innovation	2480	0.886	0.318
Overdraft facility	2326	0.537	0.499
Internal R&D	2470	0.117	0.321
Membership organisation	2492	0.381	0.486
Machinery	2265	0.296	0.457
Lines of credit	2145	0.214	0.411
Internet security	2214	236.187	2437.394
Training	2404	0.308	0.462
Sectors	2494	1.555	0.736
Countries	2494	2.859	1.146

Source: own calculations
Note: N equals the total number of observations

Table 2 : Results of the factors driving product innovations

Product innovation	logit model	Marginal effect	Treatment Effect
Overdraft facility	-0.099 (0.424)	-0.015(0.424)	-0.037(0.026)**
Internal R&D	-1.502(0.000)***	-0.227(0.000)***	-0.344(0.000)***
Machinery	-0.389 (0.002)**	-0.059 (0.002)**	-0.119(0.000)***
Lines of credit	-0.342 (0.020)*	-0.052(0.020)*	-0.119(0.000)***
Internet security	-0.399 (0.002)**	0.061(0.002)**	-
Training	-0.236 (0.061)	-0.036 (0.061)	-.0321(0.079)
Control variables			
Membership organisation	-0.154(0.335)	-0.023(0.335)	-0.033(0.051)
Other services	0.066(0.641)	0.009(0.639)	
Retail	-0.225(0.197)	-0.036(0.210)	
Hungary	0.558(0.004)**	0.082(0.005)**	
Poland	0.046(0.777)	0.008(0.778)	
Constant	-1.173(0.000)***	-	

Summary statistics			
Pseudo R^2	0.0974		
N	1973		
Prob>chi^2	0.000***		
Log pseudo	-937.12		
LR chi^2(11)	202.25		

Source: Own calculations.

NOTE: Significant at 99% confidence interval (CI)-***; significant at 95% CI-**; significant at 90% CI-*

Table 3 : Results of the factors driving process innovations

Process innovation	logit model	Marginal effect	Treatment Effect
Overdraft facility	-0.084 (0.597)	-0.007 (0.597)	-0.022 (0.085)
Internal R&D	-0.938(0.000)***	-0.089 (0.000)***	-0.223(0.000)***
Machinery	-0.625 (0.000)***	-0.059 (0.000)***	-0.100(0.000)***
Lines of credit	-0.141(0.435)	-0.013 (0.434)	-0.081(0.000)***
Internet security	0.433(0.009)**	0.041 (0.009)**	0.175(0.028) *
Control variables			
Membership organisation	-0.554(0.004)***	-0.053(0.004)**	-0.059(0.000)***
Training	-0.090(0.568)	-0.009 (0.568)	-0.026(0.076)
Other services	0.969(0.000)***	0.084 (0.000)***	
Retail	0.858(0.001)***	0.008 (0.000)***	
Hungary	0.809(0.000)***	0.091(0.000)***	
Poland	0.879(0.000)***	0.097(0.000)***	
Constant	-1.246(0.000) ***		
Summary statistics			
Pseudo R^2	0.1262		
N	1970		
Prob>chi^2	0.000***		
Log pseudo	-637.88		
LR chi^2(11)	184.21		

Source: Own calculations.

NOTE: Significant at 99% confidence interval (CI)-***; significant at 95% CI-**; significant at 90% CI-*

Summary of results and practical implications

This section of the these focused on analysing the various internal factors that influence small businesses innovation performances. Measures of innovations adopted were technological in nature which specifically focused on product and process innovations. The research question that was answered was what internal factors influence small businesses innovations? The results of the empirical analysis provided mixed results. The study found among others that internal funding measured with lines of credits and overdraft facilities are not positively connected with SMEs technological innovations. These funding sources reduce the likelihood of technological innovations marginally and additionally. We also found that machinery acquisitions also do not statistically influence technological innovations.

