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## **THE ROLE OF STATE ECONOMIC POLICY IN THE IMPLEMENTATION OF NEW TECHNOLOGIES AND INNOVATIONS: THE CASE OF PUBLIC-PRIVATE PARTNERSHIPS IN EU COUNTRIES**

## **РОЛЬ ДЕРЖАВНОЇ ЕКОНОМІЧНОЇ ПОЛІТИКИ У ВПРОВАДЖЕННІ НОВИХ ТЕХНОЛОГІЙ ТА ІННОВАЦІЙ: НА ПРИКЛАДІ ДЕРЖАВНО-ПРИВАТНОГО ПАРТНЕРСТВА В КРАЇНАХ ЄС**

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**Abstract.** *This article examines the role of state economic policies in promoting new technologies and innovations, with a focus on public-private partnerships (PPPs) in several EU member states. It studies how collaboration between the public and private sectors influenced by state economic policies contributes to the development of new technology. Through a comprehensive analysis of multiple case studies and empirical data, this work assesses how these policies could promote innovation and technological advancement under PPP frameworks. It particularly examines how different state interventions - such as financial incentives, regulatory frameworks, and direct investments - interact with private sector capabilities to foster technological advancements. Additionally, it identifies best practices and potential areas for policy improvement to enhance the impact of PPPs on innovation.*

**Keywords:** *state economic policy, new technologies, innovations, public-private partnerships, European Union, Germany, Sweden*

**Анотація.** *У статті розглядається роль державної економічної політики у сприянні впровадженню нових технологій та інновацій, з особливим акцентом на державно-приватне партнерство (ДПП) у кількох країнах-членах ЄС. Досліджується, як співпраця між державним і приватним секторами, що перебуває під впливом державної економічної політики, сприяє розвитку нових технологій. Завдяки комплексному аналізу кількох кейсів і*

емпіричних даних, у роботі оцінюється, як ці політики можуть сприяти інноваціям і технологічному прогресу за рахунок дії механізму ДПП. Особлива увага приділяється тому, як різні державні втручання, такі як фінансові стимули, регуляторні рамки та прямі інвестиції, взаємодіють із можливостями приватного сектору для сприяння технологічному прогресу. Крім того, у статті визначаються найкращі практики та можливі напрями вдосконалення політик для підвищення впливу ДПП на інновації.

**Ключові слова:** державна економічна політика, нові технології, інновації, державно-приватне партнерство, Європейський Союз, Німеччина, Швеція.

**Introduction.** The rapid advancement of technology is fundamentally altering modern economies, driving productivity growth, and enhancing competitiveness. In this context, the significance of state economic policy in facilitating the adoption and integration of new technologies and innovations into society cannot be overstated. PPPs have emerged as a pivotal mechanism for governments to collaborate with private sector entities, aiming to promote technological development and innovation.

State economic policy encompasses a broad spectrum of interventions aimed at influencing economic activities within a country or region. These interventions include fiscal measures, monetary policies, regulatory frameworks, and investment incentives. In the context of technological innovation, state economic policy plays a critical role in creating an environment conducive to innovation, investment, and collaboration between public and private sectors.

This article critically examines the role of state economic policy in leveraging PPPs to facilitate the implementation of new technologies and innovations in EU countries.

The purpose of this article. Despite the potential benefits of PPPs in promoting the adoption and diffusion of new technologies, the actual impact of state economic policies in facilitating these partnerships within the EU remains underexamined. The variability in policy effectiveness across different member states and sectors presents a complex landscape. This raises questions about the optimal strategies for policy formulation and implementation that truly enhance innovation through PPPs.

**The purpose of this article** is to critically analyse how state economic policies influence the success of PPPs in driving technological innovation within the EU. It seeks to identify key policy elements that are most effective in enhancing the adoption and scaling of new technologies through these partnerships.

**The following research questions are addressed in the study.**

How do state economic policies in EU countries facilitate the adoption of new technologies through Public-Private Partnerships?

What are the key factors that influence the effectiveness of these policies in different EU member states?

How do regulatory frameworks impact the operational success of PPPs in the technology sector across the EU?

What role do fiscal incentives and investments play in enhancing the capability of private sector partners within PPPs?

How can EU member states optimize their economic policies to maximize the benefits of PPPs in fostering innovation?

These elements frame the study in a way that allows for an in-depth examination of state policies, offering insights into the dynamics of public and private sector collaboration in the technological field within the EU.

**Literature Review.**

**Government Intervention as a Catalyst for Innovation.** Governments play a pivotal role in addressing market failures and fostering innovation, particularly in sectors that the private sector may neglect due to the high risks associated with long-term investments. Recent studies underscore

the necessity of public involvement in foundational research and development (R&D), arguing that without such intervention, essential but unprofitable research initiatives would be overlooked (Freeman, 1987; Acs et al., 2016).

**State Support for R&D and Innovation Systems.** Recent analyses reveal that government support through funding and tax incentives can stimulate private sector innovation, thereby enhancing economic growth. Public funding for basic and applied research forms the cornerstone for technological advancements by supporting scientific discoveries and breakthroughs. Lundvall's concept of national innovation systems illustrates how government policies can facilitate effective collaboration between various actors in the innovation process, significantly impacting the innovation ecosystem (Lundvall, 1992). For example, recent work by Zhang et al. (2022) examines the role of government incentives in promoting technological innovations within national innovation systems.

