



University
of Stavanger

NGUYEN QUOC THANG
SUPERVISOR: JUDY HONG HUANG

Innovation and firm performance
in small and medium enterprises
in Vietnam

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ABSTRACT

Innovation is a very broad concept and accepting it as a key determinant of economic growth and firm performance. Therefore, it is important to determine the variables that affect innovation, especially where there is uncertainty and a turbulent environment as is the case with markets and technologies today. This paper looks at the impact of innovation on the financial performance of small and medium-sized enterprises (SMEs) in Vietnam, exploring the moderating role of organizational legal form and training. Using the Vietnam SME Survey, this thesis seeks to answer the question of how varied innovation activities impact profitability.

The findings indicate that innovation strongly affects firm performance, and this effect is enhanced by formalized organizational forms and higher employee training. SMEs with formalized organizational forms as compared to household businesses can easily access resources, pursue strategic actions and protect intellectual property. However, some household businesses lack resources to fully engage in innovation.

Training of employees emerges as a key variable influencing innovation and financial performance. Firms that engage in training and education of their employees obtain higher returns from their innovation activities. The investment in human capital improves the capacity of the firm to generate greater productivity and efficiency which directly affect profits.

This study offers practical implications for SMEs managers and contributes further to the understanding of innovation dynamics in the context of developing countries. The results indicate the importance of formalized organizational forms and training of employees to fully exploit financial benefits from innovation activities. These considerations are beneficial for policymakers and entrepreneurs to encourage a higher level of innovativeness in firms, industries and the economy as well.

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1. INTRODUCTION & BACKGROUND OF THE RESEARCH

1.1 Introduction

Innovation plays an important role in economic development because of its contribution to wealth creation, social sustainability and efficient use of resources (Tidd, 2006). Therefore, we should be aware of drivers and outcomes of innovation (Hoskins and Bouquet, 2010). Regarding to Vietnam's context, this research contributes to the strand of literature on the impact of innovation on firm performance of Small and Medium Enterprises (SMEs). In particular, the study tests an interactive effect of innovation and firm performance, moderated by legal form and employee training. SMEs are considered as an important part of Vietnam's economy, accounting for a large share of employment and gross domestic product (GDP) (Vietnam Briefing, 2020). In contrast, SMEs are also characterized by numerous disadvantages which could have detrimental effects on their capacity to innovate. By investigating those research gaps, this study hopes to provide some practical suggestions to enhance innovation and performance of SMEs in Vietnam. Prior research has underscored the relevance of innovation from both firm performance and developmental perspectives. Schumpeter (1934) argued that innovation was the driving force behind economic growth and profit.

This standpoint has been supported by many studies (Artz et al., 2010; Calantone et al., 2002), showing that compared to less innovative firms, those that are more innovative generally achieve higher levels of performance. Nonetheless, while the main relationship between innovation and performance is widely acknowledged, limited attention has been paid to examine the moderating roles of legal form and employee training on the innovation-performance relationship. Moreover, most of previous studies were conducted in developed countries; it is necessary to investigate this issue in developing contexts, especially in Vietnam. This thesis attempts to contribute to this stream of research, and address the following interrogations. Firstly, since the legal form of business may affect firms' resources availability, corporate governance structure and rigidity (Harris and Helfat, 2007), it is expected that this form moderates the relationship between innovation and performance. Secondly, while training programs are considered as a crucial source of competitive advantage (Zhao et al., 2011), they can foster employees' knowledge and improve their capability to adapt to change (De Grip & Sauermann, 2012); hence, they can motivate innovation. Therefore, this research examines the interactive effects of innovation and firm performance, moderated by (1) Legal form and (2)

Employee training. In general, this study extends existing literature by providing insights into when and how innovation leads to better performance of firms.

1.2 Why SME?

Small and medium-sized enterprises (SMEs) play an important role in the world's economy. They constitute about 90% of the global trade and more than 50% of the employment. In the developed country like the European Union and the United States, SMEs contribute a significant share to the economic development and innovation (OECD, 2023). SMEs are responsible for about 99% of all firms and all three of private sector employment (OECD, 2023). However, the SMEs in the developing countries contribute 40% of GDP and legally create about 70% of the employment (World Bank, 2023). The SMEs in both developed and developing countries suffer some unique problems. SMEs in developed countries usually enjoy easier access to finance and a better regulatory environment but they still encounter some problems like strict credit policy and pressure from compliance costs (OECD, 2023). However, SMEs in the developing countries encounter severe problems in financing, and are often reliant on the informal lenders, and regulatory environments that disrupt the growth and sustainability (World Economic Forum, 2023). Thus, to solve these problems the response measures and new financial solutions are essential to SMEs' recovery and development of SMEs all over the world.

Furthermore, SMEs reduce the rates of poverty by providing employment and promoting entrepreneurial spirit. They also strengthen and diversify the bases of economic activity which is vital for sustainable economic development. Since SMEs are the key driving forces in the socio-economic development, it is imperative to maintain and foster their growth. There are numerous rationales for why this research stream on SMEs and not on large firms or other types of enterprises is important. First, SMEs have an unparalleled capacity to accelerate economic diversification and innovation. They often operate in specialized and niche markets. They are more flexible and thus, they easily respond to the changing circumstances and innovate products and services accordingly. It is less likely for big and bureaucratic organizations to change their course quickly in response to the shifts in market demand. Second, SMEs enhance local economies and communities. They tend to be more grounded in the local context, employing locals and procuring materials from the vicinity of their operation. Such characteristics of SMEs support community development and promote the socio-economic

conditions of the region by providing jobs and encouraging economic activities from the bottom-up approach. This is unlike the big multinational corporations which may have wider but not as deep impact on the local communities. Third, SMEs accelerate and facilitate innovations. Their size and structure make them more entrepreneurial in nature which creates an enabling environment for creativity and innovations to take place. The big firms are also innovative but they may not always focus on local or niche innovations due to their extensive operation in the broader markets. Finally, SMEs create jobs. The statistics showed that SMEs create a significant portion of total employment and even the majority of formal jobs. Jobs created by SMEs are important for economic stability and growth. By creating large numbers of jobs, SMEs help to alleviate unemployment rates and thus, contribute to social stability. Likewise, the big firms create jobs but the number and proportion of jobs created relative to their size are much lower than SMEs.

Finally, the constraints that SMEs experience, such as access to finance, skilled workers and technology, are peculiar to them and need to be addressed. The benefits of doing so could be sizeable for the economy as a whole, if SMEs can overcome these constraints.

1.3 Why Vietnam?

Vietnam is emerging as a critical player within the economically vibrant Association of Southeast Asian Nations (ASEAN), contributing significantly to the region's economic development. As an active ASEAN member, Vietnam promotes economic integration and trade liberalization, boasting a trade ratio to GDP of over 200%, placing it among the world's top economies. Secondly, Vietnam contributed substantially to formulating the ASEAN Free Trade Agreement and the ASEAN Economic Community (ASEAN, 2016). In addition to a large population, which provides a ready labor force and a large potential market, Vietnam's geographic location provides a gateway for other economies to giant markets in China and ASEAN (Asian Development Bank, 2011). During the last 30 years of reform, Vietnam has achieved remarkable socio-economic development with a huge expansion of economic scale and improved living standards. With these reforms, Vietnam has strategically improved its economy's competitiveness, partly through its national and business sectors being innovative. For instance, Vietnam has increased investing in Research and Development (R&D) activities with the ratio of R&D over GDP doubling from 0.178 in 2002 to 0.374 in 2013 (UNESCO, 2016). The expertise of the workforce has been lifted with increasing numbers of students

attending college and university and thus producing higher qualified employees. Improving and developing infrastructure and financial markets have also led to enhanced innovation to the extent that its innovation ranking has lifted globally (World Intellectual Property Organization, 2018). According to the Global Innovation Index, the position of Vietnam rose from 71st in 2014 to 47th in 2017, placing third in the Southeast Asia with only Singapore and Malaysia ahead. The number of patent applications ranked 50th in the WIPO World Intellectual Property Indicators 2017 report. Although Vietnam was selected as the factory base for world innovation corporations, Microsoft and Samsung, concerns about the innovation of firms in Vietnam remain. While a range of initiatives advance the innovation capabilities of Vietnamese firms, the impact of these measures seems low when considering the proportion of firms introducing new products/processes has declined (CIEM et al., 2014). Although innovation inputs such as labor, knowledge, infrastructures, finance and institutions, have increased, the real innovation outputs of businesses require more efforts to transform them into new products or new technologies.

1.4 Overview of SME in Vietnam

The profile of SMEs in Vietnam has significantly transformed in the last decades. Vietnamese SMEs in the past were known for low technology absorption and lack of innovation due to the constraint of resources and lack of encouragement from the government (Brandt et al., 2016). However, the high economic growth rate and integration in the world economy created the pressure for change toward more innovation. Before that, SMEs simply played the game of producing in a low-cost/labor-intensive manner. Under the pressure of competition and globalization, in addition to marketing strategy, organizations had to innovate to enhance their competitive advantage. SMEs have been considered as the backbone of the Vietnamese economy. SMEs account for more than 98% of the total enterprises. In addition, it contributes to nearly 40% of GDP and creates jobs for more than half of the labor force (Vietnam Briefing, 2020). SMEs have played an important role in the restructuring of Vietnam's economy moving from the centralized planned economy towards a market-oriented economy. They are mostly scattered among small business owners mainly in services, trade, particularly manufacturing, and retail and wholesale trade with emphasis on two large cities of Hanoi and Ho Chi Minh City (Brandt et al., 2016).

Nevertheless, Vietnam SMEs still encounter several issues such as finance (strict credit policies of the banking sector), markets (limited access to foreign markets), technology (low adoption of technology), business environment (inefficient business regulation), and human capital (shortage of staff with professional certificates and managerial skills) (World Bank, 2020).

Innovation is key to tackle those barriers and propelling SMEs' growth. Although they are limited in resources, Vietnamese SMEs now more than ever understand that innovation activities are crucial to enhance competitiveness and productivity. For instance, digital technology adoption such as online sales, cloud-based services, and data analysis is now more popular than ever though it still faces obstacles (Walsh et al., 2023). Digital technologies help SMEs to save time in doing business transactions, broaden their market, and make data-driven decisions. Automation and Industry 4.0 also begin to penetrate production lines in Vietnamese manufacturing firms, however, the pace is slower than in large firms (Hai, 2021). The Vietnamese government has launched many programs to encourage SMEs' innovation activities. Subsidies for spending on research and development (R&D) and tax credits for innovative firms are financial incentives that reduce the cost of adopting technology (Vietnam Ministry of Planning and Investment, 2022). The opening of innovation hubs and incubators is thus beneficial for the SMEs where they find the necessary resources, support and network through which they can effectively innovate and develop their innovations. In addition, it is equally important to recognize the fact that the digital revolution has affected the various SMEs in Vietnam hugely with many firms undergoing digitization in their operations to remain relevant. Advancements in the internet and mobility have made the e-commerce and other digital marketing goals possible and reachable for the SMEs leading to the expansion of their market area and customer interfaces (Gao et al., 2023). The recent outbreak of COVID-19 virus has accelerated digitalization process even faster as SMEs have to adapt to the 'new normal' (Bruce et al., 2023). SMEs collaboration with academia is also encouraged to strengthen knowledge transfer and develop solutions (Ghobakhloo et al., 2021).

1.5 Research question

Compared with other countries, Vietnam is a transitional agriculture economy with lower capital and labor productivity. Rapid development of technologies, environmental fluctuations and market uncertainty force firms to assess their abilities for innovation. In this research, I would like to answer those questions based on Vietnamese SMEs:

- What determinants affect firm performance of Vietnamese SMEs?
- How does innovation affect firm performance of Vietnamese SMEs?
- How do legal form and training moderate the innovation effect on firm performance?