Again, the study found that innovation trainings undertaken by these small businesses are not positive and statistically significant in enhancing both product and process innovations. These results can be due to the weak absorptive capacities of these firms that make them unable to absorb new knowledge. Surprisingly, we found no evidence in the sample supporting the positive relationship between internal R&D and technological innovations. This result could be attributed to the few small businesses in these countries engage in internal R&D. It's probable that they collaborate with other partners such as universities and other research organisations. The results of the control variables also show that networking with business associations is negatively correlated to small businesses technological innovations. For the sectoral comparison, we find that firms in the service sector are not likely to be product innovators. Contrary, we find that small businesses in the service sectors are process innovators. Finally, the results on the country dummies show that firms in Poland and Hungary are process innovators, while only firms in Hungary are product innovators.

The results of this section call for valuable insights and practical implications that might be considered by firm managers and policy makers to boost small businesses innovations.

1. Internal funding available to SMEs demonstrated to be insignificant in boosting technological innovations. Governments and policy makers in the Visegrad group must consider increasing financial supports to innovative small businesses as this can have spill over effects. These finances could be invested in the innovation process.
2. Another important policy implication for small business managers and policy makers in the Visegrád Group is to put in appropriate measures to increase SMEs absorptive capacities so that they can effectively adopt and make good use of new knowledge from innovation training activities. Policy initiatives can be focused on employing skilled personnel with university degrees and technical and vocational certificates.
3. As possible implication for practitioners, we recommend small businesses in the Visegrád Group to simultaneously invest in internal and external R&D. Increasing the levels of R&D both internally and externally will require these small businesses to improve their absorptive capacities to be able to assimilate new knowledge emanating from this research.
4. Policy makers in the Visegrád Group should consider investment in new tools and machinery as part of innovation policies and should provide supports and incentives for their expansion as medium for small businesses innovations.

5.2 Analysing the external factors influencing SMEs innovation

The specific objective two seeks to find out the external factors driving SMEs innovations. *To fulfil this objective the research question sought to find out*

the external factors driving firm-level innovations. The logit regression model was employed in the first stage to establish the relationships between external factors and other firm characteristics. Then we used the marginal effects analysis to help quantify the magnitude of change in the directions of these relationships as described in the methodology section. We begin the results and discussion with the descriptive statistics to provide a brief overview of the sample characteristics.

Table 4 : Descriptive statistics for the combined samples.

Variables	N	Mean	Stand. Dev.
Technological innovation	2468	.839	.367
Technology license	2470	.123	.328
Government contract	2386	1.809	1.800
External R&D	2480	1.956	.204
International quality certificate	2466	.251	.433
Informal competition	2368	1.774	.417
Financial services	2268	.612	5.527
Sectors	2494	1.554	.736
Countries	2494	2.859	1.146

Source: own calculations

Note: N equals the total number of observations

Table 5 : Results of the factors driving technological innovations

Technology innovation	logit model	Marginal effect
Government contract	.259 (0.121)	.025 (0.0166)
External R&D	.869 (0.001)***	.085 (0.001)***
International quality certificate	-.588 (0.001)***	-.057 (0.000)***
Informal competition	.127 (0.464)	.012 (0.464)
Financial services	.034 (0.076)*	.002(0.077)**
Other services	.976 (0.000)***	.086 (0.000)***
Retail services	.642 (0.008)***	.063 (0.002)***
Hungary	.773 (0.000)***	.103 (0.000)***
Slovakia	1.557 (0.000)***	.165 (0.000)***
Poland	1.192(0.000)***	.141 (0.000)***
Constant	-1.261 (0.051)*	
Summary statistics		
Pseudo R^2	0.0915	
N	2028	
Prob>chi^2	0.000***	
Log pseudo	-682.58	

LR chi^2(11)	126.47	

Source: Author's own

NOTE: Significant at 99% confidence interval (CI)-***; significant at 95% CI-**; significant at 90% CI-*

Summary of results and practical implications

This section focused on analysing the various external factors that influence small businesses' innovation performances. Measures of innovations adopted were technological innovation. The research question that was answered was what external factors influence small business innovations? The results of the empirical analysis provided mixed results. The study found, among others, that government contracts and informal competition from unregistered firms are not positively connected with SMEs' technological innovation outcomes. These factors reduce the likelihood of technological innovations' outcomes marginally.

Again, the study found that innovation that international quality certificates used by these small businesses have a negative relationship and are statistically significant in enhancing technological innovations outcomes. These results can be due to the time frames for obtaining international certificates, making these firms compete in the international and domestic markets.

Furthermore, we found a positive relationship between external R&D and technological innovations. This result could be attributed to small businesses in these countries' collaborations with external firms. They probably collaborate with other competitors as to how best they can capture the market.

Again, the study found a positive and significant relationship between the financial services, resulting in technological innovation outcomes. The financing of technological innovation through loans, etc., has been a massive boost for SMEs to adopt modern technologies and become more competitive across all countries under consideration.

The results of the control variables also show that for the sectoral comparison, we find that firms in the service sector are not likely to be technological innovators. Contrary, we find that small businesses in the service sectors are constantly adopting technological innovation. Finally, the results on the country dummies show that firms in Poland and Hungary are adopting faster technological innovation, while only firms in Hungary are adapting to technological innovations but on at a slower pace.

The results of this section call for valuable insights and practical implications that might be considered by firm managers and policy makers to boost small businesses innovations.

1. First, the results on government contract show that it has no additionality effects on technological innovations outcomes. This calls for SMEs in the Visegrad countries to improve their engagement in social services to gain contracts from the government. SME managers in these countries need to assist government in reducing greenhouse gasses and also help in their community development to gain contracts from the government.
2. Furthermore, external R &D is a significant factor influencing SME's innovation outcomes across all the model specifications for the logit regression. Therefore, this calls for these SMEs to conduct external R&D as it has demonstrated to have additionality effects on SME's innovation measures. With external R&D collaborations, firms can contract the services of consultants for the successful contribution of innovation outcomes.
3. Furthermore, this study recommends various governments to review SMEs international quality certificates by acquiring globally recognised quality certificates. This would help SMEs Improve the quality of their products which will mean that these firms will be able to identify fake products from unregistered firms. These certificates need to be regularly renewed to signify their commitments to improved quality.

5.3 Results of the barriers to SMEs innovation outcomes

The specific objective three seeks to find out some impeding factors driving SMEs innovations outcomes. To fulfil this objective the research question sought to find out the factors impeding firm-level innovations. The logit regression model was employed in the first stage to establish the relationships between the impeding factors and other firm characteristics.

Table 6 : Descriptive statistics

Descriptive Statistics

	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
product innovation	2488	.793	.0081	.4055
Technology licensed	2470	.123	.0066	.3286
Tax rates	2441	2.375	.0191	.9413
Labour regulations	3166	7.11	.072	4.043
Inadequate labour	2833	7.94	.082	4.346
Losses due to theft	2154	89.648	52.0212	2414.3668
financial obstacle	2439	4.069	.1740	8.5920

Source: own calculations
Note: N equals the total number of observations

Table 7 : Regression Analysis of factors impeding product innovation outcomes

Variables	Coefficient	Standard Error	P-Value
Tax rates	-.165	.059	0.005***
Control variable			

Countries			
Hungary	.809	.147	0.000 ***
Slovakia	1.160	.192	0.000***
Poland	.881	.137	0.000***
Constant	1.014	.168	0.000***
Summary statistics			
Pseudo R2	0.0239		
Laborregulations	.018	.012	0.147
Control variable			
Countries			
Hungary	.848	.147	0.000***
Slovakia	1.227	.193	0.000***
Poland	.807	.133	0.000***
Constant	.495	.146	0.001***
Summary statistics			
Pseudo R2	0.0213		
Inadequatelabour	.030	.012	0.014**
Control variable			
Countries			
Hungary	.843	.147	0.000***
Slovakia	1.179	.191	0.000***
Poland	.881	.143	0.000***
Constant	.406	.146	0.005***
Summary statistics			
Pseudo R2	0.0279		
Loss due to theft	.0004	.0002	0.097*
Control variable			
Countries			
Hungary	.835	.146	0.000***
Slovakia	.355	1.341	0.791
Poland	.765	.131	0.000***
Constant	.653	.106	0.000***
Summary statistics			
Pseudo R2	0.0187		
Financial obstacle	.006	.007	0.371
Control variable			
Countries			
Hungary	.865	.147	0.000***
Slovakia	1.060	.218	0.000***
Poland	.799	.132	0.000***
Constant	.637	.108	0.000***
Summary statistics			
Pseudo R2	0.0216		