**Recent Perspectives on State Economic Policy in Innovation.** Recent studies highlight the dynamic role of state economic policies in encouraging firms to innovate by mitigating risks associated with market volatility. Aghion et al. (2019) explore how state-driven uncertainties can spur innovation by mitigating risks associated with market volatility. Howell (2017) provides empirical evidence on the effectiveness of R&D grants in boosting firm-level innovation, showcasing the benefits of targeted government support. Additionally, Li and Feng (2021) analyze the impact of fiscal policies on innovation outputs, finding a significant positive correlation between government subsidies and technological advancements.

**Modern Insights and Practical Outcomes.** Combining historical insights with recent empirical evidence underlines the continued importance of strategic public intervention in fostering an integrated innovation ecosystem, particularly through PPPs in the EU. Acs et al. (2016) advocate for balanced policies that stimulate both the creation and commercialization of innovations, ensuring that innovations not only emerge but also effectively reach the market and society at large. Recent studies by Zhou and Wu (2022) emphasize the importance of government-led innovation policies in fostering sustainable technological advancements.

**General Trends and International Perspectives.** State economic policies in the EU emphasize the development of digital infrastructure, renewable energy, and healthcare through PPPs. Financial incentives, regulatory adjustments, and direct government funding are common trends. Countries such as Germany and Sweden have significantly increased their allocations to PPPs, focusing on high-tech and sustainable projects. This trend reflects a strategic alignment between state policies and the sectors identified as priority areas for the EU.

**Conflicts and Challenges in Policy Implementation.** Despite the benefits, regulatory barriers often hinder the effectiveness of PPPs. Complex procurement processes, legal constraints, and differing regulatory frameworks across EU member states are significant challenges. Smith and Jones (2020) discuss the complexities of public procurement processes, highlighting the delays and administrative burdens these can impose on PPP projects. Johnson et al. (2019) emphasize the legal constraints and varying regulatory frameworks that create barriers to cross-border collaboration in PPPs. More recently, Evans and Clark (2021) highlight the regulatory challenges faced by PPPs in the technology sector, suggesting the need for harmonized policies across the EU to streamline operations.

**Funding and Investment Challenges.** Funding limitations, especially for SMEs and startups, present a significant challenge. Garcia et al. (2018) highlight the difficulties SMEs face in accessing bank financing for innovation projects due to stringent collateral requirements. Brown and Smith (2020) illustrate geographical disparities in venture capital investment in the EU, demonstrating how most funds flow to established innovation hubs, leaving startups outside these areas with limited access to VC funding. Public funding initiatives, including grants, subsidies, and tax incentives, can help bridge the funding gap for innovative SMEs and startups. Simplifying application procedures and providing targeted support are essential steps in ensuring equitable access to funding and investment for innovation projects. Recent analysis by Liu et al. (2023)

underscores the importance of flexible financing mechanisms in supporting the growth of innovation-driven enterprises.

Scientific Gaps and Strengths in Research. There are significant gaps in the current research, particularly in understanding the long-term impacts of state economic policies on innovation through PPPs. Future research could focus on comparative studies across different sectors, track long-term impacts, and make global comparisons to see what works best for fostering innovation.

### **Research Methodology.**

The study on the role of state economic policy in encouraging innovation through PPPs in the EU used the combination of qualitative and quantitative methods. This comprehensive approach aimed to address the research questions and achieve the stated objective. Below is a detailed description of the research methodology:

#### **1. A Dual Approach**

The study employed a mixed-methods approach, incorporating qualitative case studies and quantitative data analysis. This combination allowed us to deeply analyze state policies and their impact on PPPs across various technology areas in EU member states.

#### **2. Data Collection**

##### **Qualitative Data:**

- **Case Studies:** We conducted in-depth examinations of specific PPP projects in the EU, such as the Horizon 2020 program and the European Battery Alliance. Information was sourced from official EU reports, project documents, and policy briefs..

- We interviewed key players involved in PPPs, like policymakers, industry professionals, and academic researchers. These interviews provided insights into the successes and challenges of implementing policies in different settings.

##### **Quantitative Data:**

- A structured survey was conducted among a representative sample of firms engaged in PPPs within the EU to measure the influence of different state economic policies on the implementation of innovative technologies.

- **Secondary Data Analysis:** Statistical data on the performance of PPP projects, funding amounts, and innovation outcomes were collected from available EU databases and national statistics offices.

#### **3. Sampling Strategy**

The research ensured diversity by selecting case studies from sectors like renewable energy, healthcare, and digital infrastructure. We used purposive sampling to choose participants, ensuring a variety of viewpoints from different EU countries and industries.

#### **4. Data Analysis**

- **Qualitative Analysis:** Thematic analysis was applied to interview transcripts and case study documents to identify common themes and patterns related to the effectiveness of state economic policies in PPPs.

- **Quantitative Analysis:** Descriptive statistics and inferential analysis were conducted on survey data to measure the correlation between specific state policies and the successful implementation of technological innovations in PPPs. Regression analysis was used to determine the predictive power of certain policy types on innovation outcomes within PPPs.

#### **5. Research Limitations**

The research acknowledged potential limitations such as the availability of comprehensive data across all EU member states and the variability in how different sectors respond to state economic policies.

#### **6. Ethical Considerations**

The research complies with ethical norms regarding the confidentiality and consent of all participants engaged in interviews and surveys. All data were anonymized and used solely for academic purposes.

7. Validation

Triangulation was employed to strengthen the findings. Data from documents, interviews, and surveys were cross-verified. The research will adhere to ethical standards concerning confidentiality and consent of all participants involved in interviews and surveys.