These questions are important for building a holistic understanding of the dynamics that affect the performance of Vietnamese SMEs. The first question addresses the determining factors that affect the performance of Vietnamese SMEs. It involves characteristics such as the size of the firm, age of the firm, location as well as other contextual factors that might confound performance. An understanding of these determining factors will offer a background context for considering how innovation relates to these factors. The next question addresses whether innovation particularly affects the performance of Vietnamese SMEs. The third question addresses how legal form and training moderate the relationship between innovation and firm performance. This involves developing hypotheses to explore if and how the form of the business (e.g. household business or corporate entity) and whether training is offered to employees influence the relationship between innovation and performance. Legal form may influence access to resources, governance, and operational flexibility, while training can improve employee capabilities and adaptability, and hence, affect a firm's capacity to innovate.

1.6 Research objectives & outcome

The aim of the present research is to investigate the impact of innovation on firm performance with the moderating effects of legal form and employee training in Vietnamese SMEs. Specifically, the study aims to examine the determinants affecting firm performance; and to investigate the moderating effects of legal form and training on the relationship between innovation and firm performance. Therefore, this study posits that the effect of innovation capability on firm performance may differ depending on the levels of institutional context (legal form) and human capital investment (employee training). In other words, the effects of innovation on performance may not be the same across firms with different levels of formal organization and employee training. Moreover, this study attempts to identify key factors that can facilitate or hamper the improvement of firm performance through innovation. Thus, finding effective solutions to remove obstacles and promote activities for innovation will be practically meaningful and significant in developing countries like Vietnam.

By exploring these research questions, the study will provide some theoretical implications and practical suggestions for enhancing Vietnamese SMEs' innovation capacity and their

performances in Vietnam's context. In Vietnam's context, the direct and indirect impacts of various levels of innovation activities on firm performance are still an empirical question and have not been studied and clarified.

1.7 Structure of the thesis

The thesis is divided into six chapters:

- 1. Introduction & background of the research:** Introduce the research background, research topic, research questions and the structure of the thesis.
- 2. Literature review:** Present relevant literatures and theories of innovation, firm performance, legal form, employee training and establish the research hypotheses.
- 3. Methodology:** Illustrate the data, research design and method used in this paper.
- 4. Analysis & Finding:** Present and explain the report results.
- 5. Discussion:** Discuss further about the findings.
- 6. Conclusion:** Summarize the key findings, theoretical contributions, practical contributions, limitations of the study and suggestion for future research.

2. LITERATURE REVIEW

2.1 Innovation definition

Innovation is a complex and multidimensional concept which identified as the key driver of economic growth, competitiveness and welfare of nations. Even though innovation has been measured in different ways, definition included in the Oslo Manual covers the creation, diffusion and implementation of new or significantly improved products, processes, marketing and organizational methods within the firm and society (OECD/Eurostat, 2018). Schumpeter (1934) was a pioneer academic thinker who argued that firms generate economic value through innovation by changing their products, services as well as business processes. This argument is supported by many scholars by emphasizing firms' recombination of knowledge, skills and resources for achieving innovation (Cakar & Erturk, 2010; Lawson & Samson, 2001; Schiuma, 2013; Zhao et al., 2005). According to OECD (2005), innovation could be manifested in different ways such as new products, new production technologies, new marketing and organizational management methods. Innovation could be observed when companies can effectively turn their ideas into innovative products or business processes that yield benefits for the company and its stakeholders (Dodgson et al., 2014). It can generate value, create new markets and sustain firm's market share (Rothaermel & Hess, 2007) which possibly leads to

better firm's performance and growth. Additionally, innovation provides firms with a learning opportunity to develop their knowledge and capabilities to adjust their change in market (Teece et al., 1997). In general, the process of innovation can be divided into some phases such as identification, selecting and applying innovative ideas (Birkinshaw et al., 2008; Kastle & Steen, 2011; Roper et al., 2017). Therefore, the company must manage the interaction and connection between its capital, knowledge and organizational assets for innovations (Hogan et al., 2011; Nisula & Kianto, 2013; Weerawardena & Mavondo, 2011).

The benefits of innovation for companies are manifold. Firstly, innovation creates competitive advantage as companies differentiate their products and services and thus, meet the changing customer requirements as well as adapt to the fluctuations in the market (Porter, 1985). Furthermore, it can improve efficiency and productivity as new better processes and technologies are introduced which reduce the costs and advance the firm's performance (Drucker, 1985). Innovation can also generate new business models which lead to new revenue streams and growth opportunities (Chesbrough, 2003). Finally, innovative companies can better track the dynamics of the external world and thus, react to it with new products, processes or business methods (Teece et al., 1997).

Following the words of Antonio et al. (2010), firms have to prolong the life cycle of their products while they are on the market or invent new products through innovation. Thus, it is crucial for companies to possess sustained innovation capabilities, in other words, to be prepared to deal with novelty, as they enter the competitive environments. Michael Porter, the most prolific thinker about competitive strategy, argues that innovation is the only long-run way that companies can carve out their competitive advantage and thereby, earn sustained profits (Porter, 1990). Innovative companies will otherwise face the danger of becoming obsolete in the competitive market as the rival firms that adopt the new technologies and practices will perform better than them. Skarzynski and Gibson (2008) estimate that approximately 70% of companies need to have the innovation capabilities to attain good firm performance. Davila et al. (2006) suggest that firms need to develop the creative abilities which are based on positive attitudes, skills and motivation of the employees to create useful innovations.

2.2 Types of innovation

There are various types of innovation, specifically “Product innovation,” “Process innovation,” “Marketing innovation,” “Organizational innovation” (OECD, 2005). Product and process innovation are considered to be very important types of innovation and one of the most discussed types of innovation, because they are the most visible types of innovation for the company.

- **Product Innovation:** is defined to be the creation and development of new or significantly improved devices, products or technology. This kind of innovation can be through new products, new customer needs satisfaction, or radical product innovation, which means a fundamental change in their performance and/or usefulness. Firms invest in product innovation in order to appeal to new customers or to increase their market shares at the expense of their current ones (Schumpeter, 1934; Trott, 2008).
- **Process innovation:** can be defined as the introduction of new tools or the radical modification of existing tools, and it is typically done in order to increase productivity, reduce costs, enhance its quality of products or services (Teece et al., 1997; Davenport, 1993).
- **Organizational innovation:** is defined as the adoption of new value chains or new ways of doing things, in terms of how the business processes operate and the workplace is organized, or in terms of its relations with others. Organizational innovation can be defined as any change in the firm’s ways of doing things in regard to the firm’s processes and structures, with the intention of improving the effectiveness and/or efficiency of the firm (Lam, 2004; Damanpour & Aravind, 2012).
- **Marketing innovation:** Marketing innovation is the implementation of a new marketing method that replaces existing marketing methods and to change substantially the manner in which products or services are conceived, and the way they are delivered to the customers. Marketing innovations include a change in product design, changes in packing, changes in distribution in channels, and advertising (Kleinschmidt et al., 1991).

In this paper, mainly the first two types will be emphasized; product innovation and process innovation which affect both the demand and supply sides and firm performance greatly.

2.3 Firm performance

Performance of a firm can be regarded as a multidimensional construct which involves various aspects of the overall success and achievements of a company (Naser et al., 2004). Usually both operating and financial performance are used to measure the overall performance of a firm and these two dimensions are considered as the key performance dimensions of firms by many scholars such as Garvin (1987), Lee et al. (2001) and Sousa and Voss (2002). Furthermore, Lakhal et al. (2006) after having a large number of articles in the fields of strategic management, marketing and operations management, identified three basic aspects of business performance, which are financial performance, efficiency and effectiveness. operational efficiency and market efficiency.

- **Financial performance:** represents a company's ability to achieve its commercial and financial objectives (Lee et al., 2001; Richard et al., 2009; Lakhal et al., 2006). It shows how profitable the company's operations are, how well the company controls costs, and whether the company achieves profitability. Adequate returns on invested resources. Some commonly used financial performance measures include revenue growth, profits (i.e. profit margin), and return on assets.
- **Operational performance:** shows the firm's capacity to operate in order to attain fundamental business objectives (Flynn et al, 2010; Hendrick et al., 2009). A company's operating activities consist the company's internal operations and the activities flowing within the company. Operational performance evaluates the effectiveness and efficiency with which these internal activities are carried out. Commonly used operational performance indicators include production efficiency, supply chain management and overall productivity of operations.
- **Market performance:** indicates the firm's capacity to enhance customer experience and widen its network (Saunila et al., 2014). Market performance evaluates customer satisfaction, market share and customer relationship. This factor relates to the company's ability to meet the market demand, to win and keep customers and to compete with other companies in the market.

Firm performance can be viewed as a performance outcome of activities and strategies for which the firms strive for their own survival and existence (Richard et al., 2009). Among several

dimensions of performance, profitability is regarded as one of the most easily understood and directly measured performance (Kaplan & Norton, 1996). Profitability shows how well a firm generates income in relation to its revenue, cost and expenses, over a specified period of time (Higgins, 2015). Therefore, profit change which is treated as the dependent variable in this study shows firm's performance across time. Profit shows the welfare of a firm. It indicates how well a firm generates income and is able to cover its expenses (Grant, 1996). Operationally, profit is the amount of revenue minus the cost and expenses of a firm. For this reason, profit is considered as a direct measure of financial performance of a firm. Many firms use profitability benchmarks to evaluate and monitor their performance (Sudarshan and Santalo, 2007). The dependent variable in the model, profit change captures firm performance overall through its tangible and intangible results produced by the firm over time (Kaplan & Norton, 1996). In addition, profitability is regarded as the most crucial goal of firms (Johnson et al., 2008). Therefore, profit change captures the firm's capability to meet its overriding objectives which can be used to steer the firm's strategic choices (Atkinson et al., 2008). Profitability based performance measures are employed by firms to guide their activities such as resource mobilization, market growth, product innovation and choice of technologies (Johnson et al., 2008). In addition, profit is a holistic measure that encompasses the effects of various strategic and operational factors (Kaplan & Norton, 1996). Thus, profit change as the dependent variable in the model captures the joint effect of different independent variables.

2.4 Innovation and Firm performance

Innovations can actually enhance the firm performance in several aspects. Particularly, four different performance dimensions are employed in the literature to represent firm performance (Narver and Slater, 1990; Barringer and Bluedorn, 1999; Antoncic and Hisrich, 2001; Hornsby et al., 2002; Hagedoorn and Cloudt, 2003; Yilmaz and Ergun., 2005). These dimensions are innovative performance, production performance, market performance and financial performance. Many empirical researches show that corporate level innovation activities have a positive impact on financial performance of companies. Firms always try to create and capture value through innovations and improved products and processes (Pisano and Wheelwright, 1995). In this context, Damanpour and Evan (1984) argue that financially profitable firms often innovate and innovation enables firms to react appropriately to demand markets and exploit new opportunities. This argument is in line with Cohen and Levinthal's (1990) absorptive

capacity, which means that firms that invest in innovation are more likely to absorb and exploit new knowledge and thus gain new knowledge. gain higher profits. Many of these studies show a positive association between innovation and firm performance, but some of them also show a negative association or no association at all (Chandler and Hanks. 1994; Subramanian and Nilakanta. 1996; Hult et al. 2004).