Source: Author's own

NOTE: Significance at 99% confidence interval (CI)-***; significance at 95% CI-**; significance at 90% CI-*

Table 8 : factors impeding Technology license acquisition

Variables	Coefficient	Standard Error	P-Value

Tax rates	.102	.071	0.150
Control variable			
Countries			
Hungary	-.684	.218	0.002 ***
Slovakia	.997	.196	0.000***
Poland	-.250	.185	0.176
Constant	-2.160	.221	0.000***
Summary statistics			
Pseudo R2	0.0488		
Laborregulations	.019	.017	0.265
Control variable			
Countries			
Hungary	-.692	.218	0.002***
Slovakia	1.063	.202	0.000***
Poland	-.148	.184	0.422
Constant	-2.094	.208	0.000***
Summary statistics			
Pseudo R2	0.0478		
Inadequatelabour	.015	.016	0.334
Control variable			
Countries			
Hungary	-.697	.218	0.001***
Slovakia	1.007	.196	0.000***
Poland	-.430	.202	0.034**
Constant	-2.060	.201	0.000***
Summary statistics			
Pseudo R2	0.0613		
Loss due to theft	-.001	.0007	0.060**
Control variable			
Countries			
Hungary	-.692	.217	0.001***
Slovakia	4.807	2.030	0.018
Poland	-.181	.182	0.318
Constant	-1.934	.152	0.000***
Summary statistics			
Pseudo R2	0.0185		
Financial obstacle	.020	.006	0.001***
Control variable			
Countries			
Hungary	-.715	.220	0.001***
Slovakia	.676	.224	0.003***
Poland	-.189	.184	0.304
Constant	-1.989	.154	0.000***
Summary statistics			
Pseudo R2	0.0540		

Source: Author's own

NOTE: Significance at 99% confidence interval (CI)-***; significance at 95% CI-**; significance at 90% CI-*

Summary of Implications and Recommendations

This thesis session assessed the various determinative factors impeding SME innovation outcomes. The set of independent variables consisted of various obstacles impeding SME innovation. Two sets of dependent variables that help capture firm-level innovations were considered: product innovations and technology licenses. The research question that was answered was: Do SMEs face some challenges in their quest to be innovative? The result of the empirical analysis provided a mixed result. The study found that loss due to theft and financial obstacle positively impeded product innovation outcomes and technology license acquisition.

These variables reduce the likelihood of product innovation outcomes and technology license acquisition. We also found that inadequate labour, government taxes and labour regulation do not statistically influence product innovation and technology license. These results could be attributed to the fact that the EU government supports businesses regarding regulations; labour has not been an issue as they can get skilled and unskilled personnel to balance their workforce. The results have proven that losses due to theft had a minute impact on product innovation and technology license acquisition. Losses as a result of theft used in this thesis denote to employees sharing companies' ideas/shares to competitors when they leave the company. The results on loss as a result of theft was a significant factor impeding SMEs product innovation outcomes and technology license acquisition across the model specifications for the logit regression results. This calls for policy makers to have policy plans that would not be affected by changes in political systems. The continuation of innovation policies needs to be strictly enforced.

5.4 Researcher's remarks from qualitative inquiry

To get in depth understanding of the subject matter, the study, in addition to the quantitative inquiry conducted a short qualitative survey from experts and academic researchers. The approach intercepted fifteen (15) participants. Summary from the findings was as follows:

The preliminary findings have shown that most of the experts and academic researchers are mainly people who have researched on innovation in the Visegrad countries. They have at least some publications on the topic over the years.

With regards to the question: *How many years of research experience do you have on innovations research?*
The results show that the average years of research by most of these respondents was 4 years. Implying that they have researched on the trend of the topic at least in the past four years.

General overview of innovations in the V4
Concerning the question: *What's the present overview of SME's innovation in the Visegrad Countries.*

Most of the respondents are of the view the Visegrad countries are improving in terms of their innovation and catching up with Western European countries. Again, they can be seen as moderate innovators based on the European innovation survey. The Czech Republic is performing better than the other three countries.