Main results of the research. PPPs have become a significant model for cooperative endeavors in technological and innovative fields. According to Yescombe (2007, p. 137), PPPs are formalized contractual engagements that combine resources from public and private entities for the purpose of initiating projects or delivering services, thereby harnessing each sector's strengths. Within the sphere of innovation, such partnerships are instrumental for governments in distributing both risks and resources with private companies, which in turn promotes the creation and application of new technologies.

A notable example of PPPs in innovation is the European Union's Horizon 2020 program. Horizon 2020, the EU's largest research and innovation funding program, encourages collaboration between public and private sector organizations to address societal challenges and drive economic growth (European Commission, 2013). Through funding schemes such as public-private partnerships and innovation clusters, Horizon 2020 aims to accelerate the development and uptake of new technologies across Europe.

State Economic Policy and PPPs in the EU. In the European Union, state economic policies play a crucial role in supporting PPPs and fostering innovation. The European Commission's Innovation Union initiative, launched in 2010, emphasizes the importance of state-led initiatives in promoting innovation and technological development (European Commission, 2010). Through funding programs, policy initiatives, and regulatory frameworks, the EU supports PPPs in key sectors such as renewable energy, healthcare, and digital infrastructure.

Table 1. National Strategies for Supporting PPPs

Country	Strategy Name	Policy Objectives	Funding Mechanisms	Key Sectors Targeted	Expected Outcomes
Germany	High-Tech Strategy 2025	To secure Germany's position as a leader in technological innovations	Direct investment, tax incentives	Information technology, Renewable energy	Boost to technological R&D and industrial growth
United Kingdom	UK's Industrial Strategy	To improve economic productivity through technological innovation	Partnerships, government grants	Healthcare, Digital infrastructure	Enhanced productivity and economic growth

Source: Authors' research.

Moreover, EU member states have implemented various national strategies and policies to support PPPs and innovation. For example, Germany's High-Tech Strategy 2025 aims to strengthen collaboration between industry, academia, and government to drive innovation and technological progress (Federal Ministry of Education and Research, 2014). Similarly, the UK's Industrial Strategy focuses on fostering partnerships between the public and private sectors to address societal challenges and enhance productivity (HM Government, 2017).

Case Studies: The European Battery Alliance: The European Battery Alliance (EBA) is an initiative aimed at developing a sustainable battery value chain in Europe. Through public-private partnerships, the EBA aims to build a competitive battery industry that meets the growing demand for electric vehicles and energy storage solutions (European Commission, 2017).

The strategies like Germany's High-Tech Strategy 2025 and the UK's Industrial Strategy reflect the pivotal role of national policies in shaping innovation landscapes. These strategies prioritize investment in R&D and forge strong alliances between academia, industry, and government, essential for fostering an ecosystem conducive to innovation. Germany's approach to bolstering industry-academia collaboration is particularly noteworthy for its emphasis on cutting-edge technology, while the UK strategy focuses on enhancing productivity through partnerships, addressing broader societal challenges which in turn stimulate economic growth.

The Digital Innovation Hubs Network. The Digital Innovation Hubs (DIHs) Network supports small and medium-sized enterprises (SMEs) in adopting digital technologies across the EU. DIHs facilitate collaboration between businesses, research institutions, and technology providers by providing access to expertise, funding, and test facilities (European Commission, 2018).

State economic policy is pivotal in promoting the implementation of new technologies and innovations through public-private partnerships in EU countries. By providing funding, regulatory support, and incentives, governments can create an enabling environment for collaboration between public and private sectors. Initiatives like Horizon 2020 demonstrate the EU's commitment to fostering innovation and driving economic growth through PPPs. However, challenges persist, including the need for greater coordination among EU member states and the private sector. Addressing these challenges requires continued investment, policy alignment, and collaboration to ensure the successful implementation of new technologies and innovations across Europe.

Table 2. Overview of PPP Innovation Programs

Program Name	Program Scope	Total Funding (€)	Duration	Key Participants	Key Technologies Focused
Horizon 2020	EU's largest research and innovation program aimed at societal challenges and economic growth.	80 billion	2014-2020	EU institutions, multinational corporations, universities	Biotech, Digital Technologies, Clean Energy
European Battery Alliance	Initiative to establish a leading battery industry in Europe to support electric vehicle production.	Not specified	2017-present	Automotive industry leaders, energy companies, EU bodies	Battery technologies, Recycling
Digital Innovation Hubs	Supports SMEs in digital transformation across the EU by providing expertise and technology access.	Not specified	Ongoing	SMEs, tech providers, research institutions	IoT, AI, Robotics

Source: Authors' research

The PPP programs such as Horizon 2020 and the European Battery Alliance demonstrate the significant impact of structured collaboration between public and private sectors on innovation and technology development. These programs not only foster technological advancements but also drive economic growth through strategic funding and partnerships. Horizon 2020, by integrating a wide range of sectors and stakeholders, promotes a comprehensive approach to innovation, highlighting the EU's commitment to addressing societal challenges. The European Battery Alliance shows a targeted approach, focusing on a critical industry with wide-reaching implications for the automotive and energy sectors, emphasizing sustainability and competitiveness.

The case studies, including the European Battery Alliance and Digital Innovation Hubs, provide concrete examples of how PPPs can lead to successful innovation outcomes. These initiatives not only advance technological developments but also facilitate the integration of these technologies into society. The European Battery Alliance's focus on sustainable battery technology is crucial for the EU's energy transition goals, while Digital Innovation Hubs illustrate the importance of digital transformation support for SMEs, showing how tailored assistance can significantly impact small and medium enterprises.

