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Innovation in European SMEs: Exploring the Influence of Investments, Funding, Knowledge, and Intellectual Assets

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Abstract

This study examines the factors influencing innovation activities among small and medium-sized enterprises (SMEs) across Europe, utilizing data from the European Innovation Scoreboard 2024. SMEs play a vital role in the European economy but face significant challenges in fostering innovation due to limited resources and funding. The research explores the impact of firm investments, public and private funding, knowledge resources, and intellectual assets on SME innovation. Using Partial Least Squares Structural Equation Modeling (PLS-SEM), the analysis found that firm investments and knowledge resources have a significant positive effect on innovation activities. However, public and private funding and intellectual assets showed no significant direct influence on innovation. The findings contribute to a deeper understanding of the complex landscape of SME innovation in Europe, with implications for policy and strategic decision-making. Limitations include the cross-sectional nature of the data and the lack of sector-specific analysis, pointing to areas for further research.

Keywords: European SMEs, Innovation activities, Knowledge resources, Intellectual assets, Funding, R&D investments.

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1. Introduction

Small and medium-sized enterprises (SMEs) are central to the European economy, accounting for approximately 99% of all businesses within the European Union (EU) and contributing around 70% of private sector employment (Hogeforster et al., 2021). Recognized as engines of economic growth and technological advancement, SMEs play a crucial role in fostering innovation. However, despite their importance, SMEs encounter significant challenges that impede their ability to innovate, such as limited financial resources, restricted access to funding, and insufficient partnerships with external collaborators (Rahman & Ramos, 2013; Juergensen et al., 2020).

European SMEs must strategically acquire knowledge resources and intellectual assets to overcome these barriers and build competitive advantages (Abreu et al, 2023). Effective knowledge management practices are vital for SMEs to leverage these assets and boost their innovation capabilities (Vătămănescu et al., 2020; Ibidunni et al., 2020). Collaborative partnerships with universities and research institutions facilitate the transfer of knowledge, enabling SMEs to implement new technologies and innovative practices (Sulhaini, 2023; Marcelino-Sádaba et al., 2015). Therefore, fostering a supportive environment for collaboration and knowledge sharing is essential for the sustainability and growth of SMEs in Europe (Písař & Mazo, 2020; Alexandrakis et al., 2022).

While past research has examined the interplay between knowledge resources, public and private funding, and R&D investments in SME innovation, as well as the impact of intellectual assets on a local scale, this study offers a refreshed and comprehensive perspective. Utilizing the latest indicators from the European Innovation Scoreboard 2024, this research aims to capture a current and broad view of these relationships. By encompassing all European countries, this study seeks to identify general trends and insights into the innovation landscape of SMEs across Europe, providing a macro-level understanding rather than individualized, country-specific findings.

This study will be conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM), a robust statistical method that allows for the analysis of complex relationships between multiple variables. This approach is particularly well-suited for assessing the interconnections between knowledge resources, intellectual assets, public and private funding, firm investments, and innovation activities within European SMEs. The use of PLS-SEM will enable a comprehensive examination of the research model, providing valuable insights into the broader trends and influences across the European innovation landscape.

2. Theoretical background and hypothesis development

2.1 Public & Private Funding and Innovation

Government funding is important for boosting R&D spending in different sectors. According to Huňady et al. (2023), more government financial support leads to increased business R&D funding, especially in higher education. This is due to improvements in basic research, better research infrastructure, and developing human capital. Similarly, Dobrovolska et al. (2023) notes that state funding, like subsidies, helps shape R&D spending and encourages both local and international research. This means that government support can effectively encourage private sector investment in R&D, promoting innovation. Halásková et al. (2020) provide evidence showing that R&D efforts from the government and higher education help create new knowledge, which is crucial for improving companies' innovation. Their analysis shows that public R&D not only grows knowledge but also supports sustainable resource use, proving the importance of government funding for innovation.

Moreover, higher education institutions (HEIs) play a central role in the innovation system as research centers and partners for private companies. Leron and Baconguis (2021) state that HEIs' innovation performance is shaped by factors like government support and institutional R&D culture. George and Tarr (2021) highlight that partnerships between HEIs and private firms are key for driving innovation in R&D, as these collaborations allow for shared resources, knowledge, and expertise.

Venture capital (VC) is also an important funding source that works alongside government support. Studies show that higher R&D spending boosts entrepreneurship, especially in high-tech industries (Benlaria et al., 2023). Ren (2022) explains that industrial investment funds, along with government R&D subsidies, create strong financial channels for technological innovation. Moretti et al. (2019) add that government-funded R&D can increase private R&D investment, creating a "crowding in" effect, which means that government support can attract more private funding, enhancing overall innovation.