Internal factors influencing SMEs innovations
With regards to the question: *Which internal factors (activities) are vital for SMEs innovations?*

Four of the experts were of the view that innovations can be boosted internally by implementing the combination of internal activities. The implementation of internal activities such as R&D can have positive externalities on firm or innovation performance. They reported that small businesses should diversify their internal funds so that they can have access to sustainable funding. Secondly, they reported that small businesses need to strengthen their internal R&D capabilities. The research believe that all these suggestions proposed by these experts could help enhance innovations, but this should be contingent on these firms improving their absorptive capabilities to be able to fully benefit from these proposed activities. Some of the experts were also of the view that, firm characteristics such size and age could play key roles as internal factors that can spur small businesses innovations.

Regarding this question -*Which internal factors should SMEs focus on to be innovative, in your opinion?*

Regarding this question, there was a mixed response to this question. While some were of a different view of the internal R&D contributing to innovation outcomes, most of the respondents believed that innovation funding is crucial for SMEs in the Visegrad group of countries to catch up with advanced economies for effective innovation outcomes. The researcher believes that while all these are vital to enhancing innovations internally, small businesses need to boost their absorptive capacities to be able to contribute better to R&D also to make good use of internally generated funds.

External factors influencing SMEs innovations
Concerning the question: *Which external factors influence SMEs innovations performance?*

The responses centred on various factors such as demand-side, supply-side policies, competition, interactions in global innovation ecosystems. The responses revolved around decisions that small businesses can take for instance

regarding taking part in procurement contracts and internationalizing through exporting to benefit from novel knowledge and technologies which abound in the international ecosystem. These open innovation search can allow small businesses to complement any internal weakness with external support from partners. Both domestic and international technological linkages could have a positive spill over effects on domestic innovations in Visegrad countries.

Regarding a different question: *which of these external factors significantly impact SMEs innovation performances?*
Most of the respondents reported that increasing and sustaining public support for innovation will be the foremost external determinant that can influence SMEs innovations. These supports could boost innovations as it leads to increasing funding to SMEs who are mostly resource constrained. These supports can help SMEs to have access to funding to expend on innovations and its related activities. The researcher believes that calls from these experts on increasing public innovation support is in the right direction, but it also requires firms to improve their absorptive capabilities to be able to assimilate the benefits of these support. The experts also suggested that increasing and sustaining R&D collaboration with other partners can be a vital determinant of small businesses innovations. The researcher believes that calls for the funding could also be extended to firms that engage in these innovative partnerships.

Barriers to SMEs innovations

Again, regarding the question: *In your opinion, which major obstacles do SMEs in the Visegrad countries face in their quest to innovative?*
The experts provided various barriers small businesses face in their operations. Notably, the innovation drain was seen as a major obstacle to small businesses innovations as it creates the problem of inadequate skilled workforce vital for the success of innovation. The region is losing its qualified human capital to other countries due to wage differentials especially between Western European countries and the Visegrad countries. Again, the results of the empirical investigations show that certain element of the business environment such as tax rate serves as a significant obstacle to firms' product innovations. When corporate taxes are higher, it can increase the cost of introducing novel products and processes making the returns to investment more uncertain. Corporate tax regime can be obstacle that can weaken SMEs incentives and propensities to innovate. Higher corporate tax rates can affect and raise the cost of R&D investment and intellectual property rights protection which can go a long way to negatively impact new products and processes development. Most of the experts also pointed out that inadequate capital investment was a huge problem that can prevent small businesses to embark on innovations. It can also result in small businesses

abandoning the started innovation process because they may not have the capital to sustain it.

Concerning the question: *Which measures can be adopted by SMEs in Visegrad countries to minimize these innovation obstacles?*
Most of the experts opined those small businesses should constantly focus on human capital development, strengthen their partnerships with other firms and knowledge repositories as cooperation can be a means to share risk of these obstacles. Small businesses can also ensure that develop their internal capabilities so that they will be able to attract and make good use of public funding support which can help them overcome their resource constraint.

