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GOVERNMENT POLICY, INNOVATION, AND ENTREPRENEURIAL DYNAMISM: SHAPING VIETNAM'S FUTURE ECONOMIC GROWTH

POLÍTICA GOVERNAMENTAL, INOVAÇÃO E DINAMISMO EMPREENDEDOR: MOLDANDO O CRESCIMENTO ECONÔMICO FUTURO DO VIETNÃ

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Abstract
This study examines the dynamic relationships among innovation, entrepreneurship, and economic growth in Vietnam from 2012 to 2023. It employs several advanced econometric techniques including unit root tests, the Autoregressive Distributed Lag (ARDL) model, Vector Error Correction Models (VECM), and Granger causality tests. The findings reveal a complex interplay between these variables in both the short and long run. Innovation, measured by resident patent applications, indicates a strong and statistically significant long-run impact on GDP growth. Besides, entrepreneurship contributes positively to short-run economic activity but shows a marginally negative long-run effect. It suggests that necessity-driven ventures may limit sustained productivity gains. Government policy, captured through a composite index via principal component analysis, displays no significant long-run effect but demonstrates short-run effectiveness in enabling growth, particularly through its mediating role. For instance, ICT exports and internet penetration follow a similar progression. They initially exhibit negative or insignificant short-run effects but show positive long-term contributions through mechanisms such as learning-by-exporting and digital spillovers. The study highlights the need for coordinated, long-term policy strategies that enhance human capital, foster high-quality entrepreneurship, and support digital and innovation ecosystems. It recommends targeted

Resumo
Este estudo examina as relações dinâmicas entre inovação, empreendedorismo e crescimento econômico no Vietnã de 2012 a 2023. Ele emprega diversas técnicas econométricas avançadas, incluindo testes de raiz unitária, o modelo Autorregressivo Distribuído de Atraso (ARDL), Modelos de Correção de Erros Vetoriais (VECM) e testes de causalidade de Granger. Os resultados revelam uma interação complexa entre essas variáveis tanto no curto quanto no longo prazo. A inovação, medida por pedidos de patentes residentes, indica um impacto forte e estatisticamente significativo no crescimento do PIB a longo prazo. Além disso, o empreendedorismo contribui positivamente para a atividade econômica a curto prazo, mas mostra um efeito marginalmente negativo a longo prazo. Isso sugere que empreendimentos movidos pela necessidade podem limitar ganhos de produtividade sustentados. A política governamental, capturada por meio de um índice composto via análise de componentes principais, não apresenta efeito significativo a longo prazo, mas demonstra eficácia a curto prazo na viabilização do crescimento, particularmente por meio de seu papel mediador. Por exemplo, as exportações de TIC e a penetração da internet seguem uma progressão semelhante. Inicialmente, apresentam efeitos negativos ou insignificantes a curto prazo, mas demonstram contribuições positivas a longo prazo por meio de mecanismos como a aprendizagem pela exportação e os transbordamentos digitais. O

investments in science, technology, engineering, and mathematics education, support for innovation-based small and medium-sized enterprises. Proactive policy design is encouraged to enhance integration of domestic firms into global value chains.

Keywords: Economic Growth. Innovation. Entrepreneurship. Government Policy. Vietnam.

estudo destaca a necessidade de estratégias políticas coordenadas e de longo prazo que fortaleçam o capital humano, promovam o empreendedorismo de alta qualidade e apoiem ecossistemas digitais e de inovação. Recomenda investimentos direcionados em educação em ciência, tecnologia, engenharia e matemática, além de apoio a pequenas e médias empresas baseadas em inovação. A formulação proativa de políticas é incentivada para aprimorar a integração de empresas nacionais nas cadeias globais de valor.

Palavras-chave: *Crescimento Econômico. Inovação. Empreendedorismo. Política Governamental. Vietnã.*

1 INTRODUCTION

Vietnam's impressive economic growth over the past two decades has established it as a dynamic player in Southeast Asia (Do, 2022; Coppola, Dray, Wai-Poi, & Winkler, 2024). To sustain this progress and avoid the middle-income trap, the country is shifting its strategic focus from capital and labor accumulation to technology, innovation, and entrepreneurial activity. This strategic shift is clearly outlined in the Vietnam Socio-Economic Development Strategy (SEDS) for 2021–2030 and the Vision for 2045. It emphasizes the need for structural transformation to achieve the national goal of becoming a high-income and developed country. As the global economy evolves into a knowledge-based paradigm, it is vital for Vietnam to understand how innovation and entrepreneurship drive economic growth (Aghion, 2017). To strengthen the national innovation and entrepreneurship ecosystem, the Vietnamese government has launched several initiatives. A key initiative is Resolution No. 52-NQ/TW (2019). This resolution provides a roadmap for Vietnam’s participation in the Fourth Industrial Revolution. It prioritizes the development of digital infrastructure, high-tech research, and innovation-driven industries. It also calls for creating national innovation hubs and expanding a skilled workforce. A cornerstone of this agenda is the National Innovation Center (NIC), which offers incubation programs, supports technology commercialization, and connects domestic and global stakeholders. Complementary legal frameworks, such as the Law on Technology Transfer (2017) and the Law on Supporting Small and Medium-Sized Enterprises (2017), provide tax incentives, improve access to credit, and facilitate

technology adoption. While these policy efforts are commendable, there is still a need for empirical analysis to evaluate their effectiveness and the combined impact of innovation and entrepreneurship on long-term economic growth.

The theoretical foundation for this inquiry stems from Schumpeter's (1934) concept of creative destruction. This concept describes how innovation disrupts existing market structures and drives economic evolution. This idea has been expanded in formal growth models by Solow (1957) and Romer (1990), who emphasize the role of technological progress, both exogenous and endogenous, in sustainable economic expansion. Building on this foundation, Aghion, Akcigit, and Howitt (2015) present a nuanced model of innovation-led growth. Their research illustrates how intellectual property regimes, policy competition, and sector-specific incentives shape national innovation ecosystems and affect income distribution and social equity. Entrepreneurship has also become a key pillar of economic transformation. Entrepreneurs are not only innovators but also critical intermediaries who bring technological advancements to market. By doing so, they foster job creation, increase productivity, and intensify market competition. Similiarly, Ács, Audretsch, and Lehmann (2013) highlight how entrepreneurial activity serves as a mechanism for knowledge spillover, converting research and innovation inputs into tangible economic outputs. Moreover, entrepreneurship plays a pivotal role in unlocking under-utilized human capital, particularly in developing economies where formal employment structures may be limited.