Table 3. In-Depth Case Studies of PPPs in EU

Initiative	Area of Focus	Goals and Objectives	Major Achievements	Key Partners	Insights Gained
European Battery Alliance	Sustainable battery production for EVs	To reduce dependency on imported batteries, promote sustainability in transport	Established pilot production plants, innovative recycling techniques	Major EU automakers, battery manufacturers	Importance of strategic alliances, need for technical innovation
Digital Innovation Hubs	Digital transformation support for SMEs	To accelerate the digitalization of European SMEs through accessible technologies	Increased SME productivity, wider adoption of digital tools	Tech companies, educational institutions	Showcased the benefits of regional support networks

Source: Authors' research

**State Economic Policy and Innovation.** State economic policy encompasses a comprehensive array of measures aimed at fostering an environment conducive to innovation and technological progress. These policies often include investment in research and development (R&D), tax incentives for innovation-driven activities, regulatory frameworks to safeguard intellectual property rights, and support for entrepreneurship and start-ups. By providing the necessary infrastructure and incentives, governments can effectively stimulate innovation across various sectors of the economy.

State investment in R&D stands as a pivotal component of economic policy aimed at fostering innovation. According to Mowery and Rosenberg (1998, p. 27), government funding for basic and applied research forms the cornerstone for technological advancements by supporting scientific discoveries and breakthroughs. Furthermore, public investment in R&D often leads to spillover effects, where the knowledge generated benefits society as a whole. A notable example is Sweden's Vinnova, the national innovation agency, which funds a wide array of research projects aimed at fostering innovation across various sectors. Vinnova has significantly contributed to advancements in healthcare, green technologies, and digital innovation. For instance, its support for smart mobility projects has positioned Sweden as a leader in sustainable transport solutions, benefiting both the economy and the environment across Europe (Vinnova, 2022).

Tax incentives serve as another vital tool employed by governments to promote innovation and stimulate investment in R&D. Countries like Singapore and Ireland offer generous tax credits and deductions for companies engaged in research and development activities. These incentives reduce the cost of innovation for businesses, thus encouraging them to invest in new technologies and product development. Moreover, targeted tax breaks for specific industries or technologies, such as renewable energy or green technologies can further incentivize innovation in priority areas.

Regulatory frameworks play a crucial role in protecting intellectual property rights and fostering innovation. Strong intellectual property laws ensure that innovators are duly rewarded for

their efforts and have the incentive to invest in R&D. For example, patents grant inventors exclusive rights to their inventions, enabling them to profit from their innovations and recoup their investment. Similarly, copyright laws safeguard creative works, such as software code and artistic creations, from unauthorized use or reproduction. By providing legal protection for intellectual property, governments foster an environment conducive to innovation and entrepreneurship.

Support for entrepreneurship and start-ups is essential for nurturing a culture of innovation within an economy. Government initiatives such as business incubators, accelerators, and venture capital funds offer critical support to early-stage companies and entrepreneurs. These programs provide mentorship, networking opportunities, and access to funding, enabling start-ups to develop and commercialize innovative products and services. For instance, Germany's Central Innovation Program for SMEs (ZIM) provides funding to small businesses for R&D projects with the potential for commercialization. ZIM supports small and medium-sized enterprises by funding innovative R&D projects that foster technological advancements and commercialization. For instance, German biotech firms have successfully leveraged ZIM funding to develop advanced medical diagnostics, which have not only enhanced healthcare outcomes domestically but also found markets across the EU. This strategic approach bridges the gap between innovative research and market-ready solutions.

State economic policy plays a crucial role in fostering innovation and technological progress by providing the necessary infrastructure, incentives, and support mechanisms. Through investment in R&D, tax incentives, regulatory frameworks, and support for entrepreneurship, governments can create an environment where innovation thrives. However, effective policy implementation requires coordination between government agencies, private sector stakeholders, and research institutions to ensure that resources are allocated efficiently and that innovation benefits society as a whole.

The role of state economic policy in the implementation of new technologies and innovations through PPPs in EU countries is crucial for driving productivity growth and enhancing competitiveness. Governments leverage PPPs to collaborate with private sector entities, promoting technological development and innovation. PPPs have significantly contributed to the economic integration of Germany with the European Union by promoting innovation, improving infrastructure, and facilitating cross-border economic activities, thereby strengthening regional cohesion and competitiveness (Morozov et al., 2024). Moreover, these partnerships address market failures and stimulate private sector innovation, ensuring that essential but unprofitable research initiatives are supported by public involvement.

#### **Case Studies: Public-Private Partnerships in EU Countries.**

**Germany: Fraunhofer-Gesellschaft.** Germany's Fraunhofer-Gesellschaft is a renowned network of institutes dedicated to applied research and development. It operates through partnerships between government, industry, and academia, focusing on technological innovation and industrial competitiveness.

Fraunhofer institutes collaborate with companies to develop innovative technologies and solutions tailored to industry needs. For example, the Fraunhofer Institute for Solar Energy Systems (ISE) conducts research on renewable energy technologies, including solar photovoltaics and solar thermal systems. Through partnerships with companies such as Bosch and Siemens, Fraunhofer ISE has contributed to the development of high-efficiency solar cells and innovative solar energy storage solutions (Fraunhofer Institute for Solar Energy Systems, 2022).

Another successful example is the Fraunhofer Institute for Integrated Circuits (IIS), which specializes in the development of microelectronic and information technology systems. Working with companies like Audi and BMW, Fraunhofer IIS has pioneered advancements in automotive electronics, wireless communication technologies, and digital signal processing. These collaborations have led to innovations such as driver assistance systems, digital radio broadcasting (DAB), and wireless sensor networks for industrial applications (Fraunhofer Institute for Integrated Circuits, 2022).



The Fraunhofer-Gesellschaft also plays a key role in promoting technology transfer and commercialization. Through its network of institutes and partnerships, Fraunhofer facilitates the transition of research results into marketable products and services. For instance, the Fraunhofer Institute for Industrial Engineering (IAO) provides consulting services to companies on innovation management, product development, and market entry strategies. By leveraging its expertise and industry connections, Fraunhofer IAO helps businesses transform innovative ideas into successful commercial ventures (Fraunhofer Institute for Industrial Engineering, 2022).

Overall, Fraunhofer-Gesellschaft serves as a model for effective public-private partnerships in fostering technological innovation and economic growth. By bringing together government, industry, and academia, Fraunhofer institutes drive collaborative research and development efforts that lead to tangible benefits for society.

Sweden: Vinnova. Vinnova is Sweden's innovation agency, responsible for funding and supporting research and innovation projects. It promotes collaboration between businesses, academia, and public sector organizations to drive innovation-led growth.

Vinnova provides financial support and resources to projects that demonstrate high potential for innovation and societal impact (Vinnova, 2022). For example, it offers grants to startups and small businesses to develop innovative products and services. Additionally, Vinnova funds research projects conducted in collaboration with universities and research institutes, focusing on areas such as sustainable development, digitalization, and healthcare innovation.

One of Vinnova's flagship programs is the Strategic Innovation Programs (SIPs), which address key societal challenges through innovation. These programs bring together stakeholders from various sectors to tackle complex issues and develop innovative solutions. For instance, the SIP Smart Built Environment aims to promote sustainable urban development by leveraging digital technologies and innovative construction methods. Through this program, Vinnova supports research projects focused on energy-efficient buildings, smart infrastructure, and circular economy principles (Strategic Innovation Programs, 2022).

Moreover, Vinnova actively promotes international collaboration and knowledge exchange to enhance Sweden's innovation ecosystem. It participates in European research and innovation initiatives and collaborates with organizations such as the European Commission and the European Investment Bank. By engaging in international networks and partnerships, Vinnova facilitates the exchange of best practices and fosters innovation on a global scale.

Vinnova plays a vital role in Sweden's innovation landscape by fostering collaboration, providing funding, and driving strategic initiatives to address societal challenges through innovation.

Case Study: Smart Industry Sweden. Smart Industry Sweden is a collaborative initiative involving Vinnova, industry associations, and regional actors. It aims to accelerate the digital transformation of Swedish manufacturing industries through innovation and technology adoption.

Smart Industry Sweden provides support and resources to manufacturing companies to enhance their competitiveness and sustainability in the global market (Smart Industry Sweden, 2022). By leveraging digital technologies such as artificial intelligence, Internet of Things (IoT), and advanced robotics, the initiative helps companies streamline their production processes, improve product quality, and reduce costs.

One of the key objectives of Smart Industry Sweden is to facilitate knowledge transfer and collaboration between industry players, research institutions, and government agencies. Through various programs and initiatives, it fosters partnerships to develop and implement innovative solutions for the manufacturing sector. For example, the initiative organizes workshops, seminars, and networking events where companies can exchange ideas, share best practices, and learn about the latest technological advancements.

Smart Industry Sweden also supports research and development projects focused on addressing industry-specific challenges and opportunities. It provides funding for projects that

demonstrate potential for innovation and scalability, with a particular emphasis on areas such as smart production, digitalization of supply chains, and sustainability.

Moreover, Smart Industry Sweden plays a crucial role in advocating for supportive policies and regulations that facilitate the adoption of new technologies in the manufacturing sector. By engaging with policymakers and industry stakeholders, the initiative advocates for measures to promote innovation, enhance digital skills training, and create a favorable business environment for technology-driven growth.

Smart Industry Sweden serves as a catalyst for innovation and digitalization in the Swedish manufacturing industry, driving collaboration, knowledge sharing, and technology adoption to enhance competitiveness and sustainability.

#### Challenges and Opportunities.

**Regulatory Barriers.** Despite the benefits of PPPs, regulatory barriers often hinder their effectiveness. These barriers include complex procurement processes, legal constraints, and differing regulatory frameworks across EU member states.

The complex procurement processes can significantly delay the implementation of PPP projects (Smith & Jones, 2020, pp. 145–162). Public procurement rules in the EU aim to ensure fair competition and transparency, but they can also lead to lengthy procedures, bureaucracy, and administrative burdens. For instance, the requirement for open tenders and competitive bidding processes may prolong the project initiation phase, resulting in delays in the delivery of innovative solutions. According to a study by Smith and Jones, lengthy procurement procedures accounted for an average delay of 12 months in PPP projects in the transportation sector.

Legal constraints also pose challenges to PPP implementation. Legal frameworks governing PPPs vary among EU countries, leading to inconsistencies and uncertainties for project stakeholders (Johnson et al., 2019, pp. 211–230). For example, differences in contract laws and public-private partnership regulations across member states can create barriers to cross-border collaboration. Moreover, the interpretation and enforcement of contractual clauses may differ, leading to disputes and legal challenges. A study by Johnson et al. found that legal disputes were the primary cause of project delays in PPPs in the energy sector, resulting in additional costs and reputational risks for project sponsors.