Concerning the question: *What policy recommendations (measures) need to be implemented to make SMEs more innovative.*
Most of the respondents were of the view that country specific policies are key to enhancing innovations. Policies should focus on providing adequate financial resources for innovation support to these small businesses. The researcher believes that the effectiveness and efficiency of these public investments will require bold transformations of national R&D and innovation systems with particular focus on their allocated. Demand-side policies could also be made favourable for small businesses by setting quotas or even limiting some calls just to them. These policies can somehow protect them from unfavourable competitions from large firms.

6. CONCLUSION

Small and medium-sized enterprises (SMEs) continue to face with the paradox of developing new products and technologies on the one hand and minimizing costs on the other. Though these SMEs must be innovative to survive and grow, however, compared to large firms, SMEs have several challenges in their innovation process, which adversely influence their overall innovation performance. This thesis enhances the current body of knowledge (SMEs and Innovation related literature in that it compares internal and external environment of SMEs based on competence and performance differences. It also presents firms with a clear indication of how to align their internal organization to achieve high innovation performance to achieve incremental innovation. Again, it is generally understood that in a period of advanced technologies and coupled with increasingly flow of information, a firm's ability to innovate has become a crucial driver of growth, competitiveness, and sustainability (Kwarteng, Jibril, Nwaiwu, Pilík & Chovancova, 2021).

Research and Development and innovation play vital roles in generating sustainable productivity, growth, and job creation (Odei et al., 2020; Muscio & Ciffolilli, 2020). The tendency to generate new knowledge through research is

fundamental to developing innovative services, products, and processes, which facilitate higher industrial competitiveness, productivity, and overall economic prosperity. SMEs have been exposed to global competition because of constant feedback from customers' demand for new and quality products. These intense competitions mean that firms, especially SMEs, are constantly looking for strategies to survive and have a competitive advantage over their market rivals. There is no clear pathway to achieving sustainable innovations, so this requires different approaches. In this thesis, the researcher developed integrated research models to examine the internal and external factors and firm characteristics that influence SMEs innovation outcomes within the Visegrad countries. The main theoretical underpinnings of the thesis were resource-based view, open innovations and the national innovation systems model. This research is divided into three sections based on the specific objectives.

The specific objective one sought to examine the internal factors influencing SME product and process innovation outcomes within the Visegrad Group. The study examined the influence of internal R&D, overdraft facility, membership organisation, machinery, lines of credit, internet security, training, sectors and countries. The results of the empirical analysis demonstrated that, in general, these internal factors promote SMEs' innovation outcomes which helps them perform better than their competitors internally. The researcher found that internal R&D, machinery, lines of credit and internet security was a significant factor contributing to SMEs ' product and process innovation outcomes. The findings also revealed that that a firm's investment in machinery was an influential factor in deciding on a firm's choice for product innovation. This study also concluded that firms in the Visegrad countries were likely to indulge in both process and production activities on an annual basis, which is quite remarkable as they are classified as modest innovators.

The second specific objective is to examine the external factors contributing to SME technological innovation outcomes. ~~We~~ It concluded that determinants such as technology license, government contract, external R &D, international quality certificate, informal competition and financial services contributed to SME's innovation outcomes. ~~We~~ The study focused on analysing the above external factors contributing to SMEs' innovation outcomes in Visegrad countries. The results show that external R&D, international quality certificate and financial services substantially impacted technological innovation outcomes. Finally~~, we~~ it was discovered that country dummies positively influenced firms' technological innovations, implying that these countries could be technological innovators. The results especially on technological licenses and international quality certificates show that they matter for small businesses innovation performance.

Finally, the last specific objective focused on analysing barriers that impede SMEs' innovation outcomes. This study assessed the impact of tax

license, tax rates, labour regulations, inadequate labour, losses due to theft and financial obstacle etc. and how they impede the product and technology license acquisition outcomes. The analysis results showed that tax rates, loss due to theft and inadequate labour significantly impede SME product innovation outcomes and technology license acquisition.