Equally important, tax incentives and funding from governments are also key tools to boost R&D. Møen (2019) notes that direct grants and tax credits serve different goals: grants often go to high-risk projects with low private benefits, while tax credits let companies choose projects based on private gains. This tailored approach shows the importance of specific financial support for fostering innovation.

Despite these benefits, there are challenges. Demir (2019) points out that while the business sector leads in R&D spending, there needs to be a better balance with government and higher education contributions for a more complete innovation system. Finally, Petti et al. (2017) show that while innovation-support policies help firms' R&D efforts improve performance, this effect is more complex when firms already have high innovation capacity. The study suggests that policies are most effective when R&D is a main driver of innovation, especially in Chinese high-tech SMEs.

This research aims to contribute to the existing literature by providing updated insights into the broader, cross-national factors influencing SME innovation in Europe, thereby addressing gaps in understanding how public & private funding collectively shape innovative outcomes. Therefore, we can hypothesize that:

H1: Public and Private Funding positively affect Innovation Activities in European SMEs.

2.3 Intellectual assets and innovation

Patents are an essential type of intellectual asset that protect technological innovations by giving inventors exclusive rights to their creations. This protection encourages firms to invest in research and development (R&D), knowing they can benefit from their ideas without the risk of imitation. This is particularly important in technology-driven industries, where rapid change and high R&D costs make strong incentives necessary for innovation (Ren, 2023). Patents also signal a company's technological strength, attracting partners and investors, and boosting its market position (Dabić et al., 2021). Additionally, patents help companies stand out and create barriers for competitors (Turulja and Bajgorić, 2019).

Designs, which cover both the look and functionality of products, are another crucial intellectual asset. They enhance product innovation by making products more attractive and user-friendly. Using design thinking in the innovation process promotes creativity and supports the development of products that cater to user needs (Torres-Benoni, 2023). Companies that focus on design often see better business results, including higher customer satisfaction and loyalty (Faroque et al., 2017). Design-driven innovation can also lead to new business models that use unique design features to create added value (Lang and Amberg, 2010).

Trademarks are important for building a brand identity and earning consumer trust. They help set a company's products apart from those of competitors, fostering customer loyalty and encouraging repeat purchases. This kind of differentiation is vital in competitive markets where consumers have many choices. A strong trademark can create a unique value that increases market share and profitability (Beise, 2005; Yang et al., 2016). Trademarks also enhance the perceived quality of products, motivating further innovation in design (Yang et al., 2016).

Generally, intellectual assets contribute to business process innovation. Patents can help integrate new technologies that optimize production and improve performance (Hariyati and Tjahjadi, 2018). Companies that align their business processes with their intellectual assets become more flexible and better prepared to adapt to market changes and meet customer needs (Liu, 2023). Intellectual assets also promote collaboration and knowledge sharing, which are crucial for forming partnerships and alliances. This collaborative approach enables firms to use external expertise to improve their innovation capabilities and find solutions to complex challenges (Koç and Sandkuhl, 2017).

To illustrate further, intellectual assets give companies a competitive advantage in global markets. Strong portfolios of patents and trademarks help protect innovations during international expansion and shield companies from local competitors (Beise, 2005; Dabić et al., 2021). Managing intellectual property strategically ensures that companies can fully benefit from their assets and sustain their innovation efforts (Liu, 2023). Firms that promote a collaborative culture can better maximize the value of their intellectual assets through teamwork and shared knowledge (Tabeau et al., 2016).

This research aims to contribute to the existing literature by providing updated insights into the broader, cross-national factors influencing SME innovation in Europe, thereby addressing gaps in understanding how intellectual assets collectively shape innovative outcomes. Therefore, we can hypothesize that:

H2: Intellectual assets positively affect Innovation Activities in European SMEs.

2.4 Firm Investments and innovation

The influence of R&D investment on innovation performance is complex. Li (2021) showed that R&D intensity is linked to higher profitability, indicating that companies focusing on R&D tend to achieve better financial results. Demirkan et al. (2021) highlighted the importance of efficient resource management and employee training for improving product innovation, especially in SMEs. Furthermore, spending on R&D per employee is a key measure of a company's innovation potential. Research shows that higher R&D investment per employee leads to better innovation outcomes. Segarra-Blasco and Teruel (2014) found that both internal and external R&D spending positively affects company growth, suggesting that more resources allocated to R&D can boost innovation performance. On a related note, private equity is also important for driving innovation as it provides crucial funding and strategic guidance for R&D investments. This support helps companies conduct substantial research and development, which directly impacts their innovation performance. Pan et al. (2021) found that R&D investment significantly drives innovation efficiency, especially in supply chain financing. Similarly, Liu and Dong (2019) emphasized that R&D investments are essential for building technological innovation capabilities. Besides funding, private equity also brings management expertise that enhances the strategic planning of R&D activities. It is also essential to note that, companies in competitive markets often invest heavily in R&D to maintain their market position and differentiate their products (Yang and Ha, 2023). This can lead to increased R&D spending as companies strive for innovation and a greater market share. R&D activities not only enhance products but also improve operational efficiency and overall performance (Zhu and Huang, 2012).Heavy investment in R&D is linked to producing more patents and innovative products, boosting market value and profitability (Ferreira et al., 2016). This demonstrates that R&D is a strategic investment with long-term benefits that outweigh initial costs.

Nevertheless, effectiveness of R&D can be affected by factors such as the firm’s life cycle and economic conditions. Young firms often show different R&D investment patterns compared to established companies, driven by their need to build market presence (Zhang et al., 2021). During economic downturns, firms might cut R&D spending to maintain financial stability, impacting their long-term innovation potential (Patel and Chrisman, 2013). The use of digital technologies in R&D has become more significant with Industry 4.0, allowing firms to streamline processes and respond more effectively to market demands (Xia and Liu, 2021).

This research aims to contribute to the existing literature by providing updated insights into the broader, cross-national factors influencing SME innovation in Europe, thereby addressing gaps in understanding how firm investments collectively shape innovative outcomes. Therefore, we can hypothesize that:

H3: Firms Investments positively affect Innovation Activities in European SMEs.

2.5 Knowledge resources and innovation

Higher education and a skilled workforce are essential for driving innovation within businesses. Studies by Bai (2024) and Aldieri et al. (2018) show that companies with employees who have strong educational backgrounds, particularly in science, technology, engineering, and mathematics (STEM), tend to achieve better innovation outcomes.

International scientific collaboration also boosts innovation. Co-publications between researchers from different countries not only spread knowledge but create a culture of sharing new ideas that businesses can use to drive innovation (Koria et al., 2022). This is supported by Gao and Guan (2011), who found that knowledge shared through academic networks enhances firms' capacity to innovate by providing access to advanced research and global insights.

The presence of highly cited scientific publications is another sign of impactful research that companies can leverage. High-quality research outputs offer valuable information that supports the development of innovative products and processes. This is in line with Graf (2023), who highlighted the importance of global knowledge-sharing networks that facilitate the exchange of significant information.

The number of foreign doctorate students also plays an important role in boosting innovation activities. These students bring diverse perspectives and specialized expertise, enriching the talent pool within academic and business settings. This international influx of skilled individuals encourages cross-cultural knowledge sharing, which can enhance a company's innovation potential (Kaygalak and Reid, 2016).

Lifelong learning is also crucial factor for sustaining and improving a firm's innovation capacity. Kuzior et al. (2023) argue that continuous education is essential for maintaining competitiveness, as it supports adaptability and the integration of new technologies. Similarly, Zygmunt (2020) found that firms focusing on lifelong learning and human resource development are more likely to engage in successful innovation efforts.

This research aims to contribute to the existing literature by providing updated insights into the broader, cross-national factors influencing SME innovation in Europe, thereby addressing gaps in understanding how intellectual assets collectively shape innovative outcomes. Therefore, we can hypothesize that:

H4: Knowledge Resources positively affect Innovation Activities in European SMEs.

2.6 Firm investments, intellectual assets and innovation

The relationship between intellectual assets, especially patents, and how they affect investment and innovation is complex and varied. Patents are crucial for protecting new ideas, encouraging firms to invest in R&D, and shaping investment strategies. Research shows that patents give firms a temporary monopoly, allowing them to recover R&D costs and profit from their inventions. Czarnitzki and Toole (2011) explain that patent protection boosts a firm's motivation to invest in R&D by ensuring they can benefit from their innovations. Williams (2017) also notes that strong patent rights can encourage research investments, though he mentions the need for more evidence. Holgersson and Granstrand (2021) highlight that without patents; firms would have to rely on product sales alone to recover their R&D investments, showing how patents are important for investment planning.

However, the link between patents and innovation is not always simple. Schwiebacher (2013) points out that when IP ownership is complex, investment can be hindered, as firms may face challenges in negotiating with multiple patent holders, which can reduce innovation. Jin et al. (2020) found that having a strong patent portfolio can boost a firm's innovation potential and attract investors, linking patents to improved innovation and the development of human capital. On the downside, "patent thickets," or overlapping patent claims, can create obstacles by increasing costs and complicating investment decisions (Schwiebacher, 2012).