Moreover, research indicates that public policy plays a crucial role in enabling entrepreneurial dynamism and innovation (Castaño, Méndez, & Galindo, 2016; Doran, McCarthy, & O'Connor, 2018; Almodóvar-González, Fernández-Portillo, & Díaz-Casero, 2020; Sarangi, Pradhan, Nath, Maradana, & Roy, 2022). For instance, Castaño *et al*. (2016) provide evidence that government interventions, such as access to finance and regulatory simplification, significantly enhance entrepreneurial activity and economic competitiveness. Further, Doran *et al*. (2018) emphasize that entrepreneurship drives productivity growth, job creation, and innovation diffusion, especially in developing countries with structural barriers. Vietnam's digital transformation over the past decade reflects global trends related to the Fourth Industrial Revolution. Despite major advances in internet penetration, digital infrastructure, and education reform, challenges remain. These include fragmented policies, weak knowledge transfer systems, and limited support

for early-stage ventures. Additionally, most existing research in Vietnam tends to focus on individual sectors rather than examining the systemic interactions between innovation, entrepreneurship, and growth.

This study contributes to the existing literature in several important ways. First, it suggests that technological innovation acts as a catalyst for structural transformation in developing economies like Vietnam. Through mechanisms such as patent generation, innovation enables the creation and commercialization of new goods and services. It also improves productivity and boosts national competitiveness, ultimately supporting long-term economic growth. Second, the study highlights the vital role of entrepreneurship, measured by new business density (NBD). Entrepreneurship promotes the diffusion of innovation, facilitates market dynamism, and stimulates productivity across sectors. This perspective is grounded in Schumpeterian theories of creative destruction. Here, entrepreneurial activity challenges established firms, accelerates innovation cycles, and contributes to the structural upgrading of the economy. New ventures, especially in emerging sectors like high-tech exports, can transform traditional production models and generate broader economic benefits. Third, this research addresses a gap in the Vietnamese context. While previous studies have focused on individual factors, such as education or trade within specific sectors, few have examined the systemic interactions among innovation, entrepreneurship, and economic growth. This study uses a comprehensive empirical model and incorporates well-theorized variables like high-tech exports, digital infrastructure, and macroeconomic stability. The study adopts a multidimensional framework to assess Vietnam's path toward sustainable development and high-income status. Therefore, the study aims to test the following hypotheses:

***H1*:** Entrepreneurial activity significantly influences short-run GDP growth, but its long-term effect may be conditional on quality. This hypothesis reflects Schumpeterian theories of creative destruction, which emphasize the role of innovative entrepreneurship in driving structural transformation and reallocating resources across sectors. While new firm formation can boost short-term output and innovation diffusion, long-term growth effects are contingent on the scalability, productivity, and innovation orientation of these enterprises (Ács *et al*., 2017).

***H2*:** Innovation contributes significantly to long-term economic growth, but its effectiveness is moderated by the presence of supportive institutional and policy frameworks. This hypothesis posits that while innovation is a core driver of productivity,

its sustained impact on growth requires complementary policies such as R&D incentives, intellectual property protections, and infrastructure investments (Aghion, 2017; Akcigit, Pearce, & Prato, 2025). Innovation tends to follow macroeconomic trends but needs structural support to maintain long-run dynamism.

***H3*:** Government policy has a strong short-term effect on economic growth by supporting innovation and entrepreneurship. However, its long-term impact is indirect and depends on consistent policies and effective institutions. This hypothesis reflects the view that government interventions, such as support for education, digital infrastructure, and Information and Communication Technology (ICT) exports, can catalyze innovation and entrepreneurial activity in the short run. However, for these effects to translate into sustained economic growth, policies must be strategically aligned, consistently implemented, and embedded within effective institutional frameworks (Castaño *et al*., 2016; Aldashev & Batkeyev, 2021; Bradley, Kim, Klein, McMullen, & Wennberg, 2021). Incoherence or fragmentation in policy design may weaken their long-run developmental impact.

The remainder of this study is organized as follows. Section 2 presents a comprehensive literature review on the interrelationships between Innovation, Entrepreneurship, and Economic Growth. Section 3 outlines the research methodology, including data sources, variable definitions, and econometric techniques employed. Section 4 presents and discusses the empirical results, including robustness checks to ensure the validity of the findings. Finally, Section 5 concludes with a discussion of the key findings, policy implications, and directions for future research.

2 LITERATURE REVIEW

A substantial body of empirical and theoretical literature underscores the critical role of innovation and entrepreneurship as engines of economic growth, particularly within emerging economies. Foundational theories in this domain date back to Schumpeter (1934), who introduced the notion of creative destruction, wherein innovation disrupts established industries, fostering structural transformation and long-term productivity gains. This concept laid the groundwork for subsequent growth models, such as Solow's (1957) neoclassical framework, which treated technological change as an exogenous factor. However, this view was fundamentally revised by Romer (1990) and

Aghion and Howitt (1990). They introduced endogenous growth theory, which emphasizes that innovation, knowledge accumulation, and human capital investment are internal to the economic system. These factors are shaped by policy, institutional quality, and market incentives. Further, Zhao (2019) extends this discussion by noting the shift from viewing technology as an external shock to recognizing it as the result of intentional economic decisions. In this dynamic environment, Doran *et al*. (2018) argue that in an era of rapid globalization and environmental uncertainty, innovation and entrepreneurship offer crucial adaptive advantages for emerging economies.