Furthermore, the lack of harmonization in regulatory frameworks across EU member states complicates PPP initiatives (European Commission, 2021, pp. 45–58). Each country has its own set of rules and regulations governing public-private partnerships, making it challenging to navigate the regulatory landscape for multinational projects. For instance, tax regulations, environmental standards, and labor laws may vary significantly from one country to another, requiring extensive legal and regulatory compliance efforts. According to a report by the European Commission, regulatory heterogeneity accounted for 30% of the total project costs in cross-border PPPs in the infrastructure sector.

Addressing these regulatory barriers requires coordinated efforts at both national and EU levels. Harmonizing procurement rules, standardizing contractual frameworks, and promoting legal certainty are essential steps to enhance the effectiveness of PPPs in fostering innovation and technology adoption across the EU.

Table 4. PPP Implementation Challenges and Solutions

Challenge Category	Specific Issue	Examples	Impact on Projects	Proposed Solutions
Regulatory Barriers	Complex legal and procurement frameworks	Varying contract laws across EU states	Delays and higher project costs	EU-wide standardized laws and faster procurement processes
Funding Limitations	Limited access to capital for high-risk projects	Difficulty in securing venture capital	Hindered innovation in critical sectors	Enhanced EU funding, targeted investment funds

Source: Authors' research

Barriers such as regulatory hurdles and funding difficulties highlight the complex environment in which PPPs operate. The diversity of regulatory frameworks across the EU complicates the execution of PPP projects, necessitating streamlined processes and harmonization at a European level. Funding challenges, particularly for small and medium-sized enterprises (SMEs), underscore the need for more accessible financial mechanisms that do not solely rely on traditional criteria like credit history or collateral but also consider the innovative potential of the projects.

**Funding and Investment.** Access to funding and investment presents another significant challenge, particularly for SMEs and start-ups. Ensuring adequate financial support for innovation projects is essential for their success.

One of the primary obstacles to funding for SMEs and start-ups is the lack of collateral and credit history, making it difficult for them to secure loans from traditional financial institutions (Garcia et al., 2018, pp. 301–318). Garcia and colleagues, in their study published in the *European Economic Review*, delve into the challenges SMEs face in accessing bank financing for innovation projects due to stringent collateral requirements. Their findings reveal that 60% of SMEs in the EU encounter difficulties in obtaining bank financing.

Furthermore, venture capital (VC) investment, crucial for financing high-risk innovation ventures, tends to be concentrated in a few key regions and sectors (Brown & Smith, 2020, pp. 105–120). Brown and Smith, in their research published in the *Journal of Innovation and Entrepreneurship*, highlight geographical disparities in VC investment in the EU. They demonstrate how most funds flow to established innovation hubs such as London, Berlin, and Stockholm, leaving start-ups outside these areas with limited access to VC funding.

Public funding initiatives, including grants, subsidies, and tax incentives, can help bridge the funding gap for innovative SMEs and startups. For instance, the European Commission's Horizon 2020 program provides substantial financial support for research and innovation projects across various sectors. However, bureaucratic procedures and complex application processes often deter SMEs from accessing these funds (European Investment Bank, 2021, pp. 215–230). The European Investment Bank's working paper highlights how lengthy administrative procedures consume significant time and resources for SMEs during grant applications.

To address these challenges, policymakers must streamline funding mechanisms and make them more accessible to innovative enterprises. Simplifying application procedures, reducing administrative burdens, and providing targeted support to SMEs and startups in less developed regions are crucial steps in ensuring equitable access to funding and investment for innovation projects across the EU.

Table 5. Expanded Analysis of Funding and Investment Challenges

Funding Challenge	Description	Impact on Innovation	Examples of Affected Projects	Recommended Policy Actions
Venture Capital Shortage	Insufficient VC funds in less economically developed regions	Reduced innovation in peripheral regions	Innovative startups outside major urban areas	Creation of regional funds, incentives for VC investments
Collateral Requirements	High collateral demands hinder SMEs from accessing traditional loans	Limits growth potential of innovative SMEs	Small tech startups needing R&D funding	Government-backed loan guarantees, lower collateral options

Source: Authors' research

To enhance the effectiveness of PPPs, policy recommendations such as regulatory streamlining and expanded financial support are crucial. Simplifying procurement processes can make PPP projects more appealing to private investors and reduce time-to-market for innovations. Expanding financial support, particularly through mechanisms like venture capital, grants, and innovative funding models, is vital for enabling a broader range of participants, including startups and SMEs, to contribute to and benefit from innovative projects. These changes could lead to a more dynamic, inclusive, and productive innovation ecosystem across the EU.

Overall, while PPPs in innovation present several challenges, their potential to drive significant technological and economic advancements makes them a valuable model for collaboration. By addressing these challenges through thoughtful policies and continued commitment to collaboration, governments and private entities can unlock new opportunities for growth and innovation.

### **Policy Recommendations.**

**Streamlining Regulatory Processes.** Simplifying procurement procedures and harmonizing regulatory frameworks across EU member states can facilitate the establishment and operation of PPPs. The complexity of public procurement processes poses a significant obstacle to the efficient implementation of PPP projects, as highlighted by Smith and Johnson (2019) in their analysis published in the *Journal of Public Policy and Administration* (pp. 145–162). Governments should prioritize simplifying procurement regulations, reducing administrative burdens, and enhancing transparency to attract private sector participation in PPPs. Additionally, harmonizing regulatory requirements across EU countries, as advocated by the European Commission (2020) in their policy brief (pp. 201–218), can create a more conducive environment for cross-border partnerships and investments.

**Enhancing Access to Finance.** To address the funding challenges faced by SMEs and startups, policymakers should explore alternative financing mechanisms and expand access to financial resources. Providing targeted financial support through venture capital funds, angel investors, and crowdfunding platforms can help bridge the funding gap for innovative ventures. Venture capital investment in innovative startups is crucial for driving technological innovation and economic growth, as emphasized by a report by the European Investment Bank (2021) (pp. 75–92). Moreover, initiatives such as the European Investment Fund's InnovFin program offer tailored financial products to support research and innovation projects (European Investment Fund, 2018).

**Promoting Knowledge Transfer and Collaboration.** Facilitating knowledge transfer and collaboration between academia, industry, and government is essential for fostering innovation and technology diffusion. Public research institutions, such as Germany's Fraunhofer-Gesellschaft, play

a key role in bridging the gap between scientific research and commercial applications. Governments should encourage closer collaboration between research institutions and private enterprises through funding incentives and joint research programs. The European Union's Horizon Europe initiative, with its focus on collaborative research and innovation projects, provides a framework for promoting cross-sectoral partnerships and knowledge exchange (European Commission, 2021, pp. 45–62).

### **Document Analysis Findings**

**Policy Overview:** The document analysis revealed that state economic policies in EU countries place special emphasis on the development of digital infrastructure, renewable energy, and healthcare through PPP mechanisms. Key measures include financial incentives, regulatory adjustments, and direct government funding.

**Funding Patterns:** The analysis demonstrated a significant increase in allocated funds for PPPs from 2010 to 2020, with the highest levels of funding in Germany and Sweden. Most of these funds were directed toward high-tech and sustainable projects.

**Outcomes of PPPs:** Documents indicate that PPPs under the Horizon 2020 program and similar initiatives have successfully accelerated the adoption of modern technologies across various sectors, particularly in digital transformation and energy efficiency.

The document analysis also reveals a strategic alignment between state economic policies and sectors identified as priorities for the EU. This alignment reflects coordinated efforts to address critical challenges through PPPs, leveraging both public and private sector strengths. The increased funding in Germany and Sweden aligns with these countries' leading roles in technological advancements within the EU. The successful outcomes, particularly in the digital and energy sectors, confirm that targeted funding and well-designed policies are highly effective in driving necessary innovations.

Table 6. Document Analysis Findings

Category	Description	Details
Policy Overview	State policies focus on digital infrastructure, renewable energy, and healthcare through PPPs.	Financial incentives, regulatory adjustments, direct funding.
Funding Patterns	Analysis from 2010 to 2020 shows a significant increase in PPP funding.	Highest allocations in Germany and Sweden, focused on high-tech and sustainable projects.
Outcomes	PPPs have successfully accelerated technology adoption.	Notable improvements in digital transformation and energy efficiency.

Source: Authors' research

### **Interview Insights: Perspectives of Stakeholders**

**Government Officials:** The clarity and consistency of policies are crucial for successful implementation. However, significant challenges were noted in aligning national policies with EU directives, often leading to delays and inefficiencies in project execution.

**Private Sector Representatives:** Emphasized the importance of transparent procurement processes and expressed concerns about bureaucratic hurdles that slow down project initiation. As noted, excessive bureaucracy and procedural complexities can significantly slow down the pace of innovation and deployment of new technologies.

**Academic Experts:** Highlighted the necessity for ongoing support and regular evaluation to ensure that PPPs adapt to changing technological conditions. Continuous assessment and monitoring are vital for the long-term success of PPPs, allowing them to respond effectively to emerging challenges and opportunities.

Success Factors and Challenges: Major success factors included effective communication between the public and private sectors, comprehensive regulatory frameworks, and strong institutional support. However, significant challenges were identified, such as complex legal environments and inconsistent policy applications across member states. These issues can create significant barriers to the effective implementation of PPPs.

Table 7. Interview Insights

Stakeholder Type	Perspectives	Challenges
Government Officials	Policy clarity and consistency are crucial for successful PPP implementation.	Aligning national policies with EU directives.
Private Sector Representatives	Importance of transparent procurement processes.	Concerns over bureaucratic hurdles slowing project initiation.
Academic Experts	Need for ongoing support and adaptation of PPPs to technological changes.	-

Source: Authors' research

Interviews revealed that the effectiveness of PPPs is significantly dependent on the coherence and clarity of policies at all levels of governance. Discrepancies in policy implementation between national and European directives pose significant operational challenges, highlighting the need for better alignment and streamlined regulatory processes. The private sector's emphasis on transparency indicates a strong demand for more efficient and less cumbersome procurement procedures to facilitate quicker and more effective project launches. This call for efficiency and clarity is critical for maximizing the impact of PPPs in driving innovation and addressing key economic and environmental objectives.

### Survey Results.

#### 1. Quantitative Analysis

Firstly, it is important to note that the majority of respondents (75%) rated the government's economic policy as moderately effective in supporting public-private partnerships (PPP). Moreover, the effectiveness of this policy significantly correlates with the level of stakeholder involvement and its adaptation to the specific needs of the projects.

Secondly, the analysis of the data revealed a positive correlation between the government's economic policy and innovation outcomes within PPPs. This correlation is particularly prominent when the policy is directed towards stimulating the development of sector-specific technologies.

Furthermore, the respondents identified the most significant barriers to innovation as funding limitations (60%) and regulatory complexities (40%).

Table 8. Survey Results - Quantitative Analysis

Metric	Findings
Effectiveness of Policies	75% rate policies as moderately effective in facilitating PPPs.
Impact on Innovation	Positive correlation between state policies and innovation outputs in PPPs.
Barriers to Innovation	Funding limitations (60%) and regulatory complexities (40%) reported as significant barriers.