Patents also help attract venture capital (VC). Pierrakis and Saridakis (2017) found that firms active in patenting are more likely to get Venture Capital funding, as patents indicate innovation potential. Hirukawa and Ueda (2011) add that innovations often create a need for VC rather than the reverse.

The variety in a firm's patent portfolio also matters. Dong et al. (2020) found that diverse patent holdings strengthen the positive effects of R&D, allowing firms to make better use of their investments. This shows that both the number and range of patents can drive innovation performance.

Other intellectual assets, such as trademarks and designs, also affect the relationship between investment and innovation. Trademarks help build brand identity and consumer trust, supporting the launch of new products. Research by Silva and Santana (2022) shows that firms with strong trademark portfolios tend to have better market performance and innovation results. Thoma (2015) add that trademarks can make it easier for new products to enter the market, boosting further R&D investment. Designs also add value by making products more appealing, motivating firms to invest in R&D for unique products (Shin, 2023).

Strong IP laws help firms feel secure about protecting their innovations, which encourages investment in R&D (Haq, 2022). On the other hand, weak IP enforcement can discourage firms from investing due to the risk of imitation (Qayyum et al., 2022).

The type of investor matters, too. Corporate venture capital (CVC), which often provides strategic support, can boost the number of patents a startup holds and improve innovation (Grazzi et al., 2019).

Combining different types of IP, such as patents and trademarks, can strengthen a firm’s innovation strategy. Firms that use both can protect their products more effectively, covering functional and brand aspects (Grazzi et al., 2020). Studies have shown that strong IP rights lead to more patent and trademark applications, proving that a solid IP strategy supports successful innovation (Dementev, 2021).

However, the previous studies have examined the relationship between intellectual assets, firm investments and innovation activities; this research aims to contribute to the existing literature by providing updated insights into the broader, cross-national factors influencing SME innovation in Europe, thereby addressing gaps in understanding if intellectual assets moderate the relationship between firm investments and innovation activities collectively. Therefore, we can hypothesize that:

H5: Intellectual Assets moderate the relationship between Firm Investments and Innovation Activities in European SMEs.

3. Methodology

3.1 Data Collection and variables description

This study utilizes data from the European Innovation Scoreboard (EIS) 2024, which includes information for all European countries, encompassing EU Member States and 12 neighboring European nations. The EIS compiles data on innovation performance sourced from organizations such as Eurostat, OECD, and Scopus, with a strong focus on the role of small and medium-sized enterprises (SMEs) in enhancing the competitive edge of regions and countries.

The EIS is an annual report by the European Commission that evaluates and compares the innovation performance of EU Member States, neighboring European countries, and select global competitors. It relies on 32 indicators that span various areas, including the economy, business and entrepreneurship, innovation characteristics, governance and policy frameworks, climate change, and demographic trends. For more information, please visit European Innovation Scoreboard.

Following constructs were developed: Knowledge resources (New doctorate graduates, Population with tertiary education, Population involved in lifelong learning, International scientific co-publications, Scientific publications among the top 10% most cited, Foreign doctorate students as a % of all doctorate Students), Public & private funding (R&D expenditures in the public sector, Venture capital expenditures, Direct and indirect government support of business) and Firm investments (Innovation expenditures per person employed in innovation-active enterprises, Enterprises providing ICT training) as independent variables (Table 1), Innovation activities (SMEs introducing product innovations, SMEs introducing business process innovations, Innovative SMEs collaborating with others) as dependent variable and Intellectual assets (PCT patent applications, Trademark applications, Design applications) is the moderating variable (Table 1).

3.2 Data analysis technique

Partial Least Squares Structural Equation Modeling (PLS-SEM) is increasingly recognized for its efficacy in analyzing complex relationships among latent variables, particularly in exploratory research contexts. This method is particularly advantageous when dealing with small sample sizes and non-normally distributed data, making it suitable for various fields, including management and social sciences (Baquero, 2023). PLS-SEM utilizes a two-step approach, first assessing the measurement model and then the structural model, which allows for a comprehensive understanding of the relationships between, constructs (Zan, 2023).

Table 1: Variables and their descriptions (Table by authors)

Variables	Dimensions	Description
Knowledge Resources	New doctorate graduates	How many individuals with doctor degrees in science, technology, engineering, or mathematics fields graduate each year?
	Population with tertiary education	What percentage of the population aged 25-34 has completed tertiary education?
	Population involved in lifelong learning	How many individuals participate in continuous learning activities throughout their lives to update their skills and knowledge?
	International scientific co-publications	How frequently do researchers from different countries collaborate and publish together?
	Scientific publications among the top 10% most cited	What percentage of publications are among the most cited in their respective fields?
	Foreign doctorate students as a % of all doctorate Students	How many students from other countries are pursuing doctoral degrees within the country’s universities?
Public & Private Funding	R&D expenditures in the public sector	How much funding is allocated to research and development activities by the government and the higher education sector?
	Venture capital expenditures	How much private equity is raised for investment in innovate startups?
	Direct and indirect government support of business	What financial support does the government provide to business for research and development, both through direct funding and tax incentives?
Firm Investments	Innovation expenditures per person employed in innovation-active enterprises	How much is spent on innovation per employee in companies actively engaged in innovation?
	Enterprises providing ICT training	How many businesses offer training programs to enhance the ICT skills of their employees?
Innovations Activities	SMEs introducing product innovations	How many small and medium-sized enterprises have introduced new products to the market?
	SMEs introducing business process innovations	How many SMEs have implemented innovative changes to their business processes?
	Innovative SMEs collaborating with others	How many SMEs are engaged in collaborative efforts with other organizations?
Intellectual Assets	PCT patent applications	How many international patent applications are filed under the Patent Cooperation Treaty?
	Trademark applications	How many new trademarks are applied for?
	Design applications	How many new designs for products or services are being registered for protection?

Source: European Innovation Scoreboard

4. Results

4.1 Measurement model assessment

4.1.1 Construct Reliability and Validity

Reliability and validity of the measurement model were established using techniques such as, composite reliability (CR), Fornell-Larcker Criterion and Average Variance Extracted (AVE) (Table 2). Composite reliability (CR) values greater than 0.70, indicated a satisfactory to good level of reliability. AVE values needed to surpass 0.50 to ensure adequate convergent validity (Hair et al., 2014). Additionally, Cronbach's alpha values above 0.70 were considered indicative of strong model reliability. These findings show that the model's reliability level is satisfactory (Hair et al., 2014).

Table 2: Variables and their descriptions (Table by authors)

Variables	Cronbach'salpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Firm Investments	0.754	0.754	0.890	0.802
Innovation Activities	0.877	0.911	0.923	0.799
Intellectual Assets	0.811	1.149	0.865	0.683
Knowledge Resources	0.918	0.955	0.935	0.708
Public & Private Funding	0.754	0.816	0.859	0.674

4.1.2 Discriminant validity

Discriminant validity was assessed using the Fornell-Larcker criterion, requiring diagonal values to be higher than the correlations between constructs within the same rows and columns (Fornell and Larcker, 1981) (Table 3). To reinforce this assessment, the Heterotrait-Monotrait Ratio (HTMT) was applied, with acceptable values below 0.90, affirming robust discriminant validity (Henseler et al., 2016) (Table 4). The Heterotrait-Monotrait (HTMT) ratio is also discovered to be an improved method fordetermining the discriminant's reliability.

The HTMT ratios are all smaller than 0.9 (Table 4), which reveals good discriminant's reliability, according to (Henseler et al., 2016). The Smart-PLS4 software was used for hypothesis testing. The structural model provided the correlation coefficients and the significance level of the hypothesized relationships among the variables.

Table 3: Fornell-Larcker Criterion (Table by authors)

	Firm Investments	Innovation Activities	Intellectual Assets	Knowledge Resources	Public & Private Funding
Firm Investments	0.896				
Innovation Activities	0.657	0.894			
Intellectual Assets	0.550	0.419	0.826		
Knowledge Resources	0.566	0.623	0.829	0.842	
Public & Private Funding	0.609	0.581	0.733	0.749	0.821

Table 4: Heterotrait-Monotrait (HTMT) Ratio (Table by authors)

	Firm Investments	Innovation Activities	Intellectual Assets	Knowledge Resources	Public & Private Funding	Intellectual Assets x Firm Investments
Firm Investments						
Innovation Activities	0.784					
Intellectual Assets	0.576	0.366				
Knowledge Resources	0.650	0.618	0.867			
Public & Private Funding	0.796	0.668	0.742	0.873		
Intellectual Assets x Firm Investments	0.318	0.115	0.203	0.187	0.074	

4.1.3 Factor loadings

The types of latent variables and their corresponding factor loadings are presented in Figure 1. Findings revealed that factor loadings were deemed acceptable when they exceeded 0.70 (Hair et al., 2014). However, loadings between 0.40 and 0.70 could also be considered, provided that AVE and CR criteria were met (Hair et al., 2019). Items with low factor loading were removed.

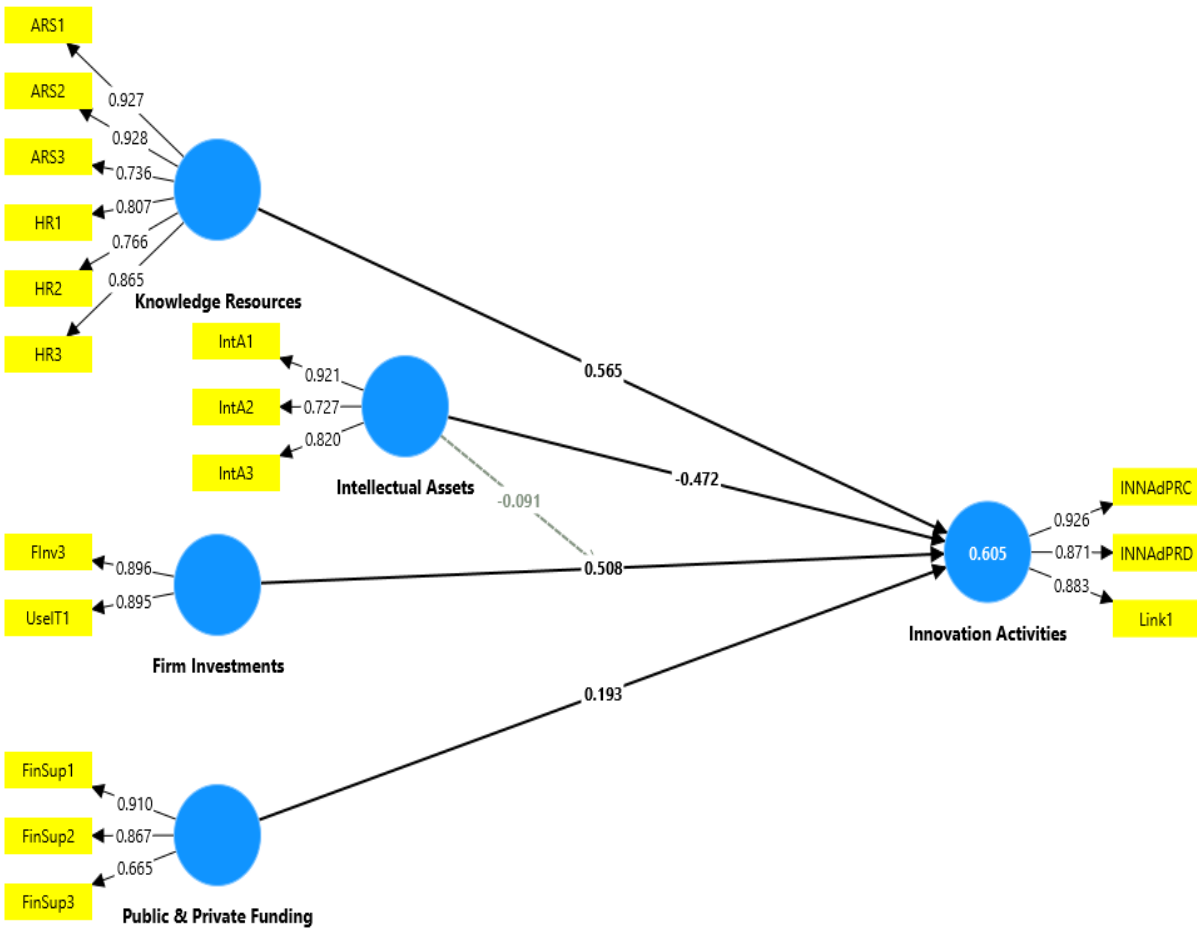

Figure 1: PLS Path model (extracted by authors)

4.1.4 Collinearity Statistics

To evaluate multicollinearity among constructs, this study used the Variance Inflation Factor (VIF) (Table 5). In Smart PLS 4, VIF is a key metric to identify potential multicollinearity, which occurs when constructs are too highly correlated and can distort model results. VIF values below 3.3 were deemed acceptable, indicating no multicollinearity concerns, while values above 5 suggested potential issues that could affect model reliability (Chin et al., 2020). This assessment ensured that the constructs were distinct enough to provide accurate and meaningful interpretations of the model.

Table 5: Variance Inflation Factor (Table by authors)

	VIF
ARS1	4.763
ARS2	4.437
ARS3	2.003
FInv3	1.576
FinSup1	2.095
FinSup2	1.979
FinSup3	1.255
HR1	2.373
HR2	1.909
HR3	3.543
INNAdPRC	4.092
INNAdPRD	3.302
IntA1	1.583
IntA2	2.232
IntA3	2.906
Link1	1.904
UseIT1	1.576
Intellectual Assets x Firm Investments	1.000

4.1.5 R Square

R^2 is an important metric in PLS-SEM, as it indicates the explanatory power of the model—how well it fits the observed data (Table 6). Higher R^2 values represent a better model fit. According to established guidelines, R^2 values of 0.75, 0.50, and 0.25 are categorized as substantial, moderate, and weak, respectively (Hair et al., 2014). In this study, the construct for Innovation Activities has a moderately strong R^2 value of 0.605, suggesting that the model explains a significant portion of the variance in innovation activities.

Table 6: R square (Table by authors)

	R-square	**R-square adjusted**
Innovation Activities	0.605	0.545

4.2 Structural Model Assessment

Finally, the bootstrapping technique was performed to test hypotheses and generate results for the structural model using PLS-SEM with a resample of 5000 in Figure 2. This approach provided a thorough validation process, ensuring the model's reliability and accuracy.

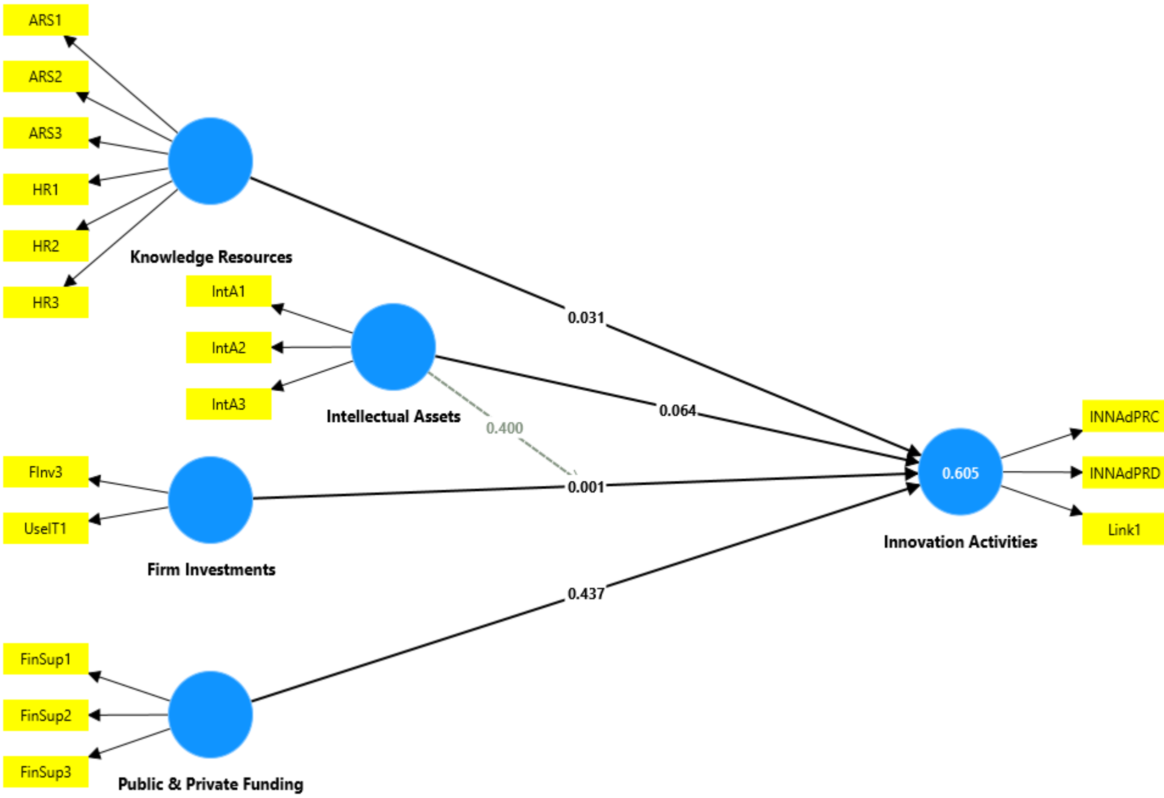

Figure 2: Structural model (extracted by authors)

4.3 Significance and Relevance of Path Coefficients

The t-value is crucial for assessing the significance of relationships. A relationship is considered significant if the t-value is greater than 1.96 or the p-value is below 0.05 (Hair et al., 2014, 2019).

In this study, the first hypothesis, H1, examined the relationship between firm investments and innovation activities. The t-value was higher than 1.96, and the p-value was lower than 0.05, signifying a positive and significant relationship. The second hypothesis, H2, examined the relationship between intellectual assets and innovation activities. The t-value was higher than 1.96, and the p-value was higher than 0.05, signifying an insignificant relationship. The third hypothesis, H3, examined the relationship between knowledge resources and innovation activities. The t-value was higher than 1.96, and the p-value was lower than 0.05, signifying a positive and significant relationship. The fourth hypothesis, H4, examined the relationship between public & private funding and innovation activities. The t-value was lower than 1.96, and the p-value was higher than 0.05, signifying an insignificant relationship. Therefore, only hypotheses H1 and H3were supported.

Moderation is indicated when the strength or direction of the relationship between two constructs changes based on a third variable. In this study, intellectual assets serve as the moderating variable. A moderating construct influences the relationship between exogenous and endogenous variables, showing its effect when the interaction's significance level is below 0.05. If the p-value is below 0.05, the moderating effect is considered significant; if it is above 0.05, the effect is not significant. In this study, the p-value for moderating effects intellectual assets was not significant, leading to the rejection of hypothesis H5. The summary of all hypotheses are shown in Table 7.

Table 7: Direct effects (extracted by authors)

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	
Firm Investments > Innovation Activities	0.508	0.522	0.157	3.227	0.001	H1 Supported
Intellectual Assets > Innovation Activities	-0.472	-0.384	0.255	1.849	0.064	H2 Not Supported
Knowledge Resources > Innovation Activities	0.565	0.526	0.261	2.163	0.031	H3 Supported
Public & Private Funding > Innovation Activities	0.193	0.149	0.248	0.777	0.437	H4 Not Supported
Intellectual Assets x Firm Investments > Innovation Activities	-0.091	-0.090	0.108	0.842	0.400	H5 Not Supported

5. Discussion

The findings of this study offer important insights into what drives innovation activities among SMEs in Europe. One significant result is that firm investments have a positive and notable impact on innovation. This shows that investing strategically in R&D and employee training can greatly boost a company's ability to innovate. Companies that spend more per employee and offer training programs, especially in ICT, tend to achieve better outcomes in innovation. This aligns with existing research that points out the benefits of R&D investments for long-term success and competitiveness.

Another key finding is the positive effect of knowledge resources on innovation activities. The data highlights the importance of a well-educated workforce and international scientific collaboration in driving innovation. High levels of education and active international co-publications contribute to the innovative capacity of firms. These findings support the view that investing in human capital and sharing knowledge are essential for fostering innovation.

However, the study found that public and private funding did not have a significant impact on innovation activities. Although funding is often seen as a vital tool for supporting innovation, these results suggest that simply having access to financial resources may not be enough. Companies need other elements, such as strategic investments and the ability to absorb and use new knowledge, to make the most of such funding.

The analysis of intellectual assets revealed no significant direct or moderating relationship with innovation activities. While intellectual assets like patents are usually considered important for protecting innovation and attracting investments, this study found that they do not directly contribute to increasing innovation. This could be due to challenges related to managing and leveraging these assets effectively, such as navigating complex patent landscapes, which might sometimes hinder innovation instead of promoting it.

5.1 Limitations

Despite these valuable findings, this study has several limitations that should be noted. First, the analysis relied on data from the *European Innovation Scoreboard*, which, while detailed, might have variations in the quality and availability of data for some countries or time periods. This could influence the consistency of the findings.

Second, while the study includes data from all European countries, the results might not fully apply to each individual country or industry. Conditions that affect innovation can differ widely across regions, so the general trends identified here may not capture specific local or sectoral nuances.

Third, the study is based on cross-sectional data, meaning it captures a snapshot in time. This approach does not allow for conclusions about causality. To understand how these relationships develop over time, future research could use longitudinal data to track changes and trends.

Another limitation is that the analysis did not differentiate between different industry sectors. The factors that drive innovation may vary between industries, so future research could benefit from a more detailed, sector-specific approach.

These limitations should be kept in mind when interpreting the findings. Future research could address these challenges by incorporating more detailed data, exploring sector-specific effects, and using qualitative methods to gain a deeper understanding of the factors that drive innovation in SMEs.

6. Conclusions

In conclusion, this study provides valuable insights into the complex factors that influence innovation in European SMEs. The findings reveal that while firm investments and knowledge resources positively contribute to innovation activities, public and private funding alone may not be sufficient to drive innovation. The role of intellectual assets as a direct or moderating factor was found to be insignificant, suggesting that the management and effective use of these assets might be more complicated than previously thought.

These results emphasize the need for policies that not only provide funding but also support strategic investments and foster a culture of learning and collaboration. SMEs should prioritize investing in their human capital and engaging in international knowledge-sharing initiatives to strengthen their innovative capabilities. Future research should address the limitations identified in this study, such as the cross-sectional nature of the data and the need for sector-specific analysis. By addressing these areas, future studies can provide a more comprehensive understanding of how to sustain and enhance innovation across Europe's diverse SME landscape.

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