In addition, innovation can help firms to distinguish themselves from their competitors by offering non-imitable products and services. This distinction leads to more customers and thus grows the firm's market share. Narver and Slater (1990) discovered a strong market orientation combined with innovativeness activities has a positive effect on the firm's profit and market share. Innovative firms are more likely to react to shifting customer needs and market conditions and thus grab a greater market share. Deshpandé et al. (1993) contend that innovative firms are more likely to survive in turbulent environments because their innovativeness allows them to keep up and maintain a competitive edge. Hult et al. (2004) strongly agrees with this postulation. demonstrates that innovative firms tend to have higher productivity levels because their innovativeness aids them to streamline processes and deploy their resources more efficiently. Moreover, empirical investigations consistently lend support to positive relationship between innovation and business performance in different settings and industries. Hagedoorn and Cloudt (2003) used several measures to capture innovation performance and discovered strong support for the relationship between innovation and firm performance. They confirmed that firms that are more innovative perform better than those that are less innovative, based on financial and market measures of success. Similarly, Rosenbusch et al. (2011) examined the relationship between innovation and performance in a meta-analysis, which is a research design for combining the findings of different studies. They found strong support for a positive relationship between innovation and firm performance according to various criteria. The meta-regression results showed that the positive relationship between innovation and performance was consistent across different industries, firm sizes, and regions. The aggregating nature of this study underscores the critical role of innovation in driving firm success.

In addition to its broad impacts, innovation specifically affects profit change, a critical indicator of firm performance. Profit change reflects a firm's ability to enhance its financial outcomes over time, responding dynamically to internal and external pressures. Innovation tends to generate large changes in profit as new sources of revenue are introduced, cost savings

captured, and product value enhanced (Hult et al., 2004). For instance, firms that consistently engage in product, process and organizational innovation are more likely to have positive profit changes than firms that do not. The reason is that innovation helps companies better meet customer needs, achieve greater efficiency in operations and exploit new products and market opportunities. In a rapidly and profoundly changing environment, only companies that are able to continuously innovate their products and delivery processes will survive and prosper (Tushman and O'Reilly, 1996). Therefore, it is hypothesised that:

H1: Innovation has a positive relationship with firm performance

2.5 Legal form, Innovation and Firm performance

The legal form of a firm has implications for the activities, strategies and overall behavior of the firm. It can affect the relationship between innovation and firm performance (Acs, 2003). Firms may be organized as a household business, a partnership, a corporate entity or in many other ways. Each legal form has its own characteristics which affect the management of innovation and resulting performance. Household businesses are often characterized by informal organization and personal management (Smallbone & Welter, 2001). They usually operate with limited resources and simple governance structures. Their capital base consists largely of personal savings and family resources, especially labor (Kalleberg & Leicht, 1991). Thus, they generally have fewer material and financial resources to invest in innovation. Based on the Resource-Based View (RBV), effectively utilizing their internal resources and capabilities is essential for firms to gain a competitive advantage through innovation (Barney, 1991). Household businesses, given their restricted and informal setups, might encounter challenges in fully leveraging these resources.

Household businesses are also often characterized as personal, family-run ventures with the result that the owners' and their families' need for income and employment may constrain the amount that can be spent on innovation. The informal status of a household business can create obstacles to the formalization and scaling up of innovative ideas (Raffaele & Scarpa, 2013). Consequently, the impact of innovation on firm performance is likely to be less than that of more formalized businesses. The informal and personal nature of such businesses usually provides flexibility, informal structures and rapid decision-making. However, they often lack the strategic orientation and formal procedures which can effectively exploit the results of innovation (Rosenbusch et al., 2011). Thus, everyday operational problems usually take priority

over investments in innovation activities, and as a result innovative activity is often limited in scope and impact (Welter & Smallbone, 2011). In addition, lack of collateral and formal business plans means that household businesses usually cannot access external finance (Kalleberg & Leicht, 1991). This limits their ability to fund major innovation projects which could result in significant performance. Further, protecting the results of innovation through intellectual property rights is also often difficult for household businesses. This can create problems concerning the appropriation of ideas by competitors and the resulting entrepreneurial rent generated by the innovation. Finally, the informal and personal nature of household businesses means that the results of innovation are rarely documented and integrated into the business system (Welter & Smallbone, 2011). Therefore, in summary, innovation in household businesses is often limited in scope, impact and magnitude. It is also often not sustained over time. However, the advantages of flexibility and rapid decision-making remain. Thus, managers of corporate firms may learn from the informal and personal nature of household businesses. Nonetheless, the limited financial and material resources and the lack of formalization are likely to hinder the achievement of high performance through innovation. Hence, it is apparent that firm performance in innovation may be constrained by the legal form of the firm. However, it is also likely that the characteristics of the owners and managers and the resources available to them, are important in determining the success of innovation. These aspects are considered in the next section. In contrast, partnerships and corporate firms generally have more formal governance structures and access to more extensive financial and other resources. They are usually able to invest more in research and development (R&D) and experimental innovation activities (Chandler, 1990). They also often have professional management and specialist staff with appropriate human capital to innovate. Further, their results of innovation can be more easily protected and exploited through formal structures such as governance and intellectual property rights. Therefore, it is hypothesised that:

H2: Legal form (household business) has a negative effect or weakens the relationship between innovation and firm performance

2.6 Training, Innovation and Firm performance

Training of employees is one key in the improvement of skills and competencies needed for innovation, and thus increase business performance. This relationship of training, innovation and firm performance can be explained by some theoretical arguments and empirical analysis.

In the modern dynamic world of businesses, programs of training designed to improve the technical and innovative abilities of employees in the organization plays an important role in production. According to Becker (1964), investment in human capital through training will improve the abilities of employees to participate in innovative activities. This is a crucial concept for companies that want to stay competitive in the medium to long term period. Training and development enable employees to gain relevant knowledge and skills which enable companies to develop a learning culture that fosters innovations and continuous improvement. Furthermore, training and innovation are multi-dimensional and the relationship is not direct. March (1991) pointed out that organizations have to consider both exploration and exploitation in their learning processes. Exploitation refers to the firm's capability to fully utilize its knowledge and skill-based technologies, while exploration is about trial and error in developing new ideas and solutions. Thus, training and development should consider both exploitation and exploration dimensions so that employees can learn how to fully exploit their skills in their day-to-day activities and at the same time explore different ways of doing things. Hamel (2006) stressed the importance of management innovation in training and development. He stated that innovative management practices which included the ways firms trained their employees accounted for large shares of successes and failures in technological and product innovations. Firms can create training and development programs that encourage creativity and provide continuous learning experiences that enhance the innovative capacity of the firm. Such programs should include activities that encourage employees to think creatively and differently in order to discover new or improved ways of doing their jobs and also be flexible enough to adapt to change. Amabile (1996) also supported the importance of creating a creative and flexible workforce through training and development. She stated that trainings should include not only technical and functional skills but also involve problem-solving skills and flexibility. Training and development help employees to think creatively and develop skills to adapt to change and uncertainty and come up with innovative solutions to complex and unstructured problems. Such holistic training can ultimately enhance firm performance. Besides increasing innovative capacity, proper and well-structured training initiatives can also affect overall firm performance. Batt (2002) revealed that firms that offered extensive training exceeded industry norms in measures of innovation and overall firm performance. This is because well-trained and developed employees are better placed to successfully implement new techniques and

technologies in manufacturing. Additionally, employees with the right knowledge, skills, and attitudes will be more likely to be motivated and engaged in their work, which will ultimately reduce workforce turnover. labor and increase overall productivity.

Strategic human resource practices like training enable firms to fully benefit from innovation. Delaney and Huselid (1996) showed that firms that place a high priority on training and development actually perform better than those that do not. Their study revealed that such firms employed more skilled and motivated workers who are the main drivers of innovation and superior performance. Firms should align their training initiatives with overall strategic goals so that their human capital - the workforce, can be competitive and capable of meeting challenging operational demands of the dynamic business world. Therefore, it is hypothesized that:

H3: Training has a positive effect or strengthens the relationship between innovation and firm performance

Figure 1 summaries the theoretical model of the relationships between innovation and firm performance with moderators legal form and training

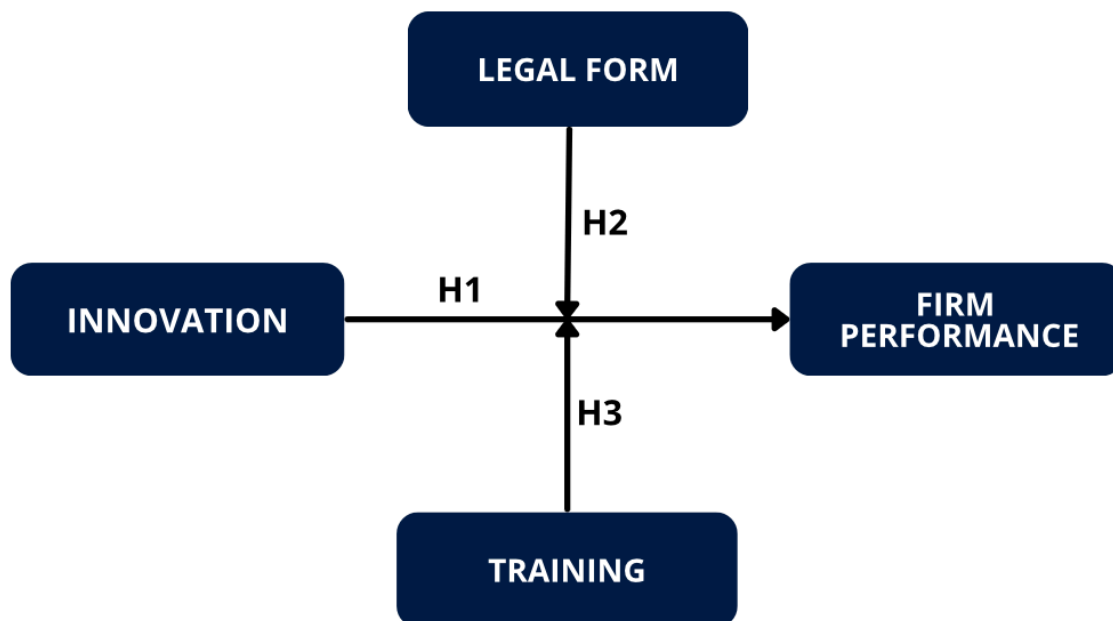


Figure 1: Research model studying the relationships among innovation and firm performance with the moderating effect of legal form and employee training

3. METHODOLOGY

3.1 Sample & data collection

The data in this article is secondary data and was taken from the Vietnam SME Survey in 2005, 2007, 2009, 2011, 2013 and 2015. The objectives of the study were to enhance the knowledge of the features of SMEs in Vietnam and the key constraints faced by Vietnamese. It is the result of a number of joint Danish and Vietnamese research institutes: The Institute of Labor Sciences and Social Affairs (ILSSA), the Central Institute of Economic Management (CIEM) and the Department of Economics Research Group (DERG) at the University of Copenhagen and UNU-Wider.

The second set of data was chosen for two reasons. First, secondary data is cheaper and faster than primary data collection especially for big studies (Johnston, 2014). Second, secondary data allows us to analyze data over a longer period of time and space to see the bigger picture (Vartanian, 2011). This is particularly relevant for a decade to study SMEs in Vietnam, where longitudinal data can be very useful for innovation and entrepreneurship. Besides, secondary data from a reputable source like Vietnam SME Survey is more reliable and valid since the data collection method and instrument has been standardized and tested many times (Smith, 2008). So secondary data can be used in this study as a base to examine the impact of innovation on Vietnamese SMEs' performance.