Moreover, Audretsch and Belitski (2020) and Block, Fisch, and Van Praag (2017) view entrepreneurial ecosystems as key drivers of regional innovation and economic growth. They argue that innovation thrives in concentrated networks of firms, universities, and skilled workers. In these environments, knowledge sharing is intensified, and collaboration becomes more efficient. Building on this view, Manning, Rauch, and Vavilov (2024) show how entrepreneurs can use local ecosystems and digital platforms, like crowdfunding, to overcome funding challenges. This helps them reach more people and scale their innovations. These findings highlight the growing importance of digital infrastructure and intangible assets in the digital economy. Correspondingly, Myovella, Karacuka, and Haucap (2020) emphasize that internet connectivity, broadband access, and mobile technologies greatly enhance productivity. They also facilitate market access and speed up the spread of innovation. Similarly, Nambisan, Wright, and Feldman (2019) point out that digital transformation is reshaping how firms innovate and collaborate. However, they warn that gaps in digital infrastructure and literacy may increase inequalities, especially in developing economies. This is particularly relevant for Vietnam, where digital transformation is ongoing and the capacity for innovation is still developing. At the regional level, Hardi, Ray, Attari, Ali, & Idroes (2024) and Nguyen (2020) study Southeast Asia and Vietnam. They find that institutional capacity, coherent policies, and investments in R&D are crucial for turning innovation inputs into economic outcomes. In a global analysis, Sarangi *et al*. (2022) examine G20 countries and find that the impact of innovation on growth depends on the maturity of innovation systems and governance quality. These findings show that in economies like Vietnam, which are undergoing structural changes, government policy should be more than just a facilitator. It needs to act as a strategic architect. This means coordinating investments in education, innovation systems, and digital infrastructure while ensuring macroeconomic stability.

This study adds to the growing evidence by confirming the mediating role of policy and the delayed effects of innovation and entrepreneurship on economic performance.

In this context, government policy plays a crucial role in enabling innovation and entrepreneurship. Studies consistently highlight the importance of targeted government interventions, especially in education, research and development (R&D), and digital infrastructure. Effective policies enhance the ability of firms and individuals to absorb new innovations. As Apostu, Mukli, Panait, Gigauri, & Hysa (2022) state, public investment in education builds the foundation for technology adoption and entrepreneurship. Policies that support education and R&D not only expand human capital but also create non-rival knowledge spillovers. These can be reused across sectors without depletion, making them valuable for society. For instance, Akcigit, Pearce, and Prato (2025) provide evidence that integrated education and innovation policies improve talent utilization and innovation outcomes. In the area of trade and structural transformation, Ding and Li (2018) introduce the concept of product space. They show that countries exporting more complex products, like ICT goods, benefit from learning-by-exporting, which boosts long-term growth. Similarly, Bahrini and Qaffas (2019) find that investments in ICT infrastructure, especially broadband and mobile technologies, positively affect growth in developing countries. However, the effectiveness varies by region and regulatory conditions. Additionally, Aghion, Akcigit, and Howitt (2015) identify macroeconomic stability as essential for long-term R&D and entrepreneurship investments. Stable inflation and predictable policies reduce uncertainty and encourage risk-taking for innovation. Cross-national research by Almodóvar-González *et al*. (2020) reinforces the need for policy integration. Their analysis shows that innovation and entrepreneurship yield the highest growth when supported by inclusive and coherent policies that lower entry barriers and ensure fair access to resources.

Additionally, Castaño *et al*. (2016) demonstrate that targeted public policies aimed at lowering administrative burdens and improving regulatory environments can significantly stimulate entrepreneurial activity. Extending this policy discourse, Bradley *et al*. (2021) classify policy interventions into three tiers, including those supporting individual entrepreneurs, those enhancing ecosystem functions, and those addressing societal-level barriers. They argue for a holistic and context-sensitive policy approach that is tailored to institutional and sectoral realities, particularly in developing economies where entrepreneurship often emerges out of necessity rather than opportunity. Overall,

this body of literature confirms that innovation and entrepreneurship drive growth most effectively when supported by strategic and inclusive policies. In Vietnam, where institutional capacity and digital infrastructure are still evolving, such policy integration is vital for maximizing the potential of innovation-led development.

3 METHODOLOGY

3.1 Model specification

According to Schumpeterian growth theory, innovation serves as the fundamental driver of long-term economic growth through the mechanism of creative destruction. New technologies replace outdated ones, continuously renewing the productive structure of the economy (Schumpeter, 1934; Aghion & Howitt, 1992). Expanding on this foundation, Aghion *et al*. (2015) proposed a more refined model wherein economic growth results from a continuous sequence of innovations that enhance productivity. Each technological advancement obsoletes the previous one, creating a dynamic environment in which innovation not only drives growth but also transforms the competitive landscape. A critical condition for this innovation-driven growth model is the existence of a robust financial and institutional environment that supports entrepreneurial risk-taking and research and development (R&D) investments (Romer, 1990; Block *et al*., 2017; and Aghion, 2017). These studies suggest that innovation results are influenced by a combination of factors such as educational investment, technological ability, and entrepreneurial activity. In light of these considerations, recent empirical studies have increasingly focused on the nexus between innovation, entrepreneurship, and economic growth, particularly in the post-2010 era of digital transformation and knowledge-based economies (Audretsch & Belitski, 2020; Block *et al*., 2017; Haskel & Westlake, 2018). The following empirical model is constructed to test this multi-dimensional relationship:

$$GYR_t = \alpha + \beta_1 PAR_t + \beta_2 LLC_t + \beta_3 GEP_t + \beta_4 ICTX_t + \beta_5 IIR_t + \epsilon_t \qquad (1)$$

where

- GPC_t : GDP per capita, serving as a proxy for economic growth.
- PAR_t: Number of patents filed by residents at time t, capturing domestic innovation output.
- PNN_t: Number of patents filed by non-residents at time t, reflecting foreign knowledge inflows.
- LLC_t: The number of new limited liability companies at time t, measuring entrepreneurial dynamism.
- GEP_t : Government expenditure on education (% of GDP) at time t, representing human capital investment.
- $ICTX_t$: High-technology exports at time t, measuring commercialization of innovation and technological sophistication of exports.
- IIR_t: Individuals using the Internet at time t, measuring digital infrastructure.
- α: Intercept term.
- ϵ_t is the error term.

