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Article

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R&D spending, competitive advantage, and firm performance in Thailand

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Abstract: The study aims to examine the relationship between R&D spending and firm performance and to test for the mediator effect of competitive advantage on the relationship between R&D spending and firm performance of private firms in Thailand. By collecting data from the sample with a questionnaire from 151 private companies in Thailand. This study's main objectives are to examine the relationship between R&D spending competitive advantage and firm performance. The research data is tested and analyzed by the structure equation model. As the results, the study found that even though R&D spending do not directly have relationship with firm performance, there is a positive relationship between R&D spending and firm performance mediated by competitive advantage of private firms in Thailand. For contribution and implication, the evidence of this study points out that competitive advantage is an important variable that will enhance the efficiency of firm performance measured by balanced scorecard from corporate R&D spending. Moreover, resource-based theory can be demonstrated to explain the relationship between R&D spending, competitive advantage, and corporate performance in Thailand as well as other countries.

Subjects: Finance; Business, Management and Accounting; Industry & Industrial Studies;

Keywords: R&D spending; firm performance; competitive advantage; Thailand

JEL Classification: M40; M41; M48

1. Introduction

The business environment is increasingly challenging and complex today, overcoming the COVID situation that is causing the corporate sector to stall, increased labor costs due to a lack of labor,

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and always changing customer behavior. A recent study even indicated that market uncertainty has a significant impact on how well a company performs (Sharfaei et al., 2023). The impact of these issues on the business's operational effectiveness is significant. Therefore, research and development are crucial in the quest for new goods to raise the competitiveness of the company. Accessibility of valuable resources, which differentiate the corporate products, is required in the business competitional world. According to the resource-based theory, it explains that resources that are valuable, rare, different from competitors and cannot be imitated. It is a resource that can create a competitive advantage for the company (Barney, 1991; Wernerfelt, 1984). Numerous studies indicated that the research and development (R&D) spending can increase competitive advantage by assisting in the development of new products and the creation of new markets, enhancing product prominence and differentiation, and positively affecting the efficiency of innovation (Artz et al., 2010; Guo et al., 2018; Liao & Tow, 2002; Zhu et al., 2020), especially in the current economic situation where consumer demand is changing rapidly. The organizations' R&D processes can benefit businesses in a variety of ways. For example, by expanding its market share through the introduction of new or superior products, R&D operation will encourage a company's profitability to stay in either the same situation or even improve. On the other benefits, R&D also can increase a company's earnings that reduce the production cost (Brown, 1972). One of the reasons for the importance of innovation in research and development is based on a study conducted in Japan on labor shortages and an aging society. Innovation is required to address these issues since they have a significant impact on operations (Konno et al., 2018). From numerous surveys of research and development activities of manufacturing industry in Thailand, it was found that the object of the research is invention of new product, recycling from original product, reduce waste from production, and reuse waste raw material to add new value for maximum benefit. Products from the R&D process can also increase competitiveness by maintaining and expanding the market share of the product and expanding the business side by side. For example, in financial and insurance industry, R&D spending are organized to develop a mobile banking platform and develop a reliable online transaction system, prevent data theft, and meet the needs of most users including investment in R&D to look for new business opportunities, to easily replace businesses that have a chance of being digital disruption (Promwong, 2021). Therefore, it can be explained that R&D spending supports R&D activities in various fields, and it can affect the ability to optimize firm performance. Businesses which spend money in R&D activities will be able to bring innovative items to market faster, thereby increasing the productivity of the business. Moreover, the cost of production can be reduced for the business. When a business increases revenue, it is considered successful. Likewise, production costs can be reduced. As a result, business performance has a potential to enhance (Chen & Ibhagui, 2019; Ghaffar & Khan, 2014; Guo et al., 2018; Lome et al., 2016).

In Thailand context Currently, the Thai private sector continues to invest spending in R&D. According to survey findings for 2019, the nation spent 193,072 million baht on research and development, up 5.9% from the previous year, with 77% coming from private investment. As a result, Thailand has a ratio of research and development spending to the gross domestic product is 1.14%. This is in line with the Plan for National Economic and Social Development No. 12, which has set a goal that by 2021, Thailand must have research and development spending per GDP of 1.5% and 2% by 2027 (NXPO, 2019). Moreover, The Office of National Higher Education Science Research and Innovation Policy Council (NXPO) has established a policy for research and development to increase global competitiveness, and it is responsible for assisting Thai private sector firms with research and development. Even so, research and development spending is on the rise in Thailand. However, when comparing the amount spent on research & development to the GDP of the nation, Thailand can also be considered to have a low ratio of research and development spending to GDP compared to developed countries such as Sweden at 3.53%, the United States at 3.45%, and Germany at 3.14%, etc (The World Bank, 2022).

A firm performance is a measurement of a company's accomplishment and ability to operate and determine whether its performance meets strategic goals (Zahra & Covin, 1993). However, the traditional performance measurement cannot assess the effectiveness of all aspects of an organization's

performance because the traditional performance is measured only by financial performance. Balanced Scorecard (BSC) is a performance measurement tool that aids in the measurement and comprehensive strategy management process by measuring both financial and non-financial performance. BSC is a concept that allows for a larger perspective of an organization's evaluation. It is also a method that can transform corporate missions into strategies. In addition, BSC can assist in connecting the company's strategy and putting it into action, without focusing only on financial measurement. BSC is focused on the management of organization's intangible assets to determine the indicators in accordance with the organization's strategy to create competitiveness and the pursuit of new innovations that will contribute to the sustainable development of the company (Harden & David, 2016). Using resource-based theory, the corporate resources can provide a competitive advantage to the company (Artz et al., 2010; Wernerfelt, 1984) and can have a positive effect on the firm performance (Pertusa-Ortega et al., 2010). Competitive advantages quickly help businesses have different abilities from competitors and to lead the market leader compared to competitors in the same industry (Healy et al., 2014; Miles et al., 1978).

However, previous related studies of relationship between R&D spending and performance are frequently concentrated in developed countries such as Norway, The United States of America, Canada, and Austria (Chen & Ibhagui, 2019; L. A. Hall & Bagchi-Sen, 2002; Lome et al., 2016; Los & Verspagen, 2000). However, developing countries continue to lack answers regarding the impact of R&D spending on firm performance. Evidence from the prior related studies has shown that the relationship between R&D spending and firm performance is possible in many directions; thus, the results are still inconclusive. On the one hand, for example, many studies have shown positive results since the results of R&D can create new products that are different from competitors and also reduce production costs as well, resulting in good performance (Guo et al., 2018; Lome et al., 2016; Sharma, 2012). On the other hand, the studies found negative correlation with firm performance since investing in R&D takes a long time to improve technology for manufacturing products, the initial investment has a negative effect on the performance (Xu & Jin, 2016). The result of prior study in Thailand found that R&D disclosure had a negative effect on the financial performance due to that is confidential business-specific causing the company to have a disadvantage in competition (Siripong et al., 2019). In addition, there may be a possibility that R&D do not directly affect the firm performance in Thailand but affects through some variables. However, there were the previous related studies that find non-linear relationship between R&D spending and firm performance (Guo et al., 2018; Kim et al., 2018). The mediating role of competitive advantage has not been explored in the current literature yet.

From the study problems above, this study's main objectives are to examine the relationship between R&D spending and firm performance. Recent studies on the effects of spending on research and development in developing nations have raised some questions about the relationship between R&D spending and firm performance. This research will advance knowledge of how spending on research and development affect performance in Thailand and other developing countries with a comparable economy. However, considering the resource-based theory, which describes the availability of valuable resources different from those of competitors, will lead to improved performance. As a result, we are of the opinion that spending on research and development is going to enhance performance. Additionally, we think that competitive advantage will operate as a factor in the transmission of R&D investment. Because if the project for research and development is effective, it can have an impact on goods or procedures that are distinct from those of rivals. It implies that the business can obtain priceless resources that could provide it with a competitive edge. And the company's success will be affected by the new beginning. Therefore, the mediator effect of competitive advantage on the relationship between R&D spending and firm performance of provate firms in Thailand will be tested and examined

This research provides some contributions expected in several dimensions. First, it provides an extension to the current literature on R&D spending competitive advantages and firm performance by integrating competitive advantages as a mediator between this relationship. Second, this

research sheds light on how competitiveness influenced this association. This is because of the reason that there is not much research that looks at competitive advantage, which serves as a mediating factor in the relationship between R&D spending and corporate performance. Most previous studies that looked at research and development spending used secondary data to gather their information (Akaphol, 2007; Ghaffar & Khan, 2014; Guo et al., 2018; Kim et al., 2018). This study is an extension of the primary data collection method. It is also discovered that in the past, the majority of research and development studies tended to focus on specific areas of study, such the pharmaceutical industry (Ghaffar & Khan, 2014; Sharma, 2012), the biotechnology industry sector (L. A. Hall & Bagchi-Sen, 2002), etc. This study will extend the scope of the study to the manufacturing industry service industry and the wholesale and retail industry. Third, this study will assist leaders in using information to plan the future of their company and make decisions that will improve performance, it supports corporate executives in gaining confidence in the organization's direction and plan that they can afford. Finally, this research has contributed to a future path for expanding managerial expertise, and to improve the literature by expanding knowledge and comprehension of resource-based theory.

The rest of this paper is organized as follows. Section 2 and 3 present background and theoretical literature review, literature review, Section 4 is empirical literature review and hypothesis development. Section 5 is research design including population, sample, data collection, variable measurement, and data analysis. Section 6 presents the empirical results and discussion. Section 7 provides the summary and conclusion, contributions, limitations, and suggestions for future study are presented in the last section.

2. Background

The study focused on private companies in Thailand, because Thailand is a country where R&D spending is less compared to developed countries. Moreover, this study selected only private companies in Thailand that are registered with The Office of National Higher Education Science Research and Innovation Policy Council (NXPO). It is because the private companies in Thailand are important variables in the country's economic, social development and creating innovations that meet the needs of the country in order to be able to adjust the status of Thailand from a middle-income economy to a high-income economy and to be able to increase the competitiveness of the country requires investment in R&D (Yodudom et al., 2020). These private companies with research and development activities have registered and disclosed spending on research and development for the year 2018. It was found that there were 9,000 private companies, an increase of 22.75% from 2017, divided into companies in the manufacturing sector, which has 3,552 companies and accounts for 39%, the service sector, which has 1,335 companies and accounts for 15%, and the wholesale/retail sector, which has 4,113 companies and accounts for 46% (NXPO, 2019).

The following are the primary responsibilities of The Office of National Higher Education Science Research and Innovation Policy Council (NXPO). (1) Responsible for scholarly and administrative activities, including assisting and encouraging the subcommittee's effective performance of its tasks under the Policy Council, committees, and special committees. (2) Provide opinions to the Policy Council on policies, strategies, higher education plans, and science plans. Research and innovation output of the country in line with national strategies, master plans, and other plans, including government policies. (3) Propose opinions to the Policy Council on the annual budget framework. Higher education and science research and innovation output of the country, including an integrated system of budget allocation and management that aims to achieve results in line with strategic policies. (4) Provide opinions to the Policy Council on accelerating and monitoring the proposal or revision of laws, rules, or regulations related to higher education, science, research, and innovation products. (5) Support for the Special Committee's Monitoring and Evaluation Initiative. (6) Coordinate the preparation, integration, and connection of higher education databases, higher education standard databases, and science database. Research and innovation output including having access to such databases for analysis. Data synthesis supporting the consideration of policy formulation, direction, and budget allocation for higher education

development and research and innovation output as well as disclosing information and analysis results public synthesis. (7) Coordinate and cooperate with goverment agencies into both domestic and international topics such as higher education, research and development, and innovation. (8) Preparing the annual report of the Policy Council under section 11 (10) on submitting an annual report on higher education, science, research, and innovation to the Cabinet and the National Assembly. (9) Carry out additional obligations as specified by this regulation or other laws or as directed by the NXPO Steering Committee, the Policy Council, the Minister, the Prime Minister, or the Minister. From the role of The Office of National Higher Education Science Research and Innovation Policy Council (NXPO), these point out that Thailand has systematically promoted R&D and there are many private companies in Thailand engaged in R&D activities to enhance their competitiveness. However, when investing in research and development, the next thing that needs to be studied is the evaluation of the investment whether it meets the goals set or not. In Thailand, there are limited studies on Thai private companies investing in research and development. This study fills a gap in the past research to provide empirical evidence about the performance of private companies in Thailand in relation to R&D spending.

3. Theoretical literature review

Resource-based theory is defined as resources of organization's assets that include (1) tangible assets such as machinery, office buildings, and capital, (2) intangible assets such as technological know-how, employment with specialized knowledge, these resources will be used to maximize efficiency in the organization's operations (Barney, 1991; Wernerfelt, 1984). Firms that have and combine valuable, rare, immobile, and difficult-to-copy resources are more likely to maintain a competitive advantage. J. B. Barney (1986) and Barney (1991) consider the ability to obtain valuable resources. It is difficult to duplicate and irreplaceable. And being able to improve resource usage is a key factor in increasing a company's efficiency. Kafouros and Wang (2008) explain that R&D can be viewed as a component in the creation of firm-specific knowledge. R&D knowledge is intangible and thus difficult to replicate. Two assumptions were formulated in the resource-based theory to analyze the source of competitive advantage. First, this concept presupposes that resource ownership among enterprises in the same industry may differ. Second, this concept assumes that individual resources used to adjust a company's strategy cannot be fully replicated between companies, implying that some resources may not be interchangeable in factor markets and thus difficult to acquire or imitate. As a result, companies can acquire valuable and difficult to replicate resources can gain a competitive advantage over competitors in the same industry (Barney, 1991). The resource-based theory has been utilized in previous research to explain the relationship between R&D spending and performance. Belderbos et al. (2004) used this idea to describe how R&D collaboration influences the distribution of new products and has a positive effect on the company's operational effectiveness. Sharma (2012) The findings confirm that research and development investment activities have a positive effect on long-term performance, where investment in research and development can boost productivity. The recent studies of the relationship between R&D spending and corporate success based on a resource-based perspective were confirmed by Lome et al. (2016), who asserted that having significant resources gives an organization a competitive advantage. Moreover, Pertusa-Ortega et al. (2010) conducted a study to expand the literature on strategy and operational efficiency by comparing two theories: resource-based theory and situational theory. The results confirm that competitive advantage strategies positively affect operational efficiency according to the resource-based theory.

This research has applied the concept of resource-based theory, in explaining the relationship between R&D spending, competitive advantage, and firm performance. This is because the concept focuses on valuable resources and is difficult to replicate. As a company invests more in R&D spending, it is more likely that the company will be able to acquire assets or resources that are more valuable than competitors, thereby increasing the business's competitiveness. In addition, the idea can also be defined as a link between R&D spending and firm performance, with a competitive advantage providing as a mediator. This is because companies with spend in R&D

activities differentiate themselves from their competition and may be able to provide products that suit their customers' expectations. This entails giving the company a competitive advantage. On the other side, a competitive advantage might be described as an organization's ability to effectively manage its existing resources. In the end, it will result in excellent firm performance.

4. Empirical literature review and hypothesis development

4.1. R&D spending

R&D Spending can be classified into three categories based on the purpose. First, increase profitability or market share by improving the quality of the original product. Second, to explore or find new business projects. Finally, to continue due to the successful project of developing products to the market (Brown, 1972). In addition, R&D Spending differs from a typical investment in several ways. The first is that more than 50% of R&D spending is accounted for by researchers' wages and salaries. Second, R&D spending is the cost of investing in intangible assets and the basis for knowledge development. Develop technology and innovative products of the company with the expectation of a return that will be able to generate profits in the future (B. H. Hall & Lerner, 2010). Third, investment in R&D has a long-term investment nature, making the method of assessing the cost of capital of R&D spending quite complex, because in the early stages of investment in R&D of these projects they may not be able to generate income for the company. The company therefore needs to reserve a large amount of cash. Due to the high uncertainty of research and development, assessing the efficiency of R&D investments is quite complex. Therefore, an integrated measurement approach that measures both financial and non-financial performance is required (Bremser & Barsky, 2004). According to a survey in The Office of National Higher Education Science Research and Innovation Policy Council (NXPO), it was found that R&D spending of private companies in Thailand includes R&D activities. Spending for hiring R&D personnel or outsourcing to do R&D land expenses building and equipment for R&D and expenses for the purchase of machinery and equipment, including software used for research and development. Furthermore, companies or juristic partnerships in Thailand are exempt from income tax on R&D spending with the aim to develop products or a new production process (NXPO, 2019).

The measure of R&D spending in the past is often measured by the method, R&D spending divided by total sales derived from secondary data collection, there has been no study on how to measure the effectiveness of R&D investments in the context of R&D companies with explicit primary data collection methods. This study is a study in a company of a private company in Thailand, which is not disclosed in public sources. Therefore, questionnaires were developed from the R&D survey reports and innovation activities in Thailand's industrial sector, by The Office of National Higher Education Science Research and Innovation Policy Council (NXPO) to be used for collecting data of variables R&D spending.

4.2. Competitive advantage

Competitive Advantage assists businesses in differentiating themselves from competitors (Barney, 1991; Miles et al., 1978). Therefore, companies need to adapt to survive by studying and formulating a competitive advantage to operate their business as best suited to the current economic conditions. According to Porter (1997) Classified the competitive advantages into two types. First, cost leadership that focuses on the process of reducing the cost of every unit of business operations, resulting in a product price per unit that is as low as possible with the aim of increasing market share. Second, differentiation strategy focuses on developing valuable products and services that create uniqueness and differentiate from competitors. Including creating the image and identity of the company that is different from competitors. The key to successful differentiation strategies is that competitors cannot copy. Furthermore, the firm's competitive advantage is critical for increasing the efficiency of the firm performance (Porter, 1997).

For research in Thailand has applied strategies to build competitiveness to apply to smart agricultural entrepreneurs, such as strategies to create advantages with information technology.

Competitive advantage can be divided into four perspectives as (1) Differentiation making a difference means developing a model and a way to create a product that is different from other competitors, (2) Cost leadership arises from consumers comparing product prices before making a purchase decision, so businesses must offer good-quality products at the most cost-effective prices, (3) Focus on niche market that means having a clear main goal, by creating a competitive advantage by focusing on niche markets or specific target customers, and (4) Quick Response is to respond to the needs of consumers immediately, this can be regarded as creating a competitive advantage in business to create flexibility in the business (Sukglun et al., 2018). For this research, competitive advantage is a latent variable consisting of the following variables which are differentiation, cost leadership, niche market, and quick response.

4.3. Firm performance

Firm performance is an indicator of its ability to perform. The most traditional performance measures focus exclusively on financial performance, which is insufficient to make planning and operating decisions in a rapidly changing and extremely competitive business environment. In addition, financial performance as the traditional performance is measured and considered short-term performance that focuses on only past information, and cannot predict the future performance (Jusoh et al., 2008). Kaplan and Norton (1992) developed BSC as a tool for assessing both financial and non-financial performance; it is an organizational performance tool that allows managers to look at business from four key perspectives: Finance perspectives are measure of the financial goals of the organization, by identifying how strategy and operations play a role in improving the bottom line of an organization. Customer perspectives are a measure of the organization's performance from the customer's point of view that reflects how, for an organization to achieve its goals, it must meet the needs of its customers to make customers the highest satisfaction. Internal process perspectives are a measure of how the organization's performance affects customer satisfaction and creates future corporate competitiveness, causing improvements in the operations of the organization. Learning and growth perspectives are measuring the readiness and development of internal resources to create more competitive opportunities and meet customer needs. This includes the organization's capacity for innovation, improvement, and learning that directly affects corporate value and creating value for customers and continually improving operational efficiency (Bilbas, 2018).

In addition, BSC are both performance measurement tools that focus on the management of an organization's intangible assets. For use in forecasting future performance and designed to determine metrics in line with corporate strategy to build competitiveness and seek innovation that will contribute to the organization's sustainable development (Harden & David, 2016). It is also an organizational performance tool that allows managers to look at business from four key perspectives: finance, customer, internal processes, and learning and growth able to link to measures objectives and business strategies to assess the performance of various aspects of the organization (Pérez et al., 2017). However, this research is a study of R&D spending variables. It has characteristics that are different from other investments. In the first phase of investment in R&D, it may not be possible to measure the effectiveness of such investments from the company's profit margins (B. H. Hall & Lerner, 2010). Therefore, this research uses the BSC method of performance measurement. This is able to appropriately linked to the R&D spending strategy with the performance measurement process (Bremser & Barsky, 2004).

4.4. Hypothesis development

4.4.1. R&D spending, competitive advantage, and firm performance

Over the past 50 years, investments in both intangible and tangible products have rapidly increased in research and development to innovate in the United States (Machokoto et al., 2021). Research and development investments are often used to create competitive advantages, long-term growth, and technological advancements that lead to a company's performance and efficiency (Parthasarthy & Hammond, 2002). Even the current study Research and development

has also been brought in to solve the problem of labor shortages as well (Konno et al., 2018). Leonard (1971) has investigated the percentage of research and development in the United States. The research showed the effect of R&D on company growth. It usually starts in the second year after R&D spending. It has been continually growing its reach for at least 9 years. Additionally, prior studies have discovered that R&D has an impact on an enterprise's innovative output (Artz et al., 2010; Zhu et al., 2020). Technology advancement and the introduction of new products are also impacted (Parthasarthy & Hammond, 2002). Furthermore, research and development encourage the creation of creative production methods and the granting of patents for new products (L. A. Hall & Bagchi-Sen, 2002; Medda, 2020). Research & development spending provides productivity gains in addition to innovation. However, prior studies have also discovered that spending on research and development has an impact on how competitive advantage operates in both cost-leading and product differentiation strategies (Guo et al., 2018). In the end, a company's performance is impacted by its increased expenditure on research and development. Research and development spending is regarded as a possible investment strategy to boost business growth prospects (Kim et al., 2018).

There are several previous related studies testing the relationship between R&D spending and firm performance. For example, a study by Sharma (2012) The study of R&D activity in the Indian pharmaceutical sector. The results confirm that research and development investment activities have a positive effect on long-term performance. Investments in research and development will boost productivity in the Indian pharmaceutical industry. According to the analysis, a 1% increase in research and development expenditures leads to output growth from 0.10% to 0.13%. This is in line with the results of a study of pharmaceutical companies in Pakistan. It appears that the results of the study agree that research and development activities have a positive effect on a company's financial performance (Ghaffar & Khan, 2014). A similar study by Lome et al. (2016) study of the relationship between research and development on company performance during the financial crisis of SMEs in Norway found that research and development had a positive effect on company performance, namely companies with expenses. Paying for research and development is a company with high growth potential. And according to the resource base perspective, having valuable resources gives an organization a competitive advantage, thus resulting in more efficient performance. Similarly, a study by Konno et al. (2018) investigated on Japanese building industry research. According to empirical findings, investing in R&D investment can boost the future by concentrating on cost-cutting, shortening the building period and increasing construction's functionality and efficiency. In addition, the study of companies in the Spanish manufacturing industry of Diéguez-Soto and Martínez-Romero (2019) examined the influence of research and development on the relationship between family business management and operational efficiency. The study confirms that R&D investment has a positive influence on operational efficiency.

On the other hand, it was discovered that the relationship between R&D spending and firm value was negative in Chinese context, and studies in technology industry investment in R&D are a long-term investment for developing technology successfully, so in first period of investment will have high cost which it can negatively affect to firm performance (Xu & Jin, 2016). In addition, a relationship between R&D and firm value was discovered a U-shaped pattern, and it shows that the correlation will be negative at the start of the investment project, turn positive subsequently and then become negative again (Kim et al., 2018). However, the findings in Thai context have revealed no relationship between R&D and financial performance, maybe because the firms in Thailand may not focus on research and development projects, or to declare that research and development activities are not significant to the operations of businesses in Thailand (Akaphol, 2007) (Figure 1).

A business may not be able to obtain a competitive advantage even if it has valuable resources if it is unable to make the most of those resources. In concept, the resource base perspective can describe the relationship between research and development expenditures and competitive advantages, where the resource-based theory places emphasis on the company's possession of

valuable resources that are difficult to imitate. This means that companies investing in R&D to a greater extent will increase the opportunity for product development to differentiate itself from competitors and increase the uniqueness of the product to gain a competitive advantage. In addition, determining the competitive advantage will help the product reach customers that meet the target audience. A review of past research found that companies tend to invest in R&D rationally because companies are affected by business competition in connection with their investment decisions and business strategies (McGrath & Nerkar, 2004). In addition, SMEs will maintain their competitive advantage by integrating and using their capabilities effectively in management, production, and marketing resources (Yusr et al., 2022).

Previous research has found that a competitive advantage has a relationship to firm performance. For instance, Pertusa-Ortega et al. (2010) found that competitive advantage had a positive effect on firm performance of large firms in Spain. The results of the study explain that firm resources and capabilities, such as rare location and differentiated products contribute to the development of competitive advantage that aim to better serve customer needs than competitors to improve firm performance. In Canada, Rivard et al. (2006) found that strategic technology support improves a company's performance as measured by revenue growth, which can be described as technological support can reduce production costs and use technology to differentiate production to increase firm performance. In some research especially in developing countries, competitive advantage may not directly affect performance but may be transmitted through other factors, such as Kharub et al. (2018) which studies a relationship between cost leadership strategy and firm performance of micro-SMEs in India, and the result has shown that cost leadership strategies have no direct impact on firm performance but effective through quality management. Also, study in Ghana found that competitive advantage does not directly affect firm performance but affects the quality of the product. It pointed out that for developing countries, companies may prioritize production strategy over competitive advantages. This may be due to the fact that most of the Ghana companies are small companies and may lack personnel with knowledge of competitive advantages, thus focusing only on the manufacturing (Amoako-Gyampah & Acquaah, 2008). However, if other factors are involved, the results may differ in different contexts of the study, but only considering the competitive advantages of both cost leaders and product differentiation. The study can still explain from a resource-based theory that competitive advantage positively influences performance. In addition, it also found studies that describe the role of competitive advantage as a variable between research cost and performance. The study in China by Guo et al. (2018) found that R&D spending was positively correlated with future performance, if the firm had a competitive advantage in product differentiation strategy, since differentiation strategy is aimed at creating a unique product or service that attracts brand loyalty. As a result, competitive advantage is likely to be a mediator variable in the relationship between R&D spending and performance. Accordingly, this study formulates the following hypotheses:

H1: R&D spending directly and positively relationship on the firm performance.

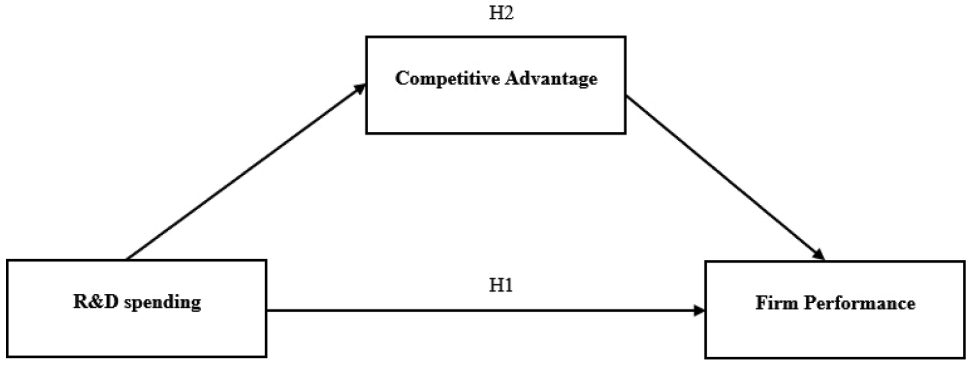

Figure 1. Conceptual framework of R&D spending, competitive advantage, and firm performance.

H2: Competitive advantage mediates the positive relationship between R&D spending on firm performance.