The thesis findings have confirmed that both internal and external factors contributed significantly to innovation outcomes within the Visegrad countries. Therefore, ~~we~~ the author of this thesis recommend that all SMEs firms invest massively for high turnover. Firms can reinvest the profit back into the firm or borrow from the bank to boost innovation activities. The result of ~~our~~ analysis has again indicated that performance-based incentives also had the highest influence on innovation outcomes. Therefore, management of SMEs should ensure they motivate employees to contribute to product and process innovation. Therefore, the study suggest that firms intensify their partnership with research organizations to encourage process or product design and development.

6.1 Theoretical academic and practical importance

Theoretical contributions

- The study contributes to the enrichment of understanding SMEs in the Visegrad countries. Innovation contributes specific knowledge concerning the financing of SMEs in the selected countries. This study has paved the way for more academic and practical enquiry into SMEs development activities within these economies where research on SMEs innovation is scant.
- The study found that internal factors such as funding, human capital, R&D all matter for small businesses innovation outcomes. These internal factors are vital resources available to these small businesses which can be harnessed to enhance and sustain their innovations. This is in line with the resource-based view of the firm.
- The main theoretical implication of the results of specific objective two demonstrates that the knowledge production models in these economies should be revised to amalgamate international technological relationships as the results have shown that quality management and assurances, and foreign technologies acquisitions through licensing agreements positively influence technological innovations. Our analysis proved that international technological links generate positive externalities to Visegrad countries which could contribute to stimulating innovations that at present day is depicted as weak. These findings contribute to the national innovation systems and open innovation theories.
- Lastly, the econometric analysis for the specific objective three advances the understanding of SMEs businesses environment by showing that it could be for instance hindered by hysterical fiscal policies. Higher corporate taxes reduce the investments small businesses can channel into

the innovation process, but this nexus between fiscal policies and firm-level innovations is terra-incognita by researchers in Visegrad countries. The result of fiscal policy influence on small businesses innovation contributes to the growing national innovation systems theory.

Practical implications

Practically, the research results offer several contributions to practice. Practically, these findings will,

- The results call for firm managers and policymakers to take full advantage of the opening process and obtain international quality certificates and foreign technologies through licensing agreements from abroad. The main practical implication for SME managers in these countries is that openness to foreign knowledge and technology inflows scientifically improves and balance the quality of domestic resources resulting in new services, products and process development.
- The results suggest that Visegrad countries and other transition countries aiming to be knowledge-based should target both small businesses and large firms with specific policies, particularly technology acquisition and R&D policies must be promoted proportionately.
- Policymakers should also consider policies that make the business environment in these countries sensitive to small businesses innovations. Negative aspect of the businesses environment such high tax rates which could pose a significant threat to innovations could be reviewed to make it favourable.
- Improving the quality of innovation support for firms and other knowledge repositories will also be key to ensuring that SMEs can stay innovative sustainably.
- Small businesses managers in these countries should place greater emphasis on demand-side policies such as engaging in public procurement process as this has been demonstrated to positively enhance innovations.
- Focused on human capital loss which is exacerbated by the innovation drain syndrome. Firms should also have enticing remuneration packages to be able to attract the right human capital needed for innovations to thrive.

Limitations of the thesis

This study's findings and conclusion need to be interpreted according to the dissertation's limitations. The cross-sectional nature of the data means that our results should be interpreted as innovations for the specified time. Secondly, the attribute of the data didn't permit the inclusion other widely known measures of innovation offered by the Oslo manual for instance non-technological innovations due to data unavailability as it was not included in this edition of the survey. The sole focus on technological innovations, means that our results need to be interpreted as such and not to suggest overall innovations. The dataset also

includes other measures that describe the state of innovations in firms such as utility models or trademarks and scientific publications. The lack of data on these measures constrains our understanding of other kinds of innovation. Finally, combining the Visegrad countries as a single analytical unit means that we cannot generalize the results of the studies that these determinants influence innovation in each country.

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Michael Amponsah Odei, Ph.D.

Examination of factors contributing to SMEs Innovation outcomes in the
Visegrad Countries

Zkoumání faktorů přispívajících k výsledkům inovací malých a středních
podniků v zemích V4

Doctoral Thesis Summary