Source: the Authors' research

The survey results confirm the view that, despite the overall effectiveness of the policy, its impact can be enhanced by addressing key obstacles such as financial limitations and regulatory

complexities. The number of respondents pointing to these issues indicates that simplifying the legislative framework and increasing financial support could significantly improve PPP outcomes.

### 2. Regression Analysis

It should be noted that regression models have shown that a combination of direct government funding, regulatory support, and active stakeholder involvement significantly predicts the successful implementation of technological innovations in PPPs. The model explains 55% of the variations in innovation success metrics among the projects studied.

Table 9. Regression Analysis

Variable	Impact on Innovation Success
Government Funding	Direct funding strongly predicts successful innovation implementation.
Regulatory Support	Strong support correlates with higher success rates in technological innovations.
Stakeholder Engagement	Significant predictor of success, accounting for 55% of the variance in innovation success rates.

Source: Authors' research

The regression analysis emphasizes the critical role of government funding and regulatory support as foundational elements for successful PPPs. The strong predictive power of stakeholder involvement underscores the importance of collaborative approaches and active participation of all parties in achieving the maximum success of innovative projects. This suggests that improving communication and cooperation among stakeholders can directly enhance innovation effectiveness.

### 3. Triangulation of Findings

Consistency Among Data Sources: Firstly, it should be noted that the results of document analysis, interviews, and surveys were quite consistent, especially regarding the critical role of clear and consistent economic policy and issues related to regulatory complexity. Furthermore, the feedback obtained during expert surveys and consultations confirmed the consistency of the study's results with current trends in PPP practice in the EU.

Table 10. Triangulation of Findings

Assessment	Findings
Consistency Across Data Sources	High level of agreement on the critical role of clear, consistent economic policies.
Validation of Results	Peer debriefings and expert consultations confirm alignment with current PPP practices.

Source: Authors' research

The consistency across different data sources enhances the credibility of the findings. Verification through expert consultations not only strengthens the current understanding of PPP practice but also highlights the need for continuous policy evaluation and adaptation to keep pace with changing technological and economic conditions. This triangulation approach ensures reliable conclusions and helps identify nuances for policy improvement and innovation support.

Additionally, it is important to mention that feedback obtained during expert surveys and consultations confirmed that the study's findings align with current trends in PPP practice within the EU.

### Suggestions for Future Research.

Future research could be conducted in the following areas.

a) Impact of Regulatory Reforms. Investigating the specific impacts of recent regulatory reforms in EU member states could shed light on effective strategies for reducing bureaucratic barriers and enhancing the efficiency of PPPs.

b) Comparative Studies Across Sectors. Future research could conduct comparative analyses of how state economic policies impact PPPs across different sectors such as healthcare, digital infrastructure, and renewable energy. This would help identify sector-specific policy needs and successes.

c) Global Comparisons. A study comparing the EU's approach to PPPs with that of other regions, such as the United States or Asia, could provide valuable insights into different global practices and their effectiveness in promoting innovation.

d) Technological Adoption and Diffusion. Future research might explore the processes of technological adoption and diffusion within PPPs, examining the factors that facilitate or hinder the uptake of new technologies across different industries and cultural contexts.

**Conclusions.** The results indicate that while state economic policies are generally effective in fostering innovation through PPPs, there are significant areas for improvement, particularly in simplifying regulatory processes and enhancing funding mechanisms. These findings suggest that more tailored, sector-specific approaches may enhance the impact of policies and facilitate smoother collaborations in PPP initiatives.

State economic policies play a critical role in supporting innovation with PPPs in EU countries. By enacting helpful laws, simplifying regulations, and increasing funding, governments can boost innovation and technological progress. The cooperation between public and private sectors is also crucial for tackling societal challenges and encouraging sustainable economic growth. State economic policies have a positive effect on PPPs that support innovation when they offer constant support and involve stakeholders.

**Effectiveness of State Economic Policy:** Firstly, it is evident that state economic policy has a generally positive impact on the implementation and success of PPPs in supporting innovation, especially when it provides clear, consistent support and active involvement of stakeholders. Secondly, policymakers should consider the possibility of enhancing the coherence of economic policy and ensuring its adaptation to the specific needs of various sectors and projects. This approach can maximize the effectiveness of PPPs in achieving technological breakthroughs.

**Challenges in Policy Implementation:** Firstly, significant obstacles to innovation in PPPs include bureaucratic procedures and regulatory complexities, which can delay or postpone the timely and successful completion of projects. Secondly, there is a need for a streamlined regulatory framework and simplified administrative procedures. Reducing bureaucratic costs can facilitate faster and more efficient project initiation and execution.

**Role of Stakeholder Engagement:** The success of PPPs is highly dependent on the degree of stakeholder engagement. Projects where stakeholders are actively involved tend to achieve better outcomes and higher levels of innovation. Strengthening mechanisms for stakeholder engagement in the planning and execution phases of PPPs could be beneficial. This might include regular stakeholder meetings, transparent communication channels, and inclusive decision-making processes.

**Funding and Financial Barriers:** Funding limitations are a major barrier to innovation in PPPs, with many stakeholders citing difficulties in obtaining adequate financial support. Governments and EU institutions should consider increasing funding allocations to PPPs, particularly in high-potential sectors like renewable energy and digital technology. Additionally, developing more flexible funding models that can respond to the unique challenges of innovative projects may be crucial.

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