The data included around 2,500 manufacturing firms in three cities and seven rural provinces in Vietnam namely, Hanoi, Hai Phong, Hochiminh City, Phu Tho, Ha Tay, Nghe An, Quang Nam, Khanh Hoa, Lam Dong and Long An that represent around 30 percent of private manufacturing enterprises in Vietnam (CIEM et al., 2014). These firms employed less than 250 workers which is the common definition of SMEs in Vietnam. The original panel, which started in 2005, the sampling method of the survey is in line with Cochran (1977) and Levy and Lemeshow (1999). The data were harvested from face-to-face interviews with owners and managers of firms. The survey includes data on firm performance, firm history, employment, business environment and owner/manager background. For example, the data include firm revenue and profit figures, size of workforce, production details, financial details and much more. The data set also offers qualitative details of experiences, problems and strategies of enterprise owners and managers. It addresses issues such as the impact of regulations on their operations, competition in the market, and training of employees. The data were cleaned,

transformed and processed using R. There is panel data as well as cross-sectional data. Using panel data allows for tracking firms over time and enables within-subjects (firm) variation to be captured. This also allows for robustness checks to ensure that we understand the dynamics of these firms.

3.2. Measures

Dependent variables

The dependent variable in this study is Profit change. Current year profit or loss relative to prior year profit or loss. This is a dummy variable that takes on a value of 1 if the firm reports an increase in profit relative to the prior year, and 0 otherwise. It is appropriate to use this variable because profit change is directly linked to the financial status and performance of an individual firm. It is an absolute measure of economic benefit which takes both revenue and cost variables into account (Brynjolfsson & Hitt, 2000, Kaplan & Norton, 1996). Compared to other performance indicators like revenue, assets or labor, profit change considers productivity and strategic management of the whole organization and therefore can reflect firm performance realistically and reliably (Rumelt, 1991).

Independent variables

The independent variable of this study is innovation. In the surveys from 2005 to 2015, companies were asked what types of innovation they had introduced since the last round. The questions related to the innovation are:

- *Has the firm introduced new product groups since last survey?*
- *Has the firm made any improvements of existing products or changed specification since last survey?*
- *Has the firm introduced new production processes/new technology since last survey?*

The moderating variables in this study are legal form and training. These variables are chosen because they have a great potential impact on firm performance. The questions regarding the moderators are:

- *What is the form of ownership/legal status of the enterprise?*
- *Does the enterprise normally train (means more than 50% of the cases) existing workers?*

The legal form will be coded 1 if the enterprise is a household business, 0 if it is incorporated under any other forms, i.e. as a Private, Partnership, Cooperative, Limited liability company, Joint Stock, Joint Venture or State Enterprise. In addition, the training variable is divided into 1 if the enterprise trains regularly more than 50% of its employees and 0 otherwise.

Control Variables

Seven control variables which are traditionally used in firm-level research are included in this study: location, export, technology level, firm age, firm size, gender and internet. The questionnaires and their explanations are as below:

Location: *What is the address of the firm?*

This dummy variable identifies the geographical position of the company (urban or rural) which implies different access to markets, resources and infrastructure.

Export: *Does your enterprise export (directly or indirectly)?*

This dummy variable identifies if the company is involved in export activities. This has a direct impact on the degree of internationalization and the exposure to competitors in mature markets.

Technology Level: *What is the main area of business and production activity?*

Set of variables that categorize the level of technology used by a firm based on the industry in which it operates (including low-tech, medium-tech, medium-tech, and high-tech). The different technological levels used by the company affect its ability to innovate and adapt to market changes. For this report, the high-tech level is considered as the reference category. The other three categories were included in the model due to the low multicollinearity among them and to ensure that the effect of each category can be uniquely estimated by the model.

Firm Age: *When did the firm start to operate as the current firm? (Year)*

This is the time during which a company operates, usually measured in years. It determines the degree of expertise and market maturity. This variable was log-transformed because its distribution was highly skewed, as explained by Box & Cox (1964) and Tabachnick & Fidell (2013).

Firm Size: *What was the total workforce end – latest year?*

This measure is the number of employees working in a company, which indicates the amount of experience and specialization that the organization has. This variable was transformed to the log scale because its distribution was not normal

Gender: *What is the gender of respondent?*

This is a classification variable that identifies the sex of the main operator or owner of the establishment, which can affect directly the way a company is managed, consequently, its final performance

Internet Usage: *Does the firm have internet access?*

This variable identifies if the company uses or not the internet in its activities.

The classification of these industries is detailed in **Table 1**. All the variables used in the analysis are summarized in more detail in **Table 2**.

Industry	Technology Level
Pharmaceuticals	High Technology
Office, accounting and computing machinery	High Technology
Radio, television and communication equipment	High Technology
Medical, precision and optical instruments, watches and clocks	High Technology
Chemicals excluding pharmaceuticals	Medium High Technology
Machinery and equipment not elsewhere classified	Medium High Technology
Electrical machinery and apparatus not elsewhere classified	Medium High Technology
Motor vehicles, trailers and semi-trailers	Medium High Technology
Railroad equipment and transport equipment not elsewhere classified	Medium High Technology
Coke, refined petroleum products and nuclear fuel	Medium Low Technology
Rubber and plastics products	Medium Low Technology
Other non-metallic products	Medium Low Technology
Basic metals and fabricated metal products	Medium Low Technology

Building and repairing of ships and boats	Medium Low Technology
Food products, beverages and tobacco	Low Technology
Textiles, textile products, leather and footwear	Low Technology
Wood and products of wood and cork	Low Technology
Pulp, paper, paper products, printing and publishing	Low Technology
Manufacturing not elsewhere classified and recycling	Low Technology

Table 1. Classification of Technology

Source: OECD (2009)

Variables	Explanation of Variables
Innovation	The introduction of innovation. Innovation = 1 if firms reported innovation, otherwise 0
Legal form	Legal form = 1 if the firm is a household business, otherwise 0
Training	Training = 1 if the enterprise regularly trains more than 50% of its workers, otherwise 0
Location	Location = 1 if the firm is located in urban areas, otherwise 0
Export	Export = 1 if the firm is engaged in exporting activities, otherwise 0
Low technology industry	Low technology industry = 1 if the firm operates in a low technology sector, otherwise 0
Medium low technology industry	Medium low technology industry = 1 if the firm operates in a medium low technology sector, otherwise 0

Medium high technology industry	Medium high technology industry = 1 if the firm operates in a medium high technology sector, otherwise 0
Firm age (Log)	Number of years in business (logarithm transformed)
Firm size (Log)	Number of total employees in firms (logarithm transformed)
Gender	Gender of the firm's owner or manager. Gender = 1 if male, 0 if female
Internet usage	Internet usage = 1 if the firm uses the internet for business activities, otherwise 0

Table 2. Variables used in the analysis

Source: Own illustration

3.3 Research design

Because of the dependent variable Profit Change is binary, this study utilized logit regression to test the hypotheses. The model is described as:

$$\log\left(\frac{p_i}{1-p_i}\right) = \sum_{k=0}^{13} \beta_k x_{ik}$$

Where p_i is the probability of a change in profit and is a set of 13 explanatory and control variables. The dependent variable is binary and so maximum likelihood estimation is used (Wooldridge, 2010).

The analysis recognizes that change in profit is strongly related to innovation in firms. Firms engage in innovation as a key business activity and the outcomes of innovation can strongly influence firm performance and profit (Schumpeter, 1934; Cohen & Levinthal, 1990). But the relationship between innovation and change in profit is not direct and may be conditioned by other variables such as the legal form of the firm and training provided to workers.

A wide set of control variables are included to address possible endogeneity problems, such as age, size, gender of owner/manager, use of the Internet, location, exporting and technology. In

the analysis of the relationship between innovation and change in profit, firm age, firm size, location and legal form were taken as the key determinants. This is because larger and older firms are more likely to engage in innovation activities (Roper & Hewitt-Dundas, 2008; Freel, 2005). Similarly, it has been argued that formally established firms and those based in urban areas have better access to markets and inputs and so are more likely to engage in innovation. The base model used in this study is a generalized linear mixed model (GLMM) that includes a range of predictors and interaction terms to accommodate complex relationships between these variables and change in profit. Initially, possible endogeneity problems were addressed, because it may be the case that innovation is affected by unobserved variables that are also related to firm performance. However, some preliminary analyses suggested that multicollinearity between predictors was not problematic. Furthermore, attempts were made to include instrumental variables but this introduced problems with stability of the model and failure to converge. For these reasons, the GLMM without instrumental variables is presented. This approach is preferred for reasons of simplicity and transparency, while still providing robust findings on the key determinants of change in profit. The tests suggested that there were no severe problems with endogeneity.

3.4. Bias testing

The sample used for this analysis was created in 2005, following the methods of Cochran (1977) and Levy and Lemeshow (1999). These authors proposed techniques to select 2,864 manufacturing firms from a universe list. In order to represent all population levels and to avoid selection bias, a stratified sample was carried out (Pannucci & Wilkins, 2010). In addition, the great response rate (98%) indicates a little non-response bias (Armstrong & Overton, 1977). The survey was carried out in two stages. In the first stage, enumerators got the total list of firms from local government agencies. A preliminary list was prepared and, from that, it was revised in the following years, firms that were closed were replaced by others randomly selected from the universe (Rand & Tarp, 2007). Only firms that responded to all surveys were included in the analysis. In the second stage, face-to-face interviews were conducted at the respondents' places of business, further enhancing the response rate. This high response rate is typical of government surveys in Vietnam, where firms generally comply with data collection efforts aimed at improving policy outcomes.

In order to treat the common method bias, both Harman's single factor test and marker variable method were used. Harman's single factor test indicated that only the first factor explained 23.4% of the variance, which indicates that there is not a serious problem of common method bias. Moreover, the marker variable was not significant in the model, supporting the results found. These measures collectively ensure the reliability and validity of the data, affirming that our methodological approach is sound and that the results are trustworthy.

4. ANALYSIS & FINDING

4.1 Descriptive analysis

From the descriptive analysis in **Table 3**, the proportion of firms engaged in innovation has been changed in the 10 years between 2005 and 2015. For 2005, corporate innovation was 66.3%, but now it goes down. In 2013, the share of youthful firms had been greatly reduced, with only 19.7% of firms stating to have a youthful idea or product. In 2015, almost all firms noticed an increase in the use of new technologies. 34.4% of firms stated they have youthful ideas or products in their work. This implies that every firm has a various degree of innovation spending and innovation emphasis throughout this duration. Data collected in 2005 indicated that numerous Vietnamese firms are investing in creating and carrying out new ideas and technologies. In general, at that time, companies in the sector are concentrating on innovative ideas and tasks. Meanwhile, the Vietnamese economy grew rapidly due to globalization, and Vietnam had joined World Trade Organization (WTO) in 2007. Perhaps, the global financial crisis in 2008 and 2009 greatly impacted the Vietnamese economy. In 2017 figures from the World Bank, the crisis reached Vietnamese firms, and in some cases, it even weakened innovation. The lowest percentage in 2013 might be due to the period when Vietnam's economy was stabilizing after the crisis and the government spent much effort to restructure the economy to cure macroeconomic imbalances and inflationary pressures (General Statistics Office, 2018). Finally, in 2015, there was an increase in the percentage of firms with innovations, possibly due to Vietnam's continuous reform in economic policies to align with international norms and attract more foreign direct investment (FDI). There were also policies and mechanisms to improve the business environment and support for small and medium enterprises (SMEs) (WTO, 2018). In addition, to have innovations, firms need to be supported continuously and they must invest in innovation. This is in line with the results from recent empirical studies of innovation trends and economic determinants of firm behavior (Na & Kang, 2019).

Year	Total (company)	Have Innovation	Do not have innovation
2005	2819	1869 (66.3%)	950 (33.7%)
2007	2631	1250 (47.5%)	1381 (52.5%)
2009	2659	1187 (44.6%)	1472 (55.4%)
2011	2512	1110 (44.2%)	1402 (55.8%)
2013	2542	500 (19.7%)	2042 (80.3%)
2015	2648	911 (34.4%)	1737 (65.6%)

Table 3. Innovation overview

Source: Own illustration

4.2 Correlation matrix

Table 4 shows the descriptive statistics and the correlation matrix for all variables used in the empirical section. It can be observed that the sample is highly composed of small and medium sized firms (SMEs), the average age of the sample's firms is 11.21 years (log value = 2,42) as well as the average of employees is 8.45 (log value = 2,13). In addition, the majority of the firms are located in rural areas (60 percent) as well as organized as household firms (63%). A few further remarks can be made:

- **Profit change:** With an average value of 0.605, the profit change is a quite moderate value for the companies. Innovation is the only variable significantly related to profit change (0.057). This means that innovative companies show greater profit changes. Profit change is also related to company size (0.025) and company age (-0.058). While the former suggests that the bigger the company the greater the profit changes, the latter suggests that the older the company the smaller the profit change.

- **Innovation:** The average percentage of innovating firms is 42%. It is positively correlated with the size of the firm (0.234), implying that larger firms are more innovative and negatively correlated with the legal form (-0.152), suggesting that household businesses are less innovative. Also, it is positively correlated with Training and Export (0.079) and (0.112). Firms that spend on training and are involved in exporting activities are more innovative, suggesting that a highly skilled labor force is an important prerequisite for innovation activities and possibly to uphold international standards or to compete in global market.

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1 Profit_change	0.605	0.488												
2 Innovation	0.420	0.493	0.057***											
3 Location	0.399	0.489	-0.073***	0.046***										
4 Legal_form	0.625	0.483	0.013	-0.152***	-0.304***									
5 Export	0.069	0.2542	-0.004	0.112***	0.094***	-0.284***								
6 Training	0.169	0.375	-0.016*	0.079***	0.064***	-0.146***	0.120***							
7 Low_tech	0.645	0.478	-0.002	-0.084***	-0.004	0.007	0.074***	-0.005						
8 Medium_low	0.268	0.443	-0.002	0.060***	0.039***	-0.010	-0.063***	0.008	-0.819***					
9 Medium_high	0.025	0.157	0.009	0.031***	0.063***	-0.062***	-0.011	0.011	-0.218***	0.034***				
10 Firm_age	2.420	0.698	-0.058***	-0.095***	-0.126***	0.247***	-0.046***	-0.021**	0.036***	-0.054***	-0.036***			
11 Firm_size	2.134	1.026	0.025***	0.234***	0.262***	-0.647***	0.403***	0.197***	-0.004	0.003	0.060***	-0.148***		
12 Gender	0.633	0.481	0.013	0.052***	-0.104***	0.109***	-0.043***	-0.031***	-0.159***	0.121***	0.060***	0.036***	-0.071***	
13 Internet	0.412	0.492	0.003	0.219***	0.288***	-0.537***	0.255***	0.128***	0.009	0.014*	0.062***	-0.199***	0.522***	-0.082***

Note. Spearman correlation matrix, with associated p-values denoted by * ($p < 0.05$); ** ($p < 0.01$); and *** ($p < 0.001$).

Table 4. Correlation matrix

4.3 Inferential analysis

Table 5 presents the regression and t-test results. From the table we can see that regression analysis and t-test results indicate strong evidence that innovation has a positive effect on output changes. The beta of innovation ($\beta = 0.2144$) indicates that firms with high innovation have higher profits than firms with low innovation. The presence of a p-value less than 0.001 for this coefficient suggests that it is statistically meaningful. Additionally, in order to evaluate the general significance of the new variable, the t-test was sampled with zero as the new variable in Model 2. The t statistic is 13.55 and the p value is 1.14×10^{-41} . This p-value is also highly significant indicating that the coefficient of innovation is different from zero. In simple terms, it means that the inclusion of innovation in the regression model significantly predicts profit change. The results support the notion that innovation has a positive effect on the profitability of firms. **Therefore, H1 was accepted.**

On the other hand, location and export have a negative effect on profit change suggesting that firms located in urban area or that engage in export activities might face significant challenges. Furthermore, the result indicates size has a positive impact on profit change that the bigger the firm the higher the profit change it records on average. Overall, this study's results support the view that innovation is very crucial to firms that seek to raise their profitability. However, at the same time, they need to be cautious of the disadvantages associated with their location and export activities.

	Profit change (1)	Profit change (2)
Innovation		0.2144***
Location	-0.3807***	-0.3740***
Export	-0.1418*	-0.1515*
Low_tech	0.0271	0.0508
Medium_low	0.0052	0.0140
Medium_high	0.1391	0.1455
Firm_age (log)	-0.1887***	-0.1819***
Firm_size (log)	0.1004***	0.0843***
Gender	0.0399	0.0268

Internet	-0.0195	-0.0491
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Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Table 5. The impact of innovation on profit change

The logit regression results shown in **Table 6** confirm a strong positive relationship between innovativeness and change in profits even though the latter includes different moderating effects.

The model included legal form as a moderator in Model 3, where legal form itself is positive (0.2694) and significant, but its interaction with innovation is negative (-0.1496). This result indicates that legal form has a positive effect on profit change; however, innovation will have no effect on profit change when firm has legal form otherwise. Hence, it can be argued that family business operations may dampen the impact of innovation on profit change. **Therefore, H2 was accepted.**

The next moderator to enter is training in Model 4. The value of innovation remains significant (0.1815), but training itself has a significant negative effect on profit change (-0.2064). However, there is a positive and significant interaction between these two variables: $\beta=0.2009$ which means that training enhances the positive effect of innovation when it comes to changing profits. **Therefore, H3 was accepted**

Model 5 contains both legal form and training as moderators. The coefficient of innovation remained positive (0.2593). Moreover, the interaction term between innovation and legal form on profit change remained negative and statistically significant (-0.1337), while the interaction between innovation and training on profit change remained positive and statistically significant (0.1855). This finding validates the results obtained from Models 3 and 4, that legal form may temper the effect of innovation, but training always intensifies the effect of innovation on profit change.

Notably, despite the introduction of moderators and their variations in Models 3, 4 and 5, the main finding remains robust; innovation still has positive and statistically significant effect on profit change. The consistency across the models validates the robustness of the findings and establishes that innovation effect on profitability is robust even when the moderating effects (legal form and training) are controlled for. This therefore validates the importance of innovation on firm performance, while the moderating effects of organizational structure and workforce development were considered to be less prominent in the innovation-performance

relationship.

The results of this study support the argument that firms that innovate will have a higher change in profit than those that do not innovate. But the moderators of innovation and profit change have differential impacts on the innovation–performance relationship. The existing literature in this field has highlighted the importance of innovation for business performance. But in this study, we also considered the moderating effects of informal structure (like household business) and formal structure (like training) on innovation–performance relationship.

	Profit change (3)	Profit change (4)	Profit change (5)
Innovation	0.2990***	0.1815***	0.2593***
Location	-0.3542***	-0.3695***	-0.3502***
Export	-0.1517*	-0.1518*	-0.1505*
Low_tech	0.0390	0.0446	0.0340
Medium_low	0.0053	0.0102	0.0023
Medium_high	0.1413	0.1365	0.1338
Firm_age (log)	-0.1989***	-0.1802***	-0.1972***
Firm_size (log)	0.1291***	0.0901***	0.1350***
Gender	0.0210	0.0250	0.0190
Internet	0.0032	-0.0449	0.0067
Legal form	0.2694***		0.2623***
Training		-0.2064***	-0.1979***
Innovation * Legal form	-0.1496*		-0.1337*
Innovation * Training		0.2009**	0.1855*

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Table 6. The impact of legal form and training on the relationship between innovation and firm performance

4.4 Robustness testing

We tested the robustness of our findings by treating innovation, training, and legal form as endogenous variables in separate models and comparing the interaction terms' coefficients

using t-tests. Innovation had a positive and significant impact on profit change in all models and therefore confirmed as the main variable to influence the improvement of firms' profitability. On the other hand, both legal form and training were statistically significant in influencing profit change. That is, the spillovers from innovation might enhance when interaction effects with training activities and suitable legal form are present. The t-test for the interaction terms indicated a t-value of 3.60 and $p = 0.00031$ which confirms the robustness of our results. The results support the notion that the moderating effects are valid and not just a mere statistical anomaly. In this way, the results of this study support the robustness of these moderating effects and validate that training and legal form as moderators have identical effects on the relationship between profit change and innovation; thus, emphasizing them towards profitability through innovation.

5. DISCUSSION

The estimation results of this study provide several key empirical findings on the relationships between innovation and firm performance which are moderated by legal form and training in Vietnamese SME.

First, consistent with prior empirical literature, innovation is positively related to firm performance. This result is consistent with the vast prior literature which has emphasized the critical role of innovation in competitive advantage and financial performance. Schumpeter (1934) posited that innovation is the primary catalyst for economic growth and firm profitability. Recent empirical studies, such as Artz et al. (2010) and Calantone et al. (2002), examined this proposition and provided additional evidence that innovative firms outperform non-innovative firms. Our results support this evidence, and show that innovation activities influence significantly higher means for each of the firm performance variables.

We also discover that firm legal form, which is household business, moderates the positive relationship between innovation and firm performance. This result implies that resource and structure constraints of household businesses hinder firms from gaining benefits from innovation activities. Household businesses are often characterized by disadvantages such as limited access to finance, less formal organization and constrained human resources (Bennett & Estrin, 2009; Welter, 2011). These disadvantages hinder the gains of innovation, and as a result it is more difficult for these firms to achieve high firm performance from innovation. This corroborates the evidence of Westhead and Howorth (2006), who showed that small family

businesses often find it difficult to grow and to sustain innovation compared with larger more formalized firms.

Moreover, our results show that the investment in training plays an important role in augmenting the positive relation between innovation and firm performance. This finding is consistent with human capital theory (Becker, 1964), which argues that firms should invest in employee training to enhance their human capital and, thus, productivity and performance. Similarly, Huselid (1995) also found that comprehensive training has a direct significant effect on organizational performance because it generates a highly skilled and flexible workforce. Moreover, Amabile (1996) argued that training programs that enhance creative problem solving and work flexibility can enhance a firm's innovative abilities and enhance performance. Our findings support these arguments and show that firms that engage in the firm-internal effective training program can better exploit their innovativeness and achieve higher performance levels. Without this complementary activity the positive effect of innovation on performance will be much lower.

The findings of this research are consistent with previous empirical studies and support the priori that both innovation and human resource practices influence firm performance. For instance, Damanpour and Evan (1984) as well as Zahra and Covin (1995) demonstrate that innovation stands as a critical determinant of firm performance and sustainable competitive advantage. Our findings expand previous research by showing the moderating effect of legal form and training. In particular, the negative moderation of household business status on the innovation-performance relationship is in line with the small business literature (Welter, 2011; Bennett & Estrin, 2009). Furthermore, the positive moderation of training on the innovation-performance relationship supports the view that the development of human capital is crucial to maintain the positive effects of innovation on firm performance.

In addition, a major contribution to the development of employment and GDP is made by Vietnamese SMEs (OECD, 2019; Tuan, 2020). However, they face peculiar challenges that may inhibit their ability to innovate and expand. This recognition has been done by Vietnam and relevant programs are now in place. These include financial incentives, simplification of regulatory procedures and investment in infrastructure for business operations (Nguyen et al., 2023; World Bank, 2019). Nevertheless, problems still persist despite these efforts. Many SMEs are unable to access finance for investment in innovation and expansion (Beck et al.,

2005). The current state of the regulatory environment is positive though it imposes considerable difficulties on small businesses mainly burdening them with compliance and administrative requirements (OECD, 2019). Henceforth, Vietnamese SMEs face prospects as well as threats. The development of trade agreements with the global market implies a rise in growth opportunities for new markets in Vietnam (Vietnam Briefing, 2020). However, it will only be possible if companies work on enhancing their capabilities in terms of innovation and quickly adapt to fluctuating market conditions. Sustainable business growth can be attained if the government still commits to supporting small business development by allocating financial resources, training as well as infrastructure for them (Vietnam Ministry of Planning and Investment, 2022).

6. CONCLUSION

6.1 Theoretical contribution

This paper contributes to the innovation-firm performance literature, especially in the context of SMEs in a developing country (Vietnam).

Firstly, despite the previous studies have shown positive effects of innovation on firm performance (Rosenbusch et al., 2011), this paper adds incremental value to the literature by investigating the moderating effects of legal form and employee training on the innovation-firm performance relationship. The negative moderating effect of legal form on the innovation-firm performance relationship supports the resource-based view (RBV) that firm's rare and valuable resources and capabilities, including organizational structure, greatly influence competitive advantage (Barney, 1991). Household businesses typically have limited and informal organizational structures and resources, and thus may not be able to fully leverage innovation as formal business organizations (Chrisman et al., 2011). This paper contributes to the literature a better understanding of how internal aspects of SMEs influence innovation and firm performance.

Secondly, this paper contributes to the literature by studying Vietnamese SMEs, in which most previous studies have focused on developed countries. The developing country context, including Vietnam, offers different economic, regulatory, and cultural conditions which influence the innovation-performance relationship. Most previous studies have ignored the special difficulties and opportunities of SMEs in such contexts, such as access to finance, institutional barriers, and market conditions (Ayyagari et al., 2011). This paper's results support

the importance of context when studying firm performance determinants, and thus contributes to a better understanding of innovation in different economic and institutional contexts.

Finally, the results of this paper's negative moderation effect of employee training on the innovation-firm performance relationship contribute to the increasing number of studies focusing on human capital and innovation. According to the human capital theory, investments in employee training improve the ability and skills of workforce, which stimulates innovation and enhances firm performance (Lepak & Snell, 1999). This paper provides evidence supporting this theory, in which firms investing in training programs are able to better leverage innovation to attain higher firm performance. This highlights the need for learning and development to create an innovative culture in SMEs (Barrett & Mayson, 2008). This kind of culture is necessary for continuous improvement and adapting to market changes. It creates an environment where employees feel valued and want to contribute to the organization's innovation efforts and hence new products, processes and business models (Martin & Terblanche, 2003).

6.2 Managerial contribution

The findings of this paper suggest some practical contributions for SME managers in developing countries such as Vietnam to utilize innovation for achieving firm performance.

Firstly, this research indicates that moving towards more formal business structures could help firms better exploit innovation. Household business managers and other informal business owners often struggle with considerable disadvantages in terms of resource access, strategic initiative implementation, and long-term innovation maintenance (Cruz et al., 2012). With more formal business structures, such as a limited liability company or a joint stock company, firms could establish better governance and have extended access to financial funding sources, as well as effectively prevent intellectual property theft. In doing so, SMEs may be able to more thoroughly exploit the outcomes of their innovation activities, thus improving overall firm performance in economic profit terms.

Secondly, this study points out the importance of employee training in driving innovation and enhancing economic-financial performance. Holistic training activities that build technical skills as well as creative thinking capabilities can greatly improve a company's innovation capacity (De Grip & Sauermann, 2012). Business managers should focus on learning and development activities, and ensure that their employees and workers are able to constantly keep

up with the latest advancements in technology and processes. Such investments in human resources to enhance innovation capacities will also result in higher financial returns in terms of productivity and efficiency, which ultimately translates into better profitability.

Additionally, this study suggests some implications regarding the effects of innovation on financial performance. Therefore business managers need to think in a more strategic way to manage innovation and realize that in order to obtain successful innovation an integrated business strategy approach is necessary. On the one hand process innovation can be used to improve business practices and to reduce production costs in this way obtain higher profit margins. On the other hand, product innovation generates new revenue streams and obtains larger market share (Birkinshaw et al., 2008). By matching innovation activities with financial goals, managers can ensure that their innovation endeavors contribute to long-term profitability (Davila et al., 2006).

Finally, due to the presence of contextual innovation barriers in developing economies, the results of this study suggest that SMEs in such regions should actively seek ways to overcome these obstacles. For example, limited access to financial resources, regulatory problems, and market uncertainty could slow down innovation activities (Beck et al., 2005). Business managers should take advantage of government initiatives and financial tools such as low-cost loans and grants that aim to help SMEs engage in innovation activities. Furthermore, networks and partnerships with other companies, research organizations, and industry associations could offer valuable resources and knowledge to facilitate firm innovation. Such collaborative activities could enable SMEs to better overcome external barriers and exploit new sources of opportunity, which in turn improves their financial performance.

6.3 Limitation

Despite the comprehensive nature described above, this study has some limitations. First, since the study is conducted for Vietnamese SMEs, the results could not be applied to firms from other countries. For example, firms from other countries may be affected by different national contexts in terms of economic development, cultural norms and values, and institutional voids. For instance, the effect of legal system and financial development in Vietnam might spill over to the role of industrial design protection. Secondly, the data was based on self-reported information from SME owners and managers. There could be some bias when respondents complete the questionnaire. For example, they may over or under-exaggerate the truth about

their engagement in different innovation activities. Third, the data was not collected for this study so some variables of interest may not be exactly aligned with our research objectives (Smith, 2008). Using secondary data means we have no control over the data collection process and any errors or biases in the original data collection will be brought into this study (Johnston, 2014). And secondary data gives us more time and space but not the depth and context of primary data (Vartanian, 2011). So future research should combine secondary data analysis with primary data collection methods like interviews or case studies to get a deeper understanding of innovation in Vietnamese SMEs. Fourth, while this study tests the moderating roles of legal form and employee training, there could be other moderators that are important and were not considered in this study. For instance, market competition, technological change and government policy might influence the way the relationship between innovation and firm performance is manifested. Therefore, it is pertinent for future studies to consider other moderators. Finally, this study adopts a general definition and measure of innovation (only product and process innovation). An interesting avenue for future research is to conceptualize and operationalize innovation as a multidimensional construct and to investigate whether different types of innovation have different effects on firm performance.

6.4 Conclusion & Recommendation

In this study, we have investigated the link between innovation and firm performance within Vietnamese SMEs, emphasizing the moderating roles of legal form and employee training. The study findings indicated that there are some determinants which have a significant impact on the firm performance including firm size, firm age, location and other characteristics. This evidence supports the relevance of innovation to firm competitive strategy and financial performance. Moreover, study findings indicated that the legal form of the firm either increases or decreases the benefit from innovation activities. Regarding access to finance and lack of formal management practices, household enterprises have been found to be more disadvantaged compared to all other types of businesses. The positive association between innovation and performance can be diminished by this constraint.

Firms and other more formal business organizations are better placed to exploit the gains of innovative activities. Employee training is considered to be a relevant moderating variable between innovation and firm performance. Firms that engage in different training practices can

enhance their innovative activities and hence perform better. Trained employees can create and sustain innovation, and as a result, can lead to better firm performance.

It is evident that Vietnamese SMEs should enhance finance accessibility via specific financial instruments such as low-interest loans and grants that aid their innovative projects. They should formalize their business form to obtain better resources and governance arrangements that boost the positive impact of innovation. The firms should engage in training of their employees especially those that develop technical and creative problem-solving skills to boost their innovative activities. Furthermore, to enable the SMEs to access the latest innovative technologies and best practices, an innovation ecosystem should be created through collaboration with research institutions and industry associations. Regulation procedures should be simplified and market access enhanced through export assistance and networking. These suggestions will allow Vietnamese SMEs to better exploit the moderating effects of legal form and training on their innovation activities. Last but not least, to enhance innovation of Vietnamese SMEs, financial, structural and human capital barriers that SMEs face should be removed, as a consequence, they can improve their overall performance in the competitive business environment.

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Appendix:

```
## Insert dataset ##  
SLDN_2005 <- read_csv("SLDN 2005.csv")  
SLDN_2007 <- read_csv("SLDN 2007.csv")  
SLDN_2009 <- read_csv("SLDN 2009.csv")  
SLDN_2011 <- read_csv("SLDN 2011.csv")  
SLDN_2013 <- read_csv("SLDN 2013.csv")  
SLDN_2015 <- read_csv("SLDN 2015.csv")  
data_2005 <- SLDN_2005  
data_2007 <- SLDN_2007  
data_2009 <- SLDN_2009  
data_2011 <- SLDN_2011  
data_2013 <- SLDN_2013  
data_2015 <- SLDN_2015  
library(readr)  
library(tidyr)  
library(dplyr)  
library("reshape2")  
library(tidyverse)  
library(ggplot2)  
library(plm)  
library(psych)  
library(lme4)  
library(lmerTest)  
library(Hmisc)  
library(xtable)  
library(AER)  
library(car)
```



```
#### Extract raw data #####
subset_2005 <- data_2005[, c("q1_05", "Eq1a03", "Eq1h03", "Eq1v03", "Eq1a04", "Eq1h04",
"Eq1v04", "q6ab_05", "q3be_05", "q12_05", "q17ba2_05", "q47a_05", "q81a_05",
"q134a_05", "q135a_05", "q136a_05", "q2c_05", "q57e_05")]
colnames(subset_2005) <- c("ID", "Revenue_03", "Profit_03", "Workforce_03",
"Revenue_04", "Profit_04", "Workforce_04", "Firm_age", "Location", "Legal_form",
"Industry", "Export", "Training", "INNO1", "INNO2", "INNO3", "Gender", "Internet")
subset_2005 <- subset_2005 %>%
  mutate(across(c(INNO1, INNO2, INNO3), .fns = ~replace(.x, .x == 2, 0)))
subset_2005$Location <- ifelse(subset_2005$Location %in% c(1, 31, 79), 1, 0)
subset_2005$Legal_form <- ifelse(subset_2005$Legal_form == 1, 1, 0)
subset_2005$Export <- ifelse(subset_2005$Export == 1, 1, 0)
subset_2005$Training <- ifelse(subset_2005$Training == 1, 1, 0)
subset_2005$Gender <- ifelse(subset_2005$Gender == 1, 1, 0)
subset_2005$Internet <- ifelse(subset_2005$Internet > 0, 1, 0)
subset_2005 <- subset_2005 %>%
  mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
         Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
         Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999 | Industry >= 3110 & Industry <= 3209 | Industry >= 3410 & Industry <= 3609,
1, 0),
         High_tech = ifelse(Industry >= 3000 & Industry <= 3109 | Industry >= 3210 & Industry
<= 3409 | Industry == 2100 | Industry == 2433, 1, 0))
subset_2005$Technology <- ifelse(subset_2005$Low_tech == 1 | subset_2005$Medium_low
== 1 | subset_2005$Medium_high == 1 | subset_2005$High_tech == 1, 1, 0)
subset_2005$Innovation <- ifelse(subset_2005$INNO1 == 1 | subset_2005$INNO2 == 1 |
subset_2005$INNO3 == 1, 1, 0)
subset_2005_long <- subset_2005 %>%
  gather(key = "Metric", value = "Value", Revenue_03, Revenue_04, Profit_03, Profit_04,
Workforce_03, Workforce_04) %>%
```

```

separate(Metric, into = c("Variable", "Year"), sep = "_") %>%
spread(key = "Variable", value = "Value")
subset_2005_long <- subset_2005_long %>%
select(ID, Year, Revenue, Profit, Workforce, everything())
subset_2007 <- data_2007[,
c("q1_07", "Eq1a05", "Eq1i05", "Eq1x05", "Eq1a06", "Eq1i06", "Eq1x06", "q6a_07", "province",
"q12_07", "q17a_4ds_07", "q44_07", "q76_07",
"q129_07", "q130_07", "q131_07", "q2c_07", "q3d_07")]
colnames(subset_2007) <- c("ID", "Revenue_05", "Profit_05", "Workforce_05",
"Revenue_06", "Profit_06", "Workforce_06", "Firm_age", "Location",
"Legal_form", "Industry", "Export", "Training", "INNO1", "INNO2",
"INNO3", "Gender", "Internet")
subset_2007$Location <- ifelse(subset_2007$Location %in% 1:3, 1, 0)
subset_2007$Legal_form <- ifelse(subset_2007$Legal_form == 1, 1, 0)
subset_2007$Innovation <- ifelse(subset_2007$INNO1 == 1 | subset_2007$INNO2 == 1 |
subset_2007$INNO3 == 1, 1, 0)
subset_2007 <- subset_2007 %>%
mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999 | Industry >= 3110 & Industry <= 3209 | Industry >= 3410 & Industry <= 3609,
1, 0),
High_tech = ifelse(Industry >= 3000 & Industry <= 3109 | Industry >= 3210 & Industry
<= 3409 | Industry == 2100 | Industry == 2433, 1, 0))
subset_2007$Technology <- ifelse(subset_2007$Low_tech == 1 | subset_2007$Medium_low
== 1 | subset_2007$Medium_high == 1 | subset_2007$High_tech == 1, 1, 0)
subset_2007_long <- subset_2007 %>%
gather(key = "Metric", value = "Value", Revenue_05, Revenue_06, Profit_05, Profit_06,
Workforce_05, Workforce_06) %>%
separate(Metric, into = c("Variable", "Year"), sep = "_") %>%

```

```

spread(key = "Variable", value = "Value")
subset_2007_long <- subset_2007_long %>%
  select(ID, Year, Revenue, Profit, Workforce, everything())
subset_2009 <- data_2009[,
c("q1_09", "EAq1a07", "EAq1i07", "EAq1x07", "EAq1a08", "EAq1i08", "EAq1x08", "q6a_09",
q3be_09", "q12a_09", "q17a_4ds_09", "q44_09", "q76_09", "q129_09", "q130_09", "q131_09", "q
2c_09", "q3d_09")]
colnames(subset_2009) <- c("ID", "Revenue_07", "Profit_07", "Workforce_07",
"Revenue_08", "Profit_08", "Workforce_08", "Firm_age", "Location",
"Legal_form", "Industry", "Export", "Training", "INNO1", "INNO2",
"INNO3", "Gender", "Internet")
subset_2009$Location <- ifelse(subset_2009$Location %in% c(1, 31, 79), 1, 0)
subset_2009$Legal_form <- ifelse(subset_2009$Legal_form == 1, 1, 0)
subset_2009$Export <- ifelse(subset_2009$Export == 1, 1, 0)
subset_2009$Export <- ifelse(subset_2009$Export == 1, 1, 0)
subset_2009$Innovation <- ifelse(subset_2009$INNO1 == 1 | subset_2009$INNO2 == 1 |
subset_2009$INNO3 == 1, 1, 0)
subset_2009 <- subset_2009 %>%
  mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
    Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
    Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999 | Industry >= 3110 & Industry <= 3209 | Industry >= 3410 & Industry <= 3609,
1, 0),
    High_tech = ifelse(Industry >= 3000 & Industry <= 3109 | Industry >= 3210 & Industry
<= 3409 | Industry == 2100 | Industry == 2433, 1, 0))
subset_2009$Technology <- ifelse(subset_2009$Low_tech == 1 | subset_2009$Medium_low
== 1 | subset_2009$Medium_high == 1 | subset_2009$High_tech == 1, 1, 0)
subset_2009_long <- subset_2009 %>%
  gather(key = "Metric", value = "Value", Revenue_07, Revenue_08, Profit_07, Profit_08,
Workforce_07, Workforce_08) %>%

```

```

separate(Metric, into = c("Variable", "Year"), sep = "_") %>%
spread(key = "Variable", value = "Value")
subset_2009_long <- subset_2009_long %>%
select(ID, Year, Revenue, Profit, Workforce, everything())
subset_2011 <- data_2011[,
c("q1_11", "EAq1a09", "EAq1i09", "EAq1x09", "EAq1a10", "EAq1i10", "EAq1x10", "q6a_11",
q3be_11", "q12a_11", "q17a_4ds_11", "q46_11", "q104a_11",
"q122_11", "q123_11", "q124_11", "q2c_11", "q3d_11")]
colnames(subset_2011) <- c("ID", "Revenue_09", "Profit_09", "Workforce_09",
"Revenue_10", "Profit_10", "Workforce_10", "Firm_age", "Location",
"Legal_form", "Industry", "Export", "Training", "INNO1", "INNO2",
"INNO3", "Gender", "Internet")
subset_2011$Location <- ifelse(subset_2011$Location %in% c(1, 31, 79), 1, 0)
subset_2011$Legal_form <- ifelse(subset_2011$Legal_form == 1, 1, 0)
subset_2011$Export <- ifelse(subset_2011$Export == 1, 1, 0)
subset_2011$Training <- ifelse(subset_2011$Training == 1, 1, 0)
subset_2011$Innovation <- ifelse(subset_2011$INNO1 == 1 | subset_2011$INNO2 == 1 |
subset_2011$INNO3 == 1, 1, 0)
subset_2011 <- subset_2011 %>%
mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999 | Industry >= 3110 & Industry <= 3209 | Industry >= 3410 & Industry <= 3609,
1, 0),
High_tech = ifelse(Industry >= 3000 & Industry <= 3109 | Industry >= 3210 & Industry
<= 3409 | Industry == 2100 | Industry == 2433, 1, 0))
subset_2011$Technology <- ifelse(subset_2011$Low_tech == 1 | subset_2011$Medium_low
== 1 | subset_2011$Medium_high == 1 | subset_2011$High_tech == 1, 1, 0)
subset_2011_long <- subset_2011 %>%

```

```

gather(key = "Metric", value = "Value", Revenue_09, Revenue_10, Profit_09, Profit_10,
Workforce_09, Workforce_10) %>%
  separate(Metric, into = c("Variable", "Year"), sep = "_") %>%
  spread(key = "Variable", value = "Value")
subset_2011_long <- subset_2011_long %>%
  select(ID, Year, Revenue, Profit, Workforce, everything())
subset_2013 <- data_2013[,
c("q1_13", "EAq1a11", "EAq1i11", "EAq1x11", "EAq1a12", "EAq1i12", "EAq1x12", "q6a_13",
q3be_13", "q12a_13", "q17a_4ds_13", "q46_13", "q104a_13", "q122_13", "q123_13", "q124_13",
"q2c_13", "q3d_13")]
colnames(subset_2013) <- c("ID", "Revenue_11", "Profit_11", "Workforce_11",
"Revenue_12", "Profit_12", "Workforce_12", "Firm_age", "Location",
"Legal_form", "Industry", "Export", "Training", "INNO1", "INNO2",
"INNO3", "Gender", "Internet")
subset_2013$Location <- ifelse(subset_2013$Location %in% c(1, 31, 79), 1, 0)
subset_2013$Legal_form <- ifelse(subset_2013$Legal_form == 1, 1, 0)
subset_2013$Export <- ifelse(subset_2013$Export == 1, 1, 0)
subset_2013$Training <- ifelse(subset_2013$Training == 1, 1, 0)
subset_2013$Innovation <- ifelse(subset_2013$INNO1 == 1 | subset_2013$INNO2 == 1 |
subset_2013$INNO3 == 1, 1, 0)
subset_2013 <- subset_2013 %>%
  mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
         Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
         Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999 | Industry >= 3110 & Industry <= 3209 | Industry >= 3410 & Industry <= 3609,
1, 0),
         High_tech = ifelse(Industry >= 3000 & Industry <= 3109 | Industry >= 3210 & Industry
<= 3409 | Industry == 2100 | Industry == 2433, 1, 0))
subset_2013$Technology <- ifelse(subset_2013$Low_tech == 1 | subset_2013$Medium_low
== 1 | subset_2013$Medium_high == 1 | subset_2013$High_tech == 1, 1, 0)

```

```

subset_2013_long <- subset_2013 %>%
  gather(key = "Metric", value = "Value", Revenue_11, Revenue_12, Profit_11, Profit_12,
Workforce_11, Workforce_12) %>%
  separate(Metric, into = c("Variable", "Year"), sep = "_") %>%
  spread(key = "Variable", value = "Value")
subset_2013_long <- subset_2013_long %>%
  select(ID, Year, Revenue, Profit, Workforce, everything())
subset_2015 <- data_2015[,
c("q1_15","EAq1a13","EAq1e13","EAq1k13","EAq1a14","EAq1e14","EAq1k14","q6a_15",
"q3ce1_15","q12a_15","q17a_4ds_15","q51_15","q95a_15",
"q121_15","q122_15","q123_15","q2c_15","q3e_15")]
colnames(subset_2015) <- c("ID", "Revenue_13", "Profit_13", "Workforce_13",
"Revenue_14", "Profit_14", "Workforce_14", "Firm_age", "Location",
"Legal_form","Industry","Export","Training", "INNO1", "INNO2",
"INNO3","Gender","Internet")
subset_2015$Location <- ifelse(subset_2015$Location %in% c(1, 31, 79), 1, 0)
subset_2015$Legal_form <- ifelse(subset_2015$Legal_form == 1, 1, 0)
subset_2015$Export <- ifelse(subset_2015$Export == 1, 1, 0)
subset_2015$Training <- ifelse(subset_2015$Training == 1, 1, 0)
subset_2015$Innovation <- ifelse(subset_2015$INNO1 == 1 | subset_2015$INNO2 == 1 |
subset_2015$INNO3 == 1, 1, 0)
subset_2015 <- subset_2015 %>%
  mutate(Low_tech = ifelse(Industry >= 0 & Industry <= 2299 | Industry >= 3610, 1, 0),
Medium_low = ifelse(Industry >= 2511 & Industry <= 2999 | Industry >= 2310 & Industry
<= 2410, 1, 0),
Medium_high = ifelse(Industry >= 2411 & Industry <= 2510 | Industry >= 2911 &
Industry <= 2999| Industry >= 3110 & Industry <= 3209| Industry >= 3410 & Industry <= 3609,
1, 0),
High_tech = ifelse(Industry >= 3000 & Industry <=3109| Industry >= 3210 & Industry
<=3409 | Industry == 2100| Industry == 2433, 1, 0))

```

```

subset_2015$Technology <- ifelse(subset_2015$Low_tech == 1 | subset_2015$Medium_low
== 1 | subset_2015$Medium_high == 1 | subset_2015$High_tech == 1, 1, 0)
subset_2015_long <- subset_2015 %>%
  gather(key = "Metric", value = "Value", Revenue_13, Revenue_14, Profit_13, Profit_14,
Workforce_13, Workforce_14) %>%
  separate(Metric, into = c("Variable", "Year"), sep = "_") %>%
  spread(key = "Variable", value = "Value")
subset_2015_long <- subset_2015_long %>%
  select(ID, Year, Revenue, Profit, Workforce, everything())
merged_dataset <- bind_rows(subset_2005_long, subset_2007_long, subset_2009_long,
subset_2011_long, subset_2013_long, subset_2015_long)
merged_dataset <- merged_dataset[, !names(merged_dataset) %in% c("Technology",
"Industry")]
merged_dataset <- merged_dataset %>%
  filter(Revenue > 100 & !is.na(Revenue))
merged_dataset <- distinct(merged_dataset)
knitr::opts_chunk$set(echo = TRUE)
merged_dataset <- merged_dataset %>%
  mutate(panel_ID = paste0(ID, Firm_age))
merged_dataset <- merged_dataset %>%
  mutate(Year = as.numeric(Year))
# Applying the calculation to the entire dataset for Revenue, Profit, and Workforce
result <- merged_dataset %>%
  arrange(panel_ID, Year) %>%
  group_by(panel_ID) %>%
  mutate(
    # Manually calculating lags
    Revenue_Lag = c(NA, head(Revenue, n = -1)),
    Profit_Lag = c(NA, head(Profit, n = -1)),
    # Calculating change ratios
    REVENUE_CHANGE_RATIO = (Revenue - Revenue_Lag) / Revenue_Lag,

```

```

    PROFIT_CHANGE_RATIO = (Profit - Profit_Lag) / Profit_Lag,
  ) %>% ungroup()
result <- result %>%
  select(-Revenue_Lag, -Profit_Lag)
result[result == Inf] <- NA
result <- na.omit(result)
result$Year <- sapply(result$Year, function(x) {
  if (nchar(x) == 1) {
    return(as.numeric(paste0("200", x)))
  } else if (nchar(x) == 2) {
    return(as.numeric(paste0("20", x)))
  } else {
    return(as.numeric(x))
  }
})
result$Firm_age_calculated <- result$Year - result$Firm_age
result <- result %>%
  select(-Firm_age, firm_age = Firm_age_calculated)
result <- result %>%
  mutate(firm_age = log(firm_age + 1))
result <- result %>%
  mutate(panel_ID = paste0(ID, Year))
result$firm_size <- log(result$Workforce + 1)
result <- result %>%
  mutate(Training = ifelse(Training == 1, 1, 0))
result <- result %>%
  mutate(Revenue_change = ifelse(REVENUE_CHANGE_RATIO > 0, 1, 0))
result <- result %>%
  mutate(Profit_change = ifelse(PROFIT_CHANGE_RATIO > 0, 1, 0))

##### Bias testing #####

```



```

data_to_test <- result[, c("Innovation", "Location", "Legal_form", "Export", "Training",
"Low_tech", "Medium_low", "Medium_high", "firm_age", "firm_size", "Gender", "Internet")]
# Perform PCA without rotation
pca_result <- principal(data_to_test, nfactors = 1, rotate = "none")
# Print the PCA result
print(pca_result)
# Extract the proportion of variance explained by the first factor
variance_explained <- pca_result$values[1] / sum(pca_result$values)
variance_explained
# Marker Variable
set.seed(123) # For reproducibility
result$marker_var <- sample(1:5, nrow(result), replace = TRUE)
logit_model_marker <- glmer(Revenue_change ~ Innovation + Location + Legal_form +
Export + Training + Low_tech + Medium_low + Medium_high + firm_age + firm_size +
Gender + Internet + marker_var + (1 | panel_ID),
family = binomial("logit"),
data = result)
summary(logit_model_marker)

##### Running analysis #####
### Model 1: Only control variables
model.1 <- glmer(Profit_change ~ Location + Export + Low_tech + Medium_low +
Medium_high + firm_age + firm_size + Gender + Internet + (1 | panel_ID),
family = binomial("logit"),
data = result)
summary(model.1)
### Model 2: Control variables + Innovation
model.2 <- glmer(Profit_change ~ Innovation + Location + Export + + Low_tech +
Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + (1 | panel_ID),
family = binomial("logit"),
data = result)

```

```

summary(model.2)
### Model 3: Control variables + Innovation + Legal_form
model.3 <- glmer(Profit_change ~ Innovation + Location + Legal_form + Export + Low_tech
+ Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + Innovation *
Legal_form + (1 | panel_ID),
              family = binomial("logit"),
              data = result)
summary(model.3)
### Model 4: Control variables + Innovation + Training
model.4 <- glmer(Profit_change ~ Innovation + Location + Export + Training + Low_tech +
Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + Innovation *
Training + (1 | panel_ID),
              family = binomial("logit"),
              data = result)
summary(model.4)
### Model 5: Control variables + Innovation + Training + Legal_form
model.5 <- glmer(Profit_change ~ Innovation + Location + Legal_form + Export + Training +
Low_tech + Medium_low + Medium_high + firm_age + firm_size + Gender + Internet +
Innovation * Legal_form + Innovation * Training + (1 | panel_ID),
              family = binomial("logit"),
              data = result)
summary(model.5)
### Correlation matrix #####
selected_columns <- result %>% select(Profit_change, Innovation, Location, Legal_form,
Export, Training, Low_tech, Medium_low, Medium_high, firm_age, firm_size, Gender,
Internet)
cor_matrix <- rcorr(as.matrix(selected_columns))
cor_coeff <- cor_matrix$r
cor_pvalues <- cor_matrix$p
corstars <- function(r, p) {
  m <- ifelse(p < .001, "****", ifelse(p < .01, "***", ifelse(p < .05, "**", " ")))

```

```

r <- formatC(r, format = "f", digits = 3)
return(paste0(r, m))
}
formatted_cor <- mapply(corstars, cor_coeff, cor_pvalues)
formatted_cor_matrix <- matrix(formatted_cor, nrow = nrow(cor_coeff), ncol =
ncol(cor_coeff), dimnames = dimnames(cor_coeff))
# Calculate mean and SD for each variable
mean_sd <- data.frame(
  Mean = colMeans(selected_columns, na.rm = TRUE),
  SD = apply(selected_columns, 2, sd, na.rm = TRUE)
)
# Combine mean, SD, and correlation matrix
formatted_cor_df <- as.data.frame(formatted_cor_matrix)
formatted_cor_df <- cbind(mean_sd, formatted_cor_df)
output_file <- "correlation_matrix.html"
sink(output_file)
cat("<table border='1'>\n")
cat("<tr><th></th><th>Mean</th><th>SD</th>")
for (colname in colnames(formatted_cor_df)[-c(1,2)]) {
  cat("<th>", colname, "</th>")
}
cat("</tr>\n")
for (i in 1:nrow(formatted_cor_df)) {
  cat("<tr><td align='right'>", rownames(formatted_cor_df)[i], "</td>")
  for (j in 1:ncol(formatted_cor_df)) {
    cat("<td align='right'>", formatted_cor_df[i, j], "</td>")
  }
  cat("</tr>\n")
}
cat("</table>\n")

```

```

cat("<p>Note: Spearman correlation matrix, with associated p-values denoted by * (p < 0.05);
** (p < 0.01); and *** (p < 0.001)</p>")
sink()
cat("The correlation matrix has been saved to", output_file, "\n")
##### t test #####
# Extract coefficients and standard errors from model.2
summary_model.2 <- summary(model.2)
coefficients <- summary_model.2$coefficients
beta_innovation <- coefficients["Innovation", "Estimate"]
se_innovation <- coefficients["Innovation", "Std. Error"]
beta_location <- coefficients["Location", "Estimate"]
se_location <- coefficients["Location", "Std. Error"]
# Calculate t-statistic
t_statistic <- (beta_innovation - beta_location) / sqrt(se_innovation^2 + se_location^2)
# Degrees of freedom (approximation, often n - k - 1)
df <- nrow(result) - length(coefficients) - 1
# Calculate p-value
p_value <- 2 * pt(-abs(t_statistic), df = df)
# Output the results
t_statistic
p_value
##### Robustness test #####
# Model with Innovation as an endogenous variable
model_innovation <- glmer(Profit_change ~ Innovation + Location + Legal_form + Export +
Low_tech + Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + (1 |
panel_ID),
family = binomial("logit"),
data = result)
summary(model_innovation)
# Model with Training as an endogenous variable

```

```

model_training <- glmer(Profit_change ~ Training + Location + Legal_form + Export +
Low_tech + Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + (1 |
panel_ID),
      family = binomial("logit"),
      data = result)
summary(model_training)
coef_innovation <- coef(summary(model_innovation))["Innovation", "Estimate"]
se_innovation <- coef(summary(model_innovation))["Innovation", "Std. Error"]
coef_training <- coef(summary(model_training))["Training", "Estimate"]
se_training <- coef(summary(model_training))["Training", "Std. Error"]

t_value <- (coef_innovation - coef_training) / sqrt(se_innovation^2 + se_training^2)
p_value <- 2 * (1 - pnorm(abs(t_value)))
print(paste("t-value: ", t_value))
print(paste("p-value: ", p_value))
# Model with Legal Form as an endogenous variable
model_legal_form <- glmer(Profit_change ~ Legal_form + Location + Export + Low_tech +
Medium_low + Medium_high + firm_age + firm_size + Gender + Internet + (1 | panel_ID),
      family = binomial("logit"),
      data = result)
summary(model_legal_form)
# Extracting coefficients and standard errors for Legal_form and Innovation
coef_legal_form <- coef(summary(model_legal_form))["Legal_form", "Estimate"]
se_legal_form <- coef(summary(model_legal_form))["Legal_form", "Std. Error"]
coef_innovation <- coef(summary(model_innovation))["Innovation", "Estimate"]
se_innovation <- coef(summary(model_innovation))["Innovation", "Std. Error"]
# Calculating t-value and p-value for the comparison between Legal_form and Innovation
t_value_legal_form <- (coef_legal_form - coef_innovation) / sqrt(se_legal_form^2 +
se_innovation^2)
p_value_legal_form <- 2 * (1 - pnorm(abs(t_value_legal_form)))
# Print the results

```

```

print(paste("t-value: ", t_value_legal_form))
print(paste("p-value: ", p_value_legal_form))
model_interaction_training <- glmer(Profit_change ~ Innovation + Training + Location +
Export + Low_tech + Medium_low + Medium_high + firm_age + firm_size + Gender + Internet
+ Innovation * Training + (1 | panel_ID),
      family = binomial("logit"),
      data = result)
summary(model_interaction_training)
model_interaction_legal_form <- glmer(Profit_change ~ Innovation + Legal_form + Location
+ Export + Low_tech + Medium_low + Medium_high + firm_age + firm_size + Gender +
Internet + Innovation * Legal_form + (1 | panel_ID),
      family = binomial("logit"),
      data = result)
summary(model_interaction_legal_form)
# Extract coefficients and standard errors for interaction terms
coef_innovation_training <-
coef(summary(model_interaction_training))["Innovation:Training", "Estimate"]
se_innovation_training <- coef(summary(model_interaction_training))["Innovation:Training",
"Std. Error"]
coef_innovation_legal_form <-
coef(summary(model_interaction_legal_form))["Innovation:Legal_form", "Estimate"]
se_innovation_legal_form <-
coef(summary(model_interaction_legal_form))["Innovation:Legal_form", "Std. Error"]
# Calculate t-value and p-value for the comparison between interaction terms
t_value_interaction <- (coef_innovation_training - coef_innovation_legal_form) /
sqrt(se_innovation_training^2 + se_innovation_legal_form^2)
p_value_interaction <- 2 * (1 - pnorm(abs(t_value_interaction)))
# Print the results
print(paste("t-value for interaction terms: ", t_value_interaction))
print(paste("p-value for interaction terms: ", p_value_interaction))

```