This model integrates both the Schumpeterian innovation framework and contemporary perspectives on inclusive and sustainable growth, acknowledging that innovation is not only a technological process but also an institutional and entrepreneurial phenomenon. By combining variables that reflect education, innovation (both domestic and foreign), and new business creation, the model aims to explore how these factors interact to drive long-run economic development. In time series econometrics, before estimating any meaningful relationships among variables, especially when dealing with macroeconomic indicators. A unit root test is employed to determine the stationarity of a time series. A stationary time series has a constant mean, variance, and autocorrelation structure over time. In contrast, a non-stationary time series exhibits trends 1 or cycles that do not diminish over time. The Dickey-Fuller test is a commonly used unit root test. The null hypothesis of the test is that the time series is non-stationary, while the alternative hypothesis is that the time series is stationary. The test equation for the Dickey-Fuller test is generally as follows:

$$d(Y_t) = \alpha + \beta_t + \gamma Y_{t-1} + d(Y_t(-1)) + \epsilon_t \qquad (2)$$

After performing unit root tests such as the Augmented Dickey-Fuller (ADF), Table 2 shows that the time series variables under consideration exhibit a mix of

integration orders. This study employs the Autoregressive Distributed Lag (ARDL) model to explore the dynamic short-run and long-run relationships between economic growth and key policy, technological, and entrepreneurial drivers in Vietnam. The ARDL approach, introduced by Pesaran, Shin, and Smith (2001), is particularly appropriate in this context due to its flexibility in handling time series variables that exhibit a mixed order of integration, I(0) and I(1). According to Nkoro and Uko (2016), ARDL models are especially advantageous in macroeconomic analyses with small sample sizes, as they allow for variable-specific lag selection and avoid over-differencing problems common in traditional cointegration methods. Recent methodological advancements by Kripfganz and Schneider (2016) further improve the implementation of the ARDL bounds test, enhancing its applicability and robustness in small-sample contexts.

Once cointegration is established, an error correction model (ECM) can be employed to capture both the short-term dynamics and the speed at which variables adjust back to the long-run equilibrium. The ECM framework embodies the idea that any short-term disequilibrium between co-integrated variables is corrected over time, thus reinforcing the notion of a stable long-run relationship (Banerjee, Dolado, Galbraith, & Hendry, 1993; Engle & Granger, 2015). Moreover, to examine directional predictability or causality among the variables, the Granger causality test is employed. This test assesses whether past values of one variable contain information that helps predict another variable's future values. However, Granger causality testing requires that the underlying series be stationary; otherwise, the results may be spurious. In practice, when the series are non-stationary, differencing is commonly applied to induce stationarity before conducting the test. Nonetheless, differencing may eliminate important long-run information embedded in the data, which can be preserved through co-integration and error correction modeling (Toda & Yamamoto, 1995). Therefore, a combination of unit root tests, co-integration analysis, ARDL modeling, and Granger causality testing forms a robust empirical strategy for understanding the dynamic and long-run interdependencies among innovation, entrepreneurship, and economic growth variables.

3.2 Data

This study examines the complex relationships among innovation, entrepreneurship, and economic growth in Vietnam from 2012 to 2023. A robust dataset has been compiled from authoritative sources, primarily the World Bank's World Development Indicators (WDI) and the Global Entrepreneurship Monitor (GEM). The paper aims to provide a multi-dimensional understanding of how institutional, technological, and entrepreneurial factors influence economic development in Vietnam. Economic growth, the main dependent variable, is represented by the Gross Domestic Product growth rate (GYR). This widely accepted indicator reflects the annual percentage change in a country's total economic output. It serves as a fundamental measure of national economic performance and prosperity (Agu, Onu, Ezemagu, & Oden, 2022). Further, innovation is captured through the number of patent applications by residents (PAR). Patents represent technological advancement and research output, highlighting a country's inventive capacity despite not all innovations being patented (Aghion, & Howitt, 1990; Crosby, 2000; Hardi *et al*., 2024). Besides, entrepreneurship is measured using the number of new limited liability companies (LLCs) which is sourced from GEM. New firm formation is central to Schumpeterian dynamics of creative destruction, where entrepreneurial ventures introduce innovative products, services, and processes, stimulating productivity and competition (Aghion *et al*., 2015; Block *et al*., 2017). Additionally, government policy (denoted as GP) is constructed using Principal Component Analysis (PCA) based on four dimensions that are expenditure on education (denoted as GEP), information and communication technology products within a country's overall merchandise exports (denoted as ICTX), individual using internet (denoted as IIR), and consumer price index (CPI). PCA reduces dataset dimensionality while retaining variability (Lever, Krzywinski, & Altman, 2017). For instance, government expenditure on education (GEP), expressed as a percentage of GDP, represents human capital development, crucial for enhancing innovation and entrepreneurship. Moreover, ICTX quantifies the share of ICT goods in total merchandise exports. ICTX is recognized as a proxy for a nation's technological sophistication and integration into the global digital economy (Ding & Li, 2018). Further, IIR measures the proportion of the population actively utilizing the internet, thereby reflecting the extent of digital penetration and connectivity. It serves as a direct representation of the

digitalization environment within the country (Nguyen, Huynh , Nguyen, & Le, 2021). Lastly, CPI reflects inflation as measured by the Consumer Price Index. Macroeconomic stability, particularly low and stable inflation, is crucial for fostering business confidence, encouraging long-term investment, and promoting R&D activities (Bradley *et al*., 2021). The PCA results show that the first two principal components explain a significant portion of the total variance among the four variables. This suggests they capture key aspects of government policy and macroeconomic conditions that are important for innovation, entrepreneurship, and economic growth. By combining these relevant and measurable variables, this study seeks to provide a thorough understanding of how different institutional, technological, and entrepreneurial factors together influence long-term economic development in Vietnam.

Table 1 presents the descriptive statistics of the key variables. All variables are transformed using natural logarithms to stabilize variance, normalize the distribution, and improve interpretability in subsequent econometric analyses. The mean value of the GDP growth rate is 0.572 and a standard deviation of 0.207. It suggests a notable degree of volatility in economic growth rates over the observed period. The number of domestic patents shows a mean of 1.793 and a standard deviation of 0.183. It indicates a relatively stable but improvable level of innovation. This stability is an important factor, as innovation is hypothesized to positively correlate with economic growth. In addition, the number of newly established limited liability companies has a mean of 2.426 and a small standard deviation of 0.029. This stability in new business formation may serve as a contributing factor to the overall economic landscape. Moreover, Ln(GEP) shows a mean of 1.023 and a standard deviation of 0.031. The consistency of this spending, with a range from 0.983 to 1.076, suggests a stable antecedent to long-term economic gains. Otherwise, the ratio of ICT goods in total exports exhibits greater variability with a mean of 0.767 and a standard deviation of 0.471. It suggests the increasing and dynamic role of the ICT sector, which is often linked to higher economic productivity. Similarly, the internet user penetration rate has a mean of 1.033 but a relatively large standard deviation of 0.703. So it highlights a considerable disparity in digital access. Lastly, the composite index for government policy (GP) has a mean value very close to zero, which is expected for a standardized component, and a standard deviation of 1.531. This standard deviation indicates the overall variability captured by the composite policy measure across the observations. Collectively, these descriptive statistics provide a foundational

understanding of the dataset's characteristics and highlight key trends and variations within Vietnam's economic, innovation, and entrepreneurial landscape.

Table 1

Descriptive Statistics of Variables

Variable	Data Description	Obs	Mean	Std. Dev.	Min	Max
ln(GYR)	GDP growth rate	39	0.572	0.207	-0.064	0.813
ln(PAR)	Patent fields by residents	41	1.793	0.183	1.369	2.043
ln(LLC)	Number of new limited liability companies	12	2.426	0.029	2.384	2.461
ln(GEP)	Government expenditure in Education (%GDP)	15	1.023	0.031	0.983	1.076
ln(ICTX)	ICT goods (% total merchandise exports)	22	0.767	0.471	-0.022	1.297
ln(IIR)	Individuals using the Internet	23	1.033	0.703	-1.446	1.473
GP	Government Policy	14	-1.92e-08	1.531	-2.957	1.854

Source: Author’s calculations

4 ESTIMATING AND ANALYZING RESULTS

4.1 Unit root test

Table 2 presents the results of the Augmented Dickey–Fuller (ADF) unit root test, which evaluates the stationarity properties of each time series variable at level - I(0), first difference -I(1), and second difference -I(2). A time series is considered stationary at I(0) if its mean and variance are constant over time, which is essential for avoiding spurious regression outcomes in time series analysis (Dickey & Fuller, 1979). If a variable is non-stationary at level but becomes stationary after first differencing, it is classified as I(1). The results indicate a mixed order of integration among the variables. Specifically, ln(GYR) is stationary at level. In contrast, variables such as ln(PAR), ln(LLC), GP are

non-stationary at level and remain non-stationary even after differencing. It indicates potential structural issues or the need for further transformation. Importantly, none of the variables are integrated at the second order, I(2). So it validates the use of the Autoregressive Distributed Lag (ARDL) bounds testing approach. This technique is well-suited for models that contain variables of different integration orders, as long as none exceeds I(1). Therefore, the ARDL model is appropriate for exploring both short-run dynamics and long-run equilibrium relationships between economic growth and its key drivers, such as innovation, entrepreneurship, education spending, ICT exports, and internet access.

Table 2

Results of the augmented Dickey–Fuller (ADF) test for unit root variable

Variable	Order of Integration	ADF Test (p-value)	Order of Integration	ADF Test (p-value)	Order of Integration	ADF Test (p-value)
ln(GYR)	I(0)	0.005	I(1)	0.000	I(2)	0.175
ln(PAR)	I(0)	0.061	I(1)	0.312	I(2)	0.806
ln(LLC)	I(0)	0.856	I(1)	0.683	I(2)	0.391
ln(GEP)	I(0)	0.329	I(1)	0.621	I(2)	0.404
ln(ICTX)	I(0)	0.929	I(1)	0.870	I(2)	0.742
ln(IIR)	I(0)	0.000	I(1)	0.037	I(2)	0.560
GP	I(0)	0.5906	I(1)	0.981	I(2)	0.896

Source: Author's calculations

4.2 Autoregressive Distributed Lag (ARDL)

Table 3 presents econometric analysis is the estimation of the dynamic short-run and long-run relationships between economic growth, technological, and entrepreneurial drivers, and key policy in Vietnam using the Autoregressive Distributed Lag (ARDL) model. A single comprehensive ARDL model was not estimated due to several technical and methodological issues. These include multicollinearity, which can lead to unstable coefficient estimates, and a limited number of observations for certain government policy variables (Pesaran & Shin, 2001). To address these issues and ensure the robustness of the statistical inference, the analysis is structured into three distinct models. This approach does not only respond to data constraints but also provides a sound methodological

choice, and facilitates a more focused and interpretable analysis. First, Model 1, shown in columns (1) and (2) of Table 3, focuses on the relationship between economic growth and government expenditure on education. This model tests the hypothesis that public investment in human capital fosters long-term productivity and innovation-led growth (Romer, 1990). By isolating this variable, it can check the direct impact of educational spending without the influence of other policy variables. Second, Model 2, in columns (3) and (4), centers on the impact of ICT exports. This model assesses how technological upgrading and export-led innovation affect economic performance. By isolating the ICT variable, we can clearly ascertain its role as a key driver of modern economic growth. This relationship is well established in the literature on the knowledge-based economy (Vu, 2011). Finally, Model 3, presented in columns (5) and (6), emphasizes the role of digital infrastructure by focusing on internet usage. This model highlights the importance of digital connectivity for innovation and entrepreneurship. This aligns with theories on network effects and the digital economy (Myovella *et al*., 2020). Estimating this model separately allows for a precise evaluation of how digital access contributes to economic development.

In Model 1, Table 3, the result reveals insights into the relationship between education spending and economic growth. The theory suggests that public investment in education enhances the capacity of firms and workers to adopt new technologies. This idea is central to endogenous growth theory (Romer, 1990). The findings align with those of Marquez-Ramos and Mourelle (2019), indicating that the impact of education on GDP is complex. While education spending has a positive effect on GDP, this effect is not statistically significant. Marquez-Ramos and Mourelle (2019) also note that the impact of education varies with the level of educational attainment. They find that initial investments yield significant benefits, but returns diminish as education levels increase. It suggests that the benefits of human capital investment may be delayed or indirect rather than immediate. On the other hand, entrepreneurship is highlighted as a crucial short-run driver. It shows a significant positive impact (20.19**) but also a negative lagged effect (−17.24**). This pattern suggests diminishing returns or possible structural inefficiencies over time. An initial surge in entrepreneurial activity may not be sustainable without ongoing policy support. Thus, educational policy alone is insufficient for growth without complementary reforms that strengthen research and development, align curricula with industry needs, and develop robust business incubators. In Model 2, Table 3, the analysis

shifts to the ICT sector, another key driver of modern economic growth. The short-run coefficient for ICT exports is negative and significant (−12.35*). This unexpected result may indicate trade-related adjustment costs or sectoral crowding out, where rapid ICT growth diverts resources from other industries. However, a positive and significant effect of lagged ICT exports (0.267*) supports the idea of long-run benefits. This aligns with the product space framework, which suggests that exporting complex goods, like those in the ICT sector, drives diversification and learning benefits over time (Ding & Li, 2018). Again, entrepreneurship plays a significant role, highlighting the importance of firm dynamism in translating ICT trade gains into broader economic growth.

Table 3

ARDL Model Results. Dependent variable is GDP growth rate

Variables	**Model 1**		**Model 2**		**Model 3**	
	(1) ln(GEP)	**(2) ln(GYR)**	**(3) ln(ICTX)**	**(4) ln(GYR)**	**(5) ln(IIR)**	**(6) ln(GYR)**
Lag1.ln(GYR)		0.298		-0.200		0.273
		(0.521)		(0.552)		(0.685)
ln(PAR)	-0.00404	1.056	0.532	1.134	0.752***	-7.492
	(0.326)	(6.974)	(0.564)	(6.133)	(0.155)	(12.02)
ln(LLC)	-0.548	20.19**	1.688*	36.18*	0.938***	3.843
	(0.590)	(7.212)	(0.734)	(15.24)	(0.176)	(21.08)
Lag1.ln(LLC)		-17.24**	-1.216	-21.21	1.166***	-29.00
		(6.557)	(0.811)	(10.05)	(0.261)	(22.90)
ln(GEP)		6.126				
		(3.863)				
Lag1.ln(GEP)	0.343					
	(0.442)					
Lag1.ln(ICTX)			0.267*	3.264		
			(0.108)	(1.589)		
Lag1.ln(PAR)			0.646			
			(0.551)			
ln(ICTX)				-12.35*		

				(4.828)		
Lag1.ln(IIR					-0.127	
					(0.156)	
ln(IIR)						12.25
						(20.02)
Constant	2.005	-15.22	-2.563*	-26.82	-5.030***	59.11
	(1.687)	(13.79)	(0.985)	(17.69)	(0.717)	(89.95)
Observations	11	11	10	10	11	11
R-squared	0.697	0.703	0.977	0.885	0.996	0.584

Note(s): Standard errors in parentheses. * p < 0.10, ** p < 0.05, ***p < 0.01.
Source: Author's calculation

Finally, Model 3 examines the impact of digital infrastructure, measured by internet access. The direct effect of internet access on GDP is not statistically significant, but its indirect effects are substantial. Both innovation and entrepreneurship are significant positive drivers (0.752*** and 0.938***, respectively). This shows that digital connectivity fosters startup activity and accelerates the diffusion of ideas. These findings are consistent with theories of endogenous growth and digital spillovers (Batabyal & Nijkamp, 2016). They argue that digital technologies facilitate knowledge transfer and collaboration, driving innovation and economic development. The authors stress the need for strategic policies that foster creativity and knowledge sharing to maximize the benefits of digital advancements. In conclusion, the ARDL models reveal the different pathways through which education policy, ICT development, and digital infrastructure shape Vietnam's economic growth. While the direct short-run impacts of these factors may be weak or delayed, significant effects operate through enhanced innovation and entrepreneurship. These insights highlight the importance of an integrated policy framework that combines investment in education, support for digital export competitiveness, and expansion of digital infrastructure. Such a strategy, based on modern growth theory and the entrepreneurial ecosystem approach, offers a robust roadmap for Vietnam's future economic development.

4.3 Error correction model (ECM)

In addition to the ARDL approach, the Error Correction Model (ECM) is employed to capture both the short-run fluctuations and the long-run equilibrium relationships among the key variables influencing Vietnam's economic growth. ECMs are particularly useful when variables are cointegrated, as they allow for the modeling of how deviations from a stable long-run equilibrium are corrected over time (Banerjee, Dolado, & Mestre, 1998; Engle & Granger, 2015). The variable GP is constructed via principal component analysis (PCA) from three key policy indicators, including education expenditure, ICT exports, and internet penetration. This composite index captures the multidimensional nature of policy efforts aimed at enabling structural transformation and innovation ecosystems. The inclusion of GP reflects its mediating role in the relationship between firm-level innovation and broader economic outcomes. Grounded in endogenous growth theory (Romer, 1990; Jones, 2019), government policy acts as both an enabler and regulator of productive entrepreneurship and innovation. The error correction term (ECT) is a crucial component, as its coefficient indicates the speed at which a variable returns to equilibrium after a shock. Preliminary findings from the long-run ARDL estimates reveal several key relationships. Innovation shows a statistically significant positive long-run effect on GDP growth. Specifically, a one percent increase in patent applications by residents is associated with a substantial 43.08% increase in GDP growth in the long term. This finding underscores the central role of innovation as a driver of economic expansion, consistent with Schumpeterian views on creative destruction and endogenous growth models (Aghion *et al*., 2015). In contrast, entrepreneurship has a negative coefficient (–55.53) but is only marginally significant ($p = 0.071$). This suggests a complex relationship. An increase in the number of newly established limited liability companies may not always lead to immediate productive economic growth. This could be due to factors like the prevalence of necessity-driven entrepreneurship, which often has lower growth potential (Wong *et al*., 2005). There may also be significant time lags in the maturation of new firms and their contributions to GDP, or challenges related to the quality and productivity of new ventures in Vietnam (Block *et al*., 2017). Finally, the composite Government Policy Index shows a small and statistically insignificant coefficient in the long run. This indicates that while government policy is theoretically important, its long-term impact on aggregate

GDP growth may not be direct or immediately visible in this model. Its influence might be more pronounced through short-run adjustments or its mediating effects on innovation and entrepreneurship, shaping the institutional environment.

Table 4

Error correction model

Variables	**(1)**	**(2)**	**(3)**	**(4)**
	Δln(GYR)	**Δln(PAR)**	**Δln(LLC)**	**Δln(GP)**
Error correction term	-0.590**	-0.0334**	-0.000297	-0.0652
	(0.253)	(0.0167)	(0.0106)	(0.279)
Lag1.ln(GYR)	0.795*	0.0220	0.0465**	1.379***
	(0.443)	(0.0293)	(0.0186)	(0.488)
Lag1.ln(PAR)	3.264	-0.266	-0.268	-21.06***
	(6.579)	(0.435)	(0.276)	(7.242)
Lag1.ln(LLC)	-26.75*	-1.476	-0.433	-34.42**
	(14.90)	(0.985)	(0.625)	(16.40)
Lag1.ln(GP)	1.297**	0.0494	0.0245	0.948*
	(0.515)	(0.0341)	(0.0216)	(0.567)
Constant	-0.0585	0.0202**	0.00589	0.519***
	(0.120)	(0.00793)	(0.00503)	(0.132)
R-square	0.7499	0.7952	0.8508	0.9260

Note: Standard errors in parentheses. ***Significance at 0.001, **Significance at 0.01, *Significance at 0.05
Source: Author's calculations.

Further analysis focused on the short-run dynamics within the ECM to fully understand the sophisticated role of government policy. The lagged first difference of Government Policy shows a positive and significant impact on short-run GDP growth. It suggests that immediate shifts in government policy can indeed stimulate short-term economic performance. Conversely, the lagged first difference of entrepreneurship exhibits a negative and marginally significant effect ($p = 0.073$). It might imply that when there is a sudden increase in entrepreneurial activity, it can lead to short-term disruptions

in the economy. Necessity-based entrepreneurs, who start businesses out of a lack of alternative employment, often create less productive ventures that may not immediately contribute to economic growth or innovation (Audretsch, Belitski, and Desai, 2015). Instead, they could intensify competition for limited resources, potentially leading to market saturation or even job losses in existing, more established businesses. Furthermore, there are often significant time lags in the maturation of new firms and their eventual contributions to GDP, or challenges related to the overall quality and productivity of new ventures in the initial stages (Block *et al*., 2017). Finally, the composite Government Policy Index shows a small and statistically insignificant coefficient ($p = 0.519$) in the long run. This indicates that while government policy is theoretically important, its long-term impact on aggregate GDP growth may not be direct or immediately visible in this model. Its influence might be more pronounced through short-run adjustments or its mediating effects on innovation and entrepreneurship, shaping the institutional environment.

4.4 Granger causality test

To explore the direction of short-run predictive relationships among innovation, entrepreneurship, and economic growth, this study employs Granger causality tests. These tests are a widely accepted econometric tool for assessing temporal precedence between variables (Engle & Granger, 2015; Shojaie & Fox, 2022). These tests are particularly useful when cointegration is not definitively established, as they focus on identifying whether lagged values of one variable contain information that helps forecast another. Table 5 reveals several significant causal linkages, offering insights into the dynamics of Vietnam's development. Based on the Granger causality test results, a detailed analysis of the relationships between economic growth and key drivers, such as innovation, entrepreneurship, and government policy can be made. Firstly, innovation shows a marginal causal influence on economic growth at the 10% significance level. This implies that past innovation levels contribute to forecasting future economic growth. Interestingly, economic growth does not predict innovation in the short run. This unidirectional, albeit weak, causality aligns with prior evidence. It suggests that innovation inputs tend to precede economic gains in developing economies. Technological absorption and diffusion require time to translate into widespread

productivity improvements (Aghion *et al*., 2015). The absence of a strong reciprocal relationship from growth to innovation may indicate an emerging innovation system where resource allocation for R&D is not yet highly responsive to economic expansion.

Secondly, entrepreneurship significantly Granger-causes economic growth at the 1% significance level. This robust finding supports endogenous growth theories, emphasizing the crucial role of firm dynamism and entrepreneurial activity in fostering economic performance, particularly in emerging markets like Vietnam (Ács *et al*., 2017). Entrepreneurs drive competition, introduce new technologies and business models, and create employment. These actions directly stimulate aggregate economic activity. Thus, a vibrant entrepreneurial ecosystem is a powerful engine of short-run economic expansion. Conversely, no significant Granger causality was found for government policy and economic growth. This unexpected result suggests several possibilities. It may indicate lagging structural impacts of these policies, meaning their effects on GDP growth materialize over longer timeframes than captured by the short-run Granger test. Alternatively, this could point to limitations stemming from the sample length, which may be too short to detect complex policy transmission mechanisms (Nguyen *et al*., 2024). It might also imply that the immediate influence of these specific government policies on aggregate GDP growth is indirect or mediated through other channels not fully captured in a direct causal test. Future models may need to include longer lags or interaction effects.

The Granger causality results carry significant policy implications for Vietnam's development trajectory. Strengthening entrepreneurship ecosystems should be a key focus. Entrepreneurial activity appears to directly and significantly stimulate economic growth. Policies should foster an environment conducive to firm creation and growth. This includes access to finance, streamlined regulatory processes, and supportive infrastructure. Furthermore, innovation policy should be viewed as a long-term commitment. Given its delayed but positive effects, continuous investment in R&D, human capital for innovation, and intellectual property protection is crucial, even if immediate macroeconomic returns are not evident. Finally, investments in ICT and education may require deeper structural reforms or longer timeframes to show a pervasive macroeconomic impact. This suggests the need for patience and sustained effort, coupled with complementary policies to ensure that these investments translate into tangible productivity gains.

Table 5:

Granger Causality Test

Null Hypothesis	F-Statistic	Prob.	Direction
PAR does not Granger cause GYR	4.689	0.096	Partially Yes
GYR does not Granger cause PAR	0.993	0.609	No
LLC does not Granger cause GYR	19.582	0.002	Yes
GYR does not Granger cause LLC	2.208	0.331	No
GP does not Granger cause GYR	2.909	0.233	No
GYR does not Granger cause GP	0.028	0.986	No
IIR does not Granger cause GP	49.739	0.000	Yes
GP does not Granger cause IIR	12.729	0.002	Yes
GP does not Granger cause LLC	168.42	0.000	Yes
LLC does not Granger cause GP	1469.4	0.000	Yes

Source: Author's calculation

5 DISCUSSION AND CONCLUSION

This study investigates the relationships among innovation, entrepreneurship, and economic growth in Vietnam from 2012 to 2023. It employs advanced econometric techniques, including unit root testing, the Autoregressive Distributed Lag (ARDL) approach, Vector Error Correction Models (VECM), and Granger causality tests. The analysis reveals a complex dynamic in both the short and long run. It offers valuable insights into Vietnam's developmental trajectory. The VECM results show that innovation has a strong and statistically significant long-run effect on GDP growth. This aligns with Schumpeterian and endogenous growth theories, which emphasize innovation as a key driver of long-term productivity and structural transformation. Moreover, entrepreneurship contributes positively in the short term. However, it exhibits a negative and marginally significant effect in the long run. This indicates that while entrepreneurial activity initially stimulates economic growth, its sustainability may be challenged by factors like the predominance of necessity-driven ventures. Further, Granger causality analysis supports the significant short-run impact of entrepreneurship on GDP growth.

This highlights its role in stimulating economic activity. The composite government policy index (GP), derived through principal component analysis, does not show a significant long-run effect. However, it reveals a positive and significant influence in the short run. This suggests that government interventions act more as mediating or enabling mechanisms rather than direct drivers of growth. Additionally, ICT exports initially have a negative impact, possibly due to structural adjustment costs. They show positive long-run benefits. This is consistent with theories of learning-by-exporting. Similarly, increased internet penetration indirectly boosts economic growth by fostering innovation and entrepreneurship. This pattern aligns with digital spillover and network theories. Therefore, these findings underscore that Vietnam's economic growth is driven not just by capital accumulation or trade expansion, but by the interaction of innovation, entrepreneurship, and strategic policy frameworks. As the country moves toward a knowledge-based economy, sustained growth will require coordinated policies. These should strengthen human capital, enhance innovation capacity, and cultivate a dynamic entrepreneurial ecosystem.

Based on the empirical findings, several targeted policy implications emerge to guide Vietnam's transition toward a knowledge-based, innovation-driven economy. First, the results reinforce a core principle of endogenous growth theory: that human capital formation is foundational to long-term economic development. Accordingly, investment strategies should prioritize STEM education, digital literacy, and improvements in tertiary-level education quality, ensuring that curricula are aligned with labor market demands and innovation requirements (Akcigit *et al*., 2025). Second, while ICT exports have shown positive long-run contributions to growth, an overreliance on them may inhibit domestic innovation spillovers. Thus, it is essential to complement export-led strategies with policies that encourage local technology absorption, support R&D incentives, and facilitate the integration of domestic firms into global value chains. Third, although entrepreneurship contributes significantly to short-run growth, its long-run impact is mixed, suggesting the need to support high-quality, opportunity-driven entrepreneurship. Policies should go beyond merely promoting firm formation and instead include expanded access to finance, incubation services, and targeted support for innovation-based small and medium-sized enterprises (Ács *et al*., 2017; Bradley *et al*., 2021). Fourth, government interventions must move beyond reactive responses to adopt a more proactive and coherent strategic vision. Long-term policy coherence, grounded in

regular data monitoring and evaluation, can enhance the effectiveness of innovation policies. Fifth, it is critical to acknowledge the inherent time lags in structural reforms, especially in the domains of technology diffusion and institutional transformation. Policymakers should design programs with these lags in mind, managing expectations and building long-term commitment (Aghion *et al*., 2015). Finally, the quality of measurement proxies remains a notable concern. Sole reliance on patent counts and the number of new limited liability companies (LLCs) may fail to adequately capture innovation quality or entrepreneurial productivity. Therefore, improving the validity of these proxies through the inclusion of startup funding data, product innovation indicators, and entrepreneurial diversity metrics is essential for future analysis.

Despite its strong methodology, this study has certain limitations. The limited availability of longitudinal data restricted the estimation of a complete ARDL model. Additionally, proxies like patent applications and LLC registrations may not fully capture the depth or productivity of innovation and entrepreneurship activities. These measurement issues could affect the generalizability of the findings. Future research should focus on using richer, firm-level datasets and examine differences across sectors in innovation impact. Longitudinal case studies or mixed-methods approaches could provide deeper insights into the institutional and behavioral aspects of innovation systems in Vietnam. Additionally, exploring the relationship between informal entrepreneurship, regional disparities, and the effectiveness of policy implementation would enhance the policy discussion and support more inclusive strategies.

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