5. Research design

5.1. The sample and data collection

The study population was a private company with research and development activities in Thailand registered by The Office of National Higher Education Science Research and Innovation Policy Council (NXPO). It consists of three industrial sectors: 1. Manufacturing industry, 2. Service industry, 3. Wholesale/retail industry. From the database, it was found that currently, there are private companies in Thailand with research and development activities listed in the directory totaling 9,000 companies, divided into the manufacturing industry of 3,552 companies, the service industry of 1,335 companies and the wholesale/retail industry of 4,113 companies. We chose to use a simple random sampling method for the convenience of data collection. Data collection started from January to March 2022. The 709 surveys distributed by email with Google Forms. Within the specified period, there were 167 response samples, but the number of samples with complete information and statistical values that could be used for data analysis was 151 samples, yielding a response rate of 21.29%. Survey questionnaires with rating scale were divided into three parts including R&D spending, competitive advantage, and firm performance. This specific sample size was considered a priority by considering the suitable sample size for analyzing from structural equation modelling (SEM) as the minimum acceptable sample size for an analysis generally. *N* = 100–150 is set as a minimum sample size for SEM research (Ding et al., 1995) (Table 1).

5.2. Variables' measurement

In this study, the research instrument was a questionnaire, which was developed from the study of concepts, theories, documents, and past research (Amoako-Gyampah & Acquaah, 2008; Brouwer & Kleinknecht, 1999; Chen & Ibhagui, 2019; Chu, 2011; Healy et al., 2014; Kaplan & Norton, 1992; Kotha & Vadlamani, 1995; Leonard, 1971; Lome et al., 2016; Sukglun et al., 2018). The details are as follows (Table 2).

5.2.1. Independent variables

R&D spending variables were therefore designated as latent variables as measured by the 7-items developed from the report of R&D surveys and innovation activities in Thailand's industrial sector. Prepared by The Office of National Higher Education Science Research and Innovation Policy Council (NXPO).

5.2.2. Mediator variables

Competitive advantage measured by the 20-items consists of four sub-dimensions, differentiation (5-items), cost leadership (5-items) niche market (5-items) and quick response (5-items) (Lidia & Izabela, 2015; Parnell et al., 2012).

5.2.3. Dependent variables

Firm performance measured by the 20-items consists of four sub-dimensions, financial (5-items), customer (5-items), internal operation (5-items), and learning and growth (5-items) (Bremser & Barsky, 2004; Suttipun & Arwae, 2020). All rating scales were based on a 5-point Likert type format (1 = strongly disagree, 5 = strongly agree).

5.3. Data analysis

To check the validity of measurement model, covariance-based criteria such as composite reliability and average variance are performed. The standardized factor loadings were all above .45 (J. Hair et al., 1998). Cronbach's alpha coefficients exceed the cut-off point level of 0.7 and the Average Variance Extracted (AVE) for all constructs is satisfactory (>0.5) (Bagozzi & Yi, 1988). In

Table 1. Sample size per sector

Industrial sectors	N	n
Manufacturing Industry	3,552	115
Service Industry	1,335	16
Wholesale & retail Industry	4,113	20
Total	**9,000**	**151**

addition, the statistics indicate that all composite reliability (CR) of scales is greater than 0.7 (J. F. Hair et al., 2010; Healy et al., 2014).

5.4. Measurement model

In Table 3, the standardized factor loadings were all above .45 (J. Hair et al., 1998), ranging from .458 to .840. The size of the Average Variance Extracted (AVE) for each variable was also acceptable at the recommended value of .50. Composite Reliabilities (CR) of constructs also ranged from .947 to .978, exceeding the recommended value of .60 (Bagozzi & Yi, 1988). Besides, Cronbach's alphas showed satisfactory levels of reliability of internal consistency, ranging from .769 to .886 (Hulland, 1999).

The discriminant validity of the constructs was assessed by using the square roots of the Average Variance Extracted (AVE) (Fornell & Larcker, 1981). As shown in Table 3, the size of the AVE values was greater than the correlations shared between the construct and other constructs in the model. This indicated the discriminant validity among constructs. In terms of convergent validity, the factor loadings on each construct were examined.

Measurement model in this study was fitted with empirical data as per model fit indices as shown in Table 4 ($\chi 2 = 128.916$, $df = 81$, $p < .000$; CFI = .962; TLI = .951; RMSEA = .063; SRMR = .058).

6. Empirical results and discussion

6.1. The descriptive analysis

Characteristics of the 151 samples were 76.2% of the firm in the manufacturing industry, the rest distributed in the service industry and the wholesale and retail industries, 10.6% and 13.2%, respectively. Most firms are between the ages of 10 and 49, accounting for 75% of the total. It was also discovered that most firms employ fewer than 500 employees (Table 5).

6.2. Hypothesis results

Structural equation model (SEM) was used to test for two main hypotheses (Table 6). The result of hypothesis 2 indicates the indirect correlation test between R&D spending and firm performance, while the finding of hypothesis 1 shows that there is no significant direct effects of R&D spending on firm Performance ($p > 0.05$). Therefore, hypothesis 1 was rejected, but hypothesis 2 was accepted. In more detail, in terms of the indirect effects of mediation analysis, the results revealed

Table 2. The variables

Variables name	Code	Content	Expected sign
Independent variables: R&D spending	R&D	7-items	+
Mediator variables: Competitive advantage	CA	20-items	+
Dependance variables: Firm performance	BSC	20-items	

Table 3. Scale items and latent variable evaluation/Construct Validity of Formative Constructs

Variable	Items	Factor loading	Cronbach' alpha	CR	AVE
R&D spending	The firm has a policy of investing in R&D on a regular basis.	0.751	0.886	0.947	0.694
	The firm has expenses associated with R&D.	0.818			
	The firm has expenses in R&D personnel.	0.926			
	The firm has outsourced its R&D.	0.542			
	The firm has expenses on land, buildings, and structures for R&D.	0.657			
	The firm spends on software used for R&D.	0.616			
	The firm has expenses on machinery and equipment for R&D.	0.756			
Competitive Advantage	Differentiation	0.775	0.833	0.947	0.750
	Cost leadership	0.787			
	Niche Market	0.688			
	Quick Response	0.731			
Firm performance	Financial Perspective	0.458	0.769	0.978	0.967
	Customer Perspective	0.617			
	Internal Operations Perspective	0.797			
	Learning and Growth Perspective	0.840			

that the indirect effects of positive relationship R&D spending on firm performance via Competitive advantage ($\beta = 0.506$, $z = 6.169$, $p < 0.00$); therefore, hypothesis 2 was supported. It shows that the R&D spending and firm performance relationship are a fully mediated relationship through contribution of R&D spending to firm performance via competitive advantage (Table 7).

Objectives of this study are (1) to examine the causal relationship of R&D spending and firm performance and (2) to examine mediation roles of competitive advantage on the relationship between R&D and firm performance. The results of the study found that R&D spending does not directly have a relationship with firm performance. However, the results of the study are inconsistent with previous research that indicates a positive relationship between R&D expenditure and performance (Ghaffar & Khan, 2014; Konno et al., 2018; Lome et al., 2016; Sharma, 2012). However, the results of this study were similar to previous studies in the Thai context of Akaphol (2007) explaining that most companies in Thailand do not focus on R&D projects. According to Thai accounting standards, R&D spending that is not expected to create economic benefits in the future. The company must recognize such expenditure as an expense in the income statement, and consistent with the report of World Bank report found that Thailand's R&D spending per GDP in the country is at a low level. Nevertheless, the study conflicts with research in large economies that find that R&D costs have a positive effect on revenue growth rates (Lome et al., 2016). In addition, some studies have found that R&D spending has a non-linear relationship with performance (Chen & Ibhagui, 2019). Even a recent Malaysian study found the same research findings. It

Table 4. Means, standard deviations, bivariate correlations, and average variance extracted

Variables (*n*=151)	Mean	SD	R&D	CA	BSC
R&D spending	2.723	.775	*0.694*	-	-
Competitive Advantage	3.789	.458	0.427	*0.750*	-
Firm Performance	3.464	.548	0.427	0.742	*0.967*

Discriminant Validity: Fornell and Larcker Criterion, the diagonal values (bolded) are the square root of AVEs, and off-diagonal values are correlation coefficients.

Table 5. Descriptive measures of overall model fit

Fit measure	Acceptable fit*	Model fit
1. χ^2/df	1 < χ^2/df< 3	128.916/81/Sig0.00
2. CFI	0.95 ≤ CFI < 0.97	0.962
3. TLI	0.95 ≤ TLI < 0.97	0.951
4. RMSEA	0.05 < RMSEA ≤ 0.08	0.063
5. SRMR	0.05 < SRMR ≤0.10	0.058

(Hu & Bentler, 1999; Schermelleh-Engel et al., 2003).

Table 6. Demographics and descriptive statistics of participants (N = 151)

Demographics variable	Industry	Percentage	Sample
	Manufacturing	76.2	115
Sector	Service	10.6	16
	Wholesale & retail	13.2	20
Year	<10	9.3	14
	10–29	39.7	60
	30–49	35.1	53
	50>	15.9	24
Employees	<100	38.4	58
	100–499	37.7	57
	500–999	12.6	19
	1,000>	11.3	17

Table 7. The results of the SEM and mediated path analysis

Direct effect, indirect effect, and total effect	Std.Coeff.	SE	*z*	p-value
Direct Effect R&D -> BSC	−0.017	0.072	−0.243	0.808
Indirect Effect R&D -> CA ->BSC	0.506	0.082	6.169	0.000***
Total Effect	**0.489**	**0.074**	**6.570**	**0.000*** **

Significant ***p<0.001; **p<0.01; *p<0.05.

came out that investments in R&D performed by Malaysian SMEs had no impact on the business's operations (Yusr et al., 2022).

To answer the second research objective, this result indicates that the relationship between R&D spending and firm performance is positive and significant if they are mediated by competitive advantage. The results of the study were based on resource-based theory that scarcely valuable resources can optimize a firm performance (Barney, 1991; J. B. Barney, 1986). It is clear that the business's investment in R&D will produce new knowledge that can be used to create products and services that are distinct from those offered by rivals and give the product a uniqueness that makes it challenging to copy (Kafouros & Wang, 2008). Therefore, spending on research and development produces a variety of businesses. Consistent with the study results of Liao and Tow (2002), it points out that research and development enhances competitiveness. It can be considered a future direction for technology companies. By supporting the development of new products and creating new markets. In particular, the company can maintain and enhance its competitive advantage by being able to provide products with novel and more complex features. Like a recent study of Guo et al. (2018), it was discovered that the percentage of R&D spending had a positive effect on product differentiation strategies, because the company can produce outstanding products to set itself apart from competition when it invests more in research & development. In addition, studies in the automotive industry in Thailand have shown the same direction of research finding that research and development has a direct positive effect on competitive advantage (Chamsuk et al., 2017).

Therefore, the more a firm must invest in research and development, the more competitive it will be. Consistent with the results of previous studies, the relationship of competitive advantage in differentiation products associated with R&D spending positively affects operating results in future (Guo et al., 2018). In addition, the results of the study were consistent with past studies that found that competitive advantage has a positive impact on financial performance, which can be explained that technology support to reduce production costs and use technology to differentiate production can increase operational efficiency (Rivard et al., 2006). This is because, in a day of strong competition, competitive advantage is one of the things that is needed to sustain a business. For example, products with the same qualities but lower pricing have a chance to generate more sales. Products at the same price but higher quality, or products that stand out from the competition, have a better chance of selling more. As a result, a competitive advantage in business contributes to improved firm profitability than competitors. However, this study may not be consistent with the Iran study of Sharfaei et al. (2023) which found that cost advantage or differentiation advantage had no effect on the operational efficiency of SMEs, which may cause by regulations in the country.

7. Summary and conclusion

Finally, the results of this research found no direct relationship between R&D spending and firm performance, but there is a positive relationship between R&D spending and firm performance mediated by competitive advantage. These results show the important role of competitive advantage as a mediate variable between the relationship between R&D spending and firm performance that can be described as when a firm has R&D spending, it will have a positive impact on the firm's competitiveness. And when a firm has a competitive advantage, it will have a further impact on better performance as well. If researchers are unable to produce new findings that differentiate the product until it is competitive, it will make the firm spend a high cost. To obtain a competitive advantage in terms of cost leadership, product differentiation, and quick response to consumer needs, businesses with R&D operations must define research clearly project goals. As a result, competitive advantage is critical as a variable that links R&D spending to a firm performance.

There are some contributions and implications from the findings of this study. Theoretically, this study adds new knowledge to testing the key role of competitive advantage as a mediating variable, the relationship between R&D spending and firm performance. It is also confirmed that

the resource-based theory can describe the competitive advantage that comes from accessing valuable, hard-to-find, and inimitable resources and difficult to replicate these resources, in some situations, require R&D activities.

In terms of practical contributions, the evidence of this study points out that competitive advantage is an important variable that will enhance the efficiency of firm performance with BSC from R&D spending; the results of this study will help companies engaged in R&D activities to clearly define their R&D spending objectives with a focus on building competitive advantage by product differentiation, reduce production costs, find target customers that match the company's products and research to develop processes to respond quickly to customer needs, and these factors will have a positive effect on firm performance. Furthermore, the findings of such studies may be useful to Thai government agencies. Able to formulate policies that appropriately support R&D efforts and improve private company performance.

This study provides some limitations. First, this research had a questionnaire data collection method and required only one respondent to answer but the data in the questionnaire consisted of many parts. Future studies may require multiple respondents. Also answer in the information that they are responsible for. Secondly, this studied relatively few samples in the study. Due to this study, there are many parts of the information that are confidential to the entity. As a result, many companies do not agree to provide information. Future studies should expand the scope of the sample and increase the number of samples for testing power. Lastly, this research is a quantitative analysis. Therefore, some definitions of the variables in the study cannot be explained by quantitative methods. In the future, it may be studied more with quality methods to increase understanding of the issues. For example, interviews with executives of companies with research and development activities to increase their understanding of the issue. Finally, this study does not address factors that influence investment decisions in R&D, which may be an important factor in influencing the direction of R&D spending. Things will have an impact on future success in the organization. In the future, studies may examine the factors, such as government assistance, organizational structure, etc., that influence a company's investment in R&D.

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References

Akaphol, S. (2007). *The relationship between firm life cycle, firm size, research and development expenditure and stock returns*. Chulalongkorn University.

Amoako-Gyampah, K., & Acquaah, M. (2008). Manufacturing strategy, competitive strategy and firm performance: An empirical study in a developing economy environment. *International Journal of Production Economics*, *111*(2), 575–592. https://doi.org/10.1016/j.ijpe.2007.02.030

Artz, K. W., Norman, P. M., Hatfield, D. E., & Cardinal, L. B. (2010). A longitudinal study of the impact of R&D, patents, and product innovation on firm performance. *Journal of Product Innovation Management*, *27*(5), 725–740. https://doi.org/10.1111/j.1540-5885.2010.00747.x

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94. https://doi.org/10.1007/BF02723327

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120. https://doi.org/10.1177/014920639101700108

Barney, J. B. (1986). Strategic factor markets: Expectations, luck, and business strategy. *Management Science*, *32*(10), 1231–1241. https://doi.org/10.1287/mnsc.32.10.1231

Belderbos, R., Carree, M., & Lokshin, B. (2004). Cooperative R&D and firm performance. *Research Policy*, *33*(10), 1477–1492. https://doi.org/10.1016/j.respol.2004.07.003

Bilbas, D. S. Z. A. (2018). The relationship between balanced scorecard and cost reduction: An empirical study on public sectors in Kurdistan Region. *International Journal of Engineering, Business and Management*, *2*(4), 44–56. https://doi.org/10.22161/ijebm.2.4.1

Bremser, W. G., & Barsky, N. P. (2004). Utilizing the balanced scorecard for R&D performance measurement. *R & D Management*, *34*(3), 229–238. https://doi.org/10.1111/j.1467-9310.2004.003350.x

Brouwer, E., & Kleinknecht, A. (1999). Innovative output, and a firm's propensity to patent. An exploration of CIS micro data. *Research Policy*, *28*(6), 615–624. https://doi.org/10.1016/s0048-7333(99)00003-7

Brown, A. E. (1972). New definitions for industrial R&D. *Research Management*, *15*(5), 55–57. https://doi.org/10.1080/00345334.1972.11756146

Chamsuk, W., Fongsuwan, W., & Takala, J. (2017). The Effects of R&D and Innovation Capabilities on the Thai Automotive Industry Part's Competitive Advantage: A SEM Approach. *Management and Production Engineering Review*, *8*(1), 101–112. https://doi.org/10.1515/mper-2017-001

Chen, Y., & Ibhagui, O. W. R&D-firm performance nexus: New evidence from NASDAQ listed firms. *The North American Journal of Economics & Finance*, *50*, 101009. https://doi.org/10.1016/j.najef.2019.101009

Chu, W. (2011). Family ownership and firm performance: Influence of family management, family control, and firm size. *Asia Pacific Journal of Management*, *28*(4), 833–851. https://doi.org/10.1007/s10490-009-9180-1

Diéguez-Soto, J., & Martínez-Romero, M. J. (2019). Family involvement in management and product innovation: The mediating role of R&D strategies. *Sustainability*, *11*(7), 2162. https://doi.org/10.3390/su11072162

Ding, L., Velicer, W. F., & Harlow, L. L. (1995). Effects of estimation methods, number of indicators per factor, and improper solutions on structural equation modeling fit indices. *Structural Equation Modeling: A Multidisciplinary Journal*, *2*(2), 119–144. https://doi.org/10.1080/10705519509540000

Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Ghaffar, A., & Khan, W. A. (2014). Impact of research and development on firm performance. *International Journal of Accounting and Financial Reporting*, *4*(1), 357. https://doi.org/10.5296/ijafr.v4i1.6087

Guo, B., Wang, J., & Wei, S. X. (2018). R&D spending, strategic position and firm performance. *Frontiers of Business Research in China*, *12*(1). https://doi.org/10.1186/s11782-018-0037-7

Hair, J. F., Black, W. C., & Babin, B. J. (2010). *Multivariate data analysis*. Pearson Prentice Hall.

Hair, J., Tatham, R., Anderson, R., & Black, W. (1998). *Multivariate data analysis* (5th ed). Prentice-Hall.

Hall, L. A., & Bagchi-Sen, S. (2002). A study of R&D, innovation, and business performance in the Canadian biotechnology industry. *Technovation*, *22*(4), 231–244. https://doi.org/10.1016/S0166-4972(01)00016-5

Hall, B. H., & Lerner, J. (2010). The financing of R&D and innovation. In *Handbook of the Economics of Innovation* (1st ed., pp. 609–639). Elsevier BV. https://doi.org/10.1016/S0169-7218(10)01014-2

Harden, J. W., & David, R. U. (2016). An introduction to the use of the balanced scorecard for performance evaluation by financial professionals. *Journal of Financial Service Professionals*, *70*(2), 81–88.

Healy, P., Serafeim, G., Srinivasan, S., & Yu, G. (2014). Market competition, earnings management, and persistence in accounting profitability around the world. *Review of Accounting Studies*, *19*(4), 1281–1308. https://doi.org/10.1007/s11142-014-9277-8

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, *6*(July 2012), 1–55. https://doi.org/10.1080/10705519909540118

Hulland, J. (1999). Use of Partial Least Squares (PLS) in strategic management research: A review of four recent studies. *Strategic Management Journal*, *20*(2), 195–204. https://doi.org/10.1002/(SICI)1097-0266(199902)20:2<195:AID-SMJ13>3.0.CO;2-7

Jusoh, R., Ibrahim, D. N., & Zainuddin, Y. (2008). The performance consequence of multiple performance measures usage: Evidence from the Malaysian manufacturers. *International Journal of Productivity and Performance Management*, *57*(2), 119–136. https://doi.org/10.1108/17410400810847393

Kafouros, M., & Wang, C. (2008). The role of time in assessing the economic effects of R&D. *Industry and Innovation*, *15*(3), 233–251. https://doi.org/10.1080/13662710802041638

Kaplan, R. S., & Norton, D. P. (1992). The balanced scorecard - measures that drive performance. *Harvard Business Review*, *70*(1), 71. https://doi.org/10.8379/HBR-06-1992-8379

Kharub, M., Mor, R. S., & Sharma, R. (2018). The relationship between cost leadership competitive strategy and firm performance a mediating role of quality management. *Journal of Manufacturing Technology Management*, *30*(6), 920–936. https://doi.org/10.1108/JMTM-06-2017-0116

Kim, W. S., Park, K., Lee, S. H., & Kim, H. (2018). R & D investments and firm value: Evidence from China. *Sustainability (Switzerland)*, *10*(11), 1–17. https://doi.org/10.3390/su10114133

Konno, Y., Itoh, Y., & Wu, H.-C. (2018). Empirical analysis of R&D in the Japanese construction industry based on the structure conduct performance model. *Cogent Business & Management*, *5*(1), 1429347. https://doi.org/10.1080/23311975.2018.1429347

Kotha, S., & Vadlamani, B. L. (1995, August). Assessing generic strategies: An empirical. *Strategic Management Journal*, *16*(1), 75–83. https://doi.org/10.1002/smj.4250160108

Leonard, W. N. (1971). Research and development in industrial growth. *Journal of Political Economy*, *79*(2), 232–256. https://doi.org/10.1086/259741

Liao, Z., & Tow, M. (2002). Do competitive strategies drive R&D? An empirical investigation of Japanese high-technology corporations. *Journal of High Technology Management Research*, *13*(2), 143–156. https://doi.org/10.1016/S1047-8310(02)00052-4

Lidia, D., & Izabela, K. (2015). Success factors and development barriers perceived by the Polish born global companies. Empirical study results. *Journal of East European Management Studies*, *20*(3), 360–390. https://doi.org/10.5771/0949-6181-2015-3-360

Lome, O., Heggeseth, A. G., & Moen, Ø. (2016). The effect of R&D on performance: Do R&D-intensive firms handle a financial crisis better? *Journal of High Technology Management Research*, *27*(1), 65–77. https://doi.org/10.1016/j.hitech.2016.04.006

Los, B., & Verspagen, B. (2000). R&D spillovers and productivity: Evidence from U.S. manufacturing microdata. *Empirical Economics*, *25*(1), 127–148. https://doi.org/10.1007/s001810050007

Machokoto, M., Gyimah, D., & Ntim, C. G. (2021). Do peer firms influence innovation? *The British Accounting Review*, *53*(5), 100988. https://doi.org/10.1016/j.bar.2021.100988

McGrath, R. G., & Nerkar, A. (2004). Real options reasoning and a new look at the R&D investment strategies of pharmaceutical firms. *Strategic Management Journal*, *25*(1), 1–21. https://doi.org/10.1002/smj.358

Medda, G. (2020). External R&D, product and process innovation in European manufacturing companies. In *Journal of Technology Transfer* (Vol. 45). Springer US. https://doi.org/10.1007/s10961-018-9682-4

Miles, R. E., Snow, C. C., Meyer, A. D., & Jr, H. J. C. (1978). Organizational strategy, structure, and process. *Academy of Management Review*, *3*(3), 546–562. https://doi.org/10.2307/257544

The Office of National Higher Education Science Research and Innovation Policy Council (NXPO). (2019). Annual Report 2019. https://anti-corruption.nxpo.or.th/wp-content/uploads/2020/06/AR-NSTDA-Final-Final.pdf

Parnell, J. A., Carolina, N., Lester, D. L., & Ko, M. A. (2012). How environmental uncertainty affects the link between business strategy and performance in SMEs. *Management Decision*, *50*(4), 546–568. https://doi.org/10.1108/00251741211220129

Parthasarthy, R., & Hammond, J. (2002). Product innovation input and outcome: Moderating effects of the innovation process. *Journal of Engineering and Technology Management - JET-M*, *19*(1), 75–91. https://doi.org/10.1016/S0923-4748(01)00047-9

Pérez, C. Á., Montequín, V. R., Fernández, F. O., & Balsera, J. V. (2017). Integrating Analytic Hierarchy Process (AHP) and Balanced Scorecard (BSC) framework for sustainable business in a software factory in the financial sector. *Sustainability (Switzerland)*, *9*(4), 527. https://doi.org/10.3390/su9040486

Pertusa-Ortega, E. M., Molina-Azorín, J. F., & Claver-Cortés, E. (2010). Competitive strategy, structure and firm performance a comparison of the resource-based view and the contingency approach. *Management Decision*, *48*(8), 1282–1303. https://doi.org/10.1108/00251741011076799

Porter, M. E. (1997). Competitive Strategy. *Measuring Business Excellence*, *1*(2), 12–17. https://doi.org/10.1108/eb025476

Promwong, K. (2021). *Results of Thai R&D investment in 2019*. The Office of National Higher Education Science Research and Innovation Policy Council. https://www.nxpo.or.th/th/7929/

Rivard, S., Raymond, L., & Verreault, D. (2006). Resource-based view and competitive strategy: An integrated model of the contribution of information technology to firm performance. *Journal of Strategic Information Systems*, *15*(1), 29–50. https://doi.org/10.1016/j.jsis.2005.06.003

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of Psychological Research Online*, *8*(2), 23–77.

Sharfaei, S., Ong, J. W., & Ojo, A. O. (2023). The impact of market uncertainty on international SME performance. *Cogent Business & Management*, *10*(1). https://doi.org/10.1080/23311975.2023.2198160

Sharma, C. (2012). R&D and firm performance: Evidence from the Indian pharmaceutical industry. *Journal of the Asia Pacific Economy*, *17*(2), 332–342. https://doi.org/10.1080/13547860.2012.668094

Siripong, W., Phramhan, N., Pimpakarn, P., Panyaying, R., Saengsri, S., Malawaichan, I., & Suttipun, M. (2019). The relationship between research and development disclosure and financial performance of listed companies in the Stock Exchange of Thailand (SET). *MUT Journal of Business Administration*, *16*(2), 173–190. https://doi.org/10.231223/157425

Sukglun, A., Suttapong, K., & Pianroj, N. (2018). Strategies for creating competitive advantage for smart farming enterprise. *Executive Journal*, *38*(1), 91–100. https://so01.tcithaijo.org/index.php/executivejournal/article/view/111945

Suttipun, M., & Arwae, A. (2020). The influence of sufficiency economy philosophy practice on SMEs' performance in Thailand. *Entrepreneurial Business and Economics Review*, *8*(2), 179–198. https://doi.org/10.15678/EBER.2020.080210

Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, *5*(2), 171–180. https://doi.org/10.1002/smj.4250050207

The World Bank. (2022). *Research and development expenditure (% of GDP)*. https://data.worldbank.org/indicator/GB.XPD.RSDV.GD.ZS

Xu, J., & Jin, Z. (2016). Research on the impact of R&D investment on firm performance in China's internet of things industry. *Journal of Advanced Management Science*, 112–116. https://doi.org/10.12720/joams.4.2.112-116

Yodudom, S., Tanachote, B., & Treesilvattanakul, K. (2020). Determinants of Thailand's national innovative capacity. *Chulalongkorn Business Review*, *42*(3), 19–38.

Yusr, M. M., Aliyu, O. A., Khattak, A., Salimon, G., & Muhammad, S. (2022). Determinants of SMEs ' product innovation performance in Malaysia: An extended model determinants of SMEs ' product innovation performance in Malaysia: An extended model. *Cogent Business & Management*, *9*(1). https://doi.org/10.1080/23311975.2022.2152649

Zahra, S. A., & Covin, J. (1993, February). Business strategy, technology policy and firm performance. *Strategic Management Journal*, *14*(6), 451–478. https://doi.org/10.1002/smj.4250140605

Zhu, H., Zhao, S., & Abbas, A. (2020). Relationship between R&D grants, R&D investment, and innovation performance: The moderating effect of absorptive capacity. *Journal of Public Affairs*, *20*(1). https://doi.org/10.1002/pa.1973