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# THE IMPACT OF DIGITALIZATION ON ENTREPRENEURIAL INNOVATION

## A COMPARATIVE ANALYSIS BETWEEN DEVELOPING ECONOMIES IN ASIA AND IN OTHER REGIONS

*Yeng-May Tan, José Ernesto Amorós, Erkko Autio, Kun Fu, and Donghyun Park*

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# The Impact of Digitalization on Entrepreneurial Innovation: A Comparative Analysis Between Developing Economies in Asia and in Other Regions

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No. 776 | April 2025



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**ABSTRACT**

This study explores the relationship between digitalization and entrepreneurial innovation across developing economies. We assess whether higher levels of digital technology development within a country enhance the innovation potential of its entrepreneurial ventures and how this impact varies between Asia and other regions. Using data from the Global Entrepreneurship Monitor (2013–2022) and the Global Innovation Index along with its subindexes, we examine 11 developing economies in Asia and 57 developing economies in other regions. We find that digital technology development generally boosts entrepreneurial innovation. However, our results reveal a significant regional variation. The impact on product innovation is significantly stronger in developing economies outside Asia. This suggests that while digitalization supports innovation generally, its effects may be more transformative in regions outside Asia. These findings offer valuable insights for policymakers seeking to leverage digitalization to drive innovation and economic growth.

***Keywords:*** digitalization, digital technologies, entrepreneurial innovation, ICT development, developing Asia, developing economies

***JEL codes:*** L26, O33, O31, O57

## I. INTRODUCTION

Digitalization—the widespread adoption of digital technologies in the economy and society such that these become infrastructural (Tilson et al., 2010)—has been arguably the most transformative force shaping economies and societies during the past decade or two (Carney, 2022).This trend has helped revolutionize industries, transform business models, and reshape how individuals and organizations operate (Bharadwaj et al., 2013; Remane et al., 2017; Gempel et al., 2018). By enabling innovation, productivity, and economic growth, digitalization has fundamentally altered the global economic landscape (Autio, 2017; Nambisan, 2017).

Entrepreneurial firms are recognized as key agents of digitalization-induced digital transformation in the economy (Autio et al., 2018). Unlike old, established incumbents, entrepreneurial firms have not invested significant amounts of money in legacy resources and processes and can more flexibly try out new affordances opened by digital advances. Because entrepreneurial start-ups are not constrained by established customer relationships, they can experiment with new products and services, often exploring opportunities opened by advances in digital technologies and infrastructures. They can also more readily harness digital technologies and infrastructures to innovate novel approaches to the creation, delivery, and capture of customer value. They can challenge established incumbents with radical new business models, forcing these to either adapt or exit. Entrepreneurial start-ups' innovative exploitation of emerging digital affordances drives digital transformation, thereby contributing to economic growth and productivity.

Received research tends to point to a positive relationship between digitalization and productivity in entrepreneurial firms. The adoption of digital technologies is associated with significant productivity gains in firms, particularly in manufacturing and routine-intensive activities (Gal et al., 2019). Some studies suggest that digitalization can improve firm productivity by 44%–52% on average, with larger effects in specific industries like retail, nonmetal, and textile (Akhmadalieva and Akhmadalieva, 2022). The Digital Economy and Society Index shows a positive relation between digitalization and entrepreneurship, which in turn positively affects productivity (Ghazy et al., 2022). However, the impact is not uniform across all firms and sectors. Firms with higher

investment shares in digital technologies tend to experience faster productivity growth, but the effect is not necessarily universal (Anderton et al., 2023). The innovation outcomes of firms' digitalization may be influenced by factors such as firm size, industry, and the availability of complementary resources (Gal et al., 2019).

The observation that the benefits of digitalization do not unfold automatically but rather may be regulated by context raises important questions. Although there is plenty of evidence linking digitalization to the generation of innovation in entrepreneurial firms, virtually all of this evidence is derived from sector or country data. If, as anecdotal data would appear to suggest, the benefits of digitalization to entrepreneurial innovation are regulated by context, this raises the question of whether contextual factors might also operate at the country level. In this paper, we ask: does digitalization contribute equally to entrepreneurial firms' product innovation in different countries?

For the empirical context to explore this question, we choose Asian emerging economies. We compare the impact of digitalization on entrepreneurial firms' product innovation performance in Asian emerging economies against emerging economies outside Asia. We choose this context for several reasons. Asia has experienced significant economic transformation in the recent decade or two due to advances in digital technologies and infrastructures, with mobile technologies and related services contributing nearly 5% to the region's gross domestic product (GDP) in 2022 alone (GSMA, 2023). A key driver of this economic impact has been the rapid growth of e-commerce, which saw revenues surge by 30%–50% in 2020 across many Asian economies—far exceeding the growth rates of most countries in other regions of the world (Dabla-Norris et al., 2023). This surge in e-commerce reflects a broader trend in digital innovation across the region, as businesses increasingly adopt digital technologies to rethink their operations and expand their reach. Asia's economic dynamism is further fueled by its focus on innovation, as evidenced by its leading position in global patent filings. The region outpaces the Americas and Europe under the Patent Cooperation Treaty of the World Intellectual Property Organization (WIPO) (Dabla-Norris et al., 2023). By 2019, Asia's share of global patents had surged from under 40% to about 54% in less than a decade, with the People's Republic of China, Japan, and the Republic of Korea leading the way.

In spite of impressive progress, one can argue that Asian emerging economies have, until fairly recently, been on the other side of the digital divide relative to the most advanced economies. The digital divide refers to disparities in access, usage, and effectiveness of digital resources (Vassilakopoulou and Hustad, 2023; World Bank, 2016; Park et al., 2015). For perspective, only a few years ago, nearly 87% of individuals in developed countries had online access, whereas only 19% of those in the least developed countries did (ITU, 2019). Even within developing economies, disparities persist. For instance, in Myanmar, online shopping surged from 3% to 21% between 2017 and 2021, yet other least-developed countries like South Sudan, Togo, and Zambia saw little to no increase or even a decline in online shopping activity during this period (Fredriksson, 2022). These global disparities indicate that the benefits of digitalization, particularly in fostering innovation, remain unevenly distributed. In developing Asia, while some entrepreneurs have effectively leveraged digital tools like e-commerce platforms and digital payment systems to drive growth, others struggle with gaps in digital infrastructure and skills (Dabla-Norris et al., 2023). These challenges are mirrored in other developing regions, though the scope and nature of the digital divide may vary (OECD et al., 2020).

In this study, we define digitalization as the broader country development of digital technologies, which includes access to and use of ICT, e-government, and e-participation. We anticipate that these advancements will enable entrepreneurs to leverage technology to introduce new products, services, or business models. We focus on examining the impact of the development of a country's digital technologies on entrepreneurial innovation, particularly on new products and services.

This empirical design allows us to pursue two main objectives. First, we seek to assess the overall impact of digital development on product innovation in entrepreneurial firms across developing economies. Second, we seek to compare whether and how this impact differs between developing Asia and other developing regions, considering their varying levels of digital maturity. Specifically, we aim to determine whether countries in developing Asia experience a stronger link between digital development and entrepreneurial product innovation compared to other developing regions, given their relatively advanced digital infrastructure.

This design supports several contributions to the literature. Despite the growing research on digitalization and entrepreneurship, several gaps remain. Most studies concentrate on developed economies. Research on the intersection between digitalization and entrepreneurship in emerging markets is still in its infancy (Hjort and Tian, 2024; Autio et al., 2022; Quinones et al., 2015). Existing literature also tends to concentrate on specific countries or particular regions, with limited comparative analyses across different developing areas. Our study addresses this gap by comparing developing Asia with other developing regions, providing empirical evidence on how digitalization impacts productive entrepreneurship across diverse economic contexts.

In the next section of this paper, we review the relevant literature. Section 3 outlines the dataset and methodology used in the analysis, while Section 4 presents and discusses the empirical results. We discuss our findings and articulate our contribution in the final section.

## II. LITERATURE REVIEW

### A. Entrepreneurship and Economic Growth

Entrepreneurship, the process of identifying and exploiting opportunities to create value, is pivotal to economic growth and development. Schumpeter's theory of innovation posits that economic development is driven by the process of 'creative destruction', where innovative entrepreneurs introduce new technologies and business models that disrupt existing industries (Schumpeter, 1934, 1942). This disruption leads to the reallocation of resources and the creation of new markets. As industries evolve and adapt to these innovations, the economy becomes more efficient, driven by a more effective use of resources. This process of innovation boosts total factor productivity (TFP) by improving the efficiency of capital and labor utilization, thereby contributing to long term economic growth (Solow, 1957). From this perspective, entrepreneurship is often seen as a positive predictor of economic growth and development (Wennekers and Thurik, 1999; Wong et al., 2005; Baumol and Strom, 2007; Reynolds, 1999).

However, not all entrepreneurial activities contribute equally to economic development. Baumol (1990) distinguishes between productive and unproductive entrepreneurship.

Productive entrepreneurship involves business activities that generate economic value and drive innovation, enhancing firms' efficiency and contributing to higher TFP (Autio et al., 2019). In contrast, unproductive entrepreneurship does not foster innovation or significant economic value (Acs and Szerb, 2007; Baumol, 1990; Wennekers and Thurik, 1999). In many developing economies, entrepreneurial activities are often necessity-driven, arising out of survival needs rather than the pursuit of innovation or growth (Doran et al., 2018; Levie and Autio, 2011).

Baumol's framework highlights the need to foreground digitalization as a potential driver of innovation and economic value creation, particularly in developing economies where digitalization holds the potential to transition entrepreneurial activities from necessity-driven (characterized by a lack of innovation and unproductivity) to opportunity-driven ones, thereby boosting overall economic productivity.

### B. Digitalization, Digital Technologies Development, and Entrepreneurship

Digitalization, defined as the integration of digital technologies into all aspects of business and society until they become infrastructural, fundamentally transforms how businesses operate (Tilson et al., 2010; Autio et al., 2022; Adner et al., 2019; Nambisan, 2017; Yoo et al., 2012). As a catalyst for innovation, digitalization reduces barriers to entry, enables business scalability, and opens up new markets (Giustiziero et al., 2022; Tilson et al., 2010; Nambisan, 2017). The impact of digital transformation on entrepreneurship is both encompassing and far-reaching. Due to its nature as a general purpose technology, its fungibility, and its non-physical attributes—along with its ease of recombination and scalability—digitalization holds great potential for improving business performance (Autio et al., 2022; Henfridsson et al., 2018; Nambisan, 2017; Fitzgerald et al., 2014; Tilson et al., 2010; Yoo et al., 2012). Digitalization fosters scalable innovations (Nambisan, 2017; Zaheer et al., 2019), stimulates business activity, and boosts competitiveness (Galindo-Martín et al., 2019). These, in turn, create a virtuous feedback loop where new innovations drive further value creation and yield additional digital dividends (Galindo-Martín et al., 2019).

The transformative effects of digitalization are critical for boosting entrepreneurial innovation and productivity. As businesses adopt digital technologies, they can innovate

more swiftly and adapt to market changes with increased agility, thereby enhancing their competitive edge. This impact is especially pertinent to developing economies, since they will likely gain the most from digitalization. Digitalization enables disruptive innovations that challenge established businesses and create new growth opportunities, even in resource constrained settings.

In this study, we evaluate digitalization using the overall level of ICT development and related indexes that capture the broader landscape of digital readiness and adoption. These indicators encompass not only the accessibility of digital infrastructure but also its usage, government involvement in digital services, and citizen engagement with digital platforms. We posit that higher levels of digitalization—reflected in improved ICT access, greater utilization of digital tools, more effective government online services, and increased e-participation—enhance entrepreneurs' product innovation activities.

### C. Empirical Evidence on Digitalization, Innovation, and Productivity

Empirical research has examined the relationship between digitalization, innovation, and entrepreneurship, particularly in developed economies. The relationship is not straightforward. Several studies highlight this variability, noting that only certain types of entrepreneurship significantly contribute to national economic growth. Wong et al. (2005) find that only high expectation entrepreneurship[1] has a strong impact on economic growth. Salgado-Banda (2007) demonstrates that entrepreneurship positively correlates with economic growth when measured by innovativeness (patent application), but shows a negative correlation when measured by self-employment. These findings suggest that the innovativeness and productivity of entrepreneurial ventures, rather than the sheer quantity of entrepreneurial activities, enhance TFP and foster economic growth.

The correlation between entrepreneurship and economic growth is likely to vary depending on a country's stage of economic development (Van Stel et al., 2005; Valliere and Peterson, 2009). Margolis (2014) finds that over half of the workforce in developing

[1] The Global Entrepreneurship Monitor defines high expectation entrepreneurship as startups and recently established businesses that are younger than 42 months, that anticipate employing a minimum of 20 individuals within a five-year period.

regions is self-employed, yet self-employment alone does not automatically lead to innovation, productivity, or economic growth (Ayyagari et al., 2011; Baumol, 1990).

Digital technologies and innovative approaches are increasingly shaping economic dynamics (ITU, 2024). Recent studies have highlighted this positive association. Ghazy et al. (2022) demonstrate a significant positive correlation between entrepreneurship and productivity, as well as between digitalization and entrepreneurship. Similarly, Gal et al. (2019) provide robust evidence that industry adoption of digital technologies boosts productivity in firms, although the impact varies across firms and industries. Hjort and Tian (2024) find that internet connectivity can significantly impact productivity in developing countries, although the impact varies substantially depending on the context and existing infrastructure. Likewise, Soluk et al. (2021) demonstrate that in India, adopting digital technologies significantly boosts support for microbusiness owners, effectively addressing institutional voids in the country. However, Kimmitt et al. (2020) note that while large enterprises in urban centers might experience immediate gains from digital advancements, SMEs in rural areas face challenges due to limited access to infrastructure and digital literacy. In a similar vein, Autio et al. (2024) argue that the quality of a country's digital entrepreneurial environment correlates with its stage of economic development, although the effectiveness of technology adoption can be influenced by factors such as formal and informal institutions, market conditions, and physical infrastructure. As such, digital disparities—variations in access, usage, and efficacy of digital technologies—across individuals, households, businesses, or geographic areas may impact entrepreneurial outcomes.

Generally, studies indicate that the adoption and use of digital technologies enhance innovation and economic productivity, but this relationship varies depending on the type of entrepreneurial business and the stage of economic development. Moreover, the impact of digital technologies is contingent upon the availability of critical resources and the broader economic environment. In this study, we focus on regional disparities, examining how these differences shape entrepreneurial outcomes. By comparing developing Asia with other developing regions, we provide empirical evidence on how the overall development of a country's digital technologies influences entrepreneurial

innovation and, thus, productivity across different economic contexts. Next, we detail the data sources, variables, and methods employed to conduct this analysis.

## III. METHOD

### A. Data and Sample

We propose that a country's development of digital technologies (DT) will influence the likelihood of product innovation in individuals' new business activities in that country. We also posit that the impact of DT on product innovation differs between developing Asia and other developing economies.

To test the theoretical hypotheses, we draw on multiple sources from both countries and individuals. The primary dataset for the current study is the Global Entrepreneurship Monitor (GEM) dataset (Reynolds, Bosma, and Autio, 2005). GEM is an annual survey that tracks individual entrepreneurial attitudes, activities, and aspirations in participating countries. The GEM dataset is composed of population-representative interviews with at least 2,000 individuals per country. GEM applies harmonized data collection methods across the participating countries (Reynolds et al., 2005). More than 70% of the data are collected through telephone surveys. The survey questionnaire is standardized across countries and translated into local languages. In countries where population-representative telephone surveys are not possible, face-to-face interviews are carried out using multistage randomized cluster sampling. We use GEM data from 2013 to 2022 for which these data are available.

GEM defines entrepreneurship as any attempt to create a new business by individuals, including self-employment (Reynolds et al., 2005). There are three categories of entrepreneurial businesses depending on the stage of a firm's development based on GEM's classification. An individual is defined as a 'nascent entrepreneur' if the person is still in the stage prior to starting a new firm and no financial payments have been made into the firm in the past three months. A 'new entrepreneur' is a person who owns and manages a new business that has paid salaries to at least some employees (including the owner-manager(s)) for more than three months but no longer than 42 months. In this study, we define the businesses started by new entrepreneurs as 'baby businesses.'

Finally, an ‘established entrepreneur’ is an owner-manager of an independent business that has paid salaries to someone for longer than 42 months. A business started by established entrepreneurs is an ‘established business.’ Our analyses were based on the samples of baby businesses defined above. We exclude from the analysis the established businesses and nascent entrepreneurs who, according to the GEM definition, are still trying to start a new business but have not paid any salaries nor conducted any concrete business activities.

For the empirical analysis, our GEM dataset covers 46,577 (unweighted) interviews among working-age individuals (16–64 years old) who were new entrepreneurs owning and managing a baby business in 11 economies in developing Asia and 57 economies in other developing regions as shown in Table 1.

We combined the individual entrepreneurship data from GEM with a country dataset describing a country’s digital technology development from the GII database published by WIPO. Other country data sources are incorporated for the empirical analysis, such as population and GDP data from the World Bank.

**Table 1. Developing Asia and Other Developing Regions in the Study**

| Developing Asian Economies | Other Developing Economies | | |
|---|---|---|---|
| Armenia | Algeria | Jamaica | Togo |
| China, People’s Republic of | Angola | Jordan | Trinidad and Tobago |
| Georgia | Argentina | Kuwait | Tunisia |
| India | Barbados | Lebanon | Türkiye |
| Indonesia | Belarus | Libya | Uganda |
| Kazakhstan | Belize | Macedonia | United Arab Emirates |
| Malaysia | Bolivia | Madagascar | Uruguay |
| Pakistan | Bosnia and Herzegovina | Malawi | Venezuela |
| Philippines | Botswana | Mexico | Zambia |
| Thailand | Brazil | Morocco | |
| Viet Nam | Bulgaria | Nigeria | |
| | Burkina Faso | Oman | |
| | Cameroon | Panama | |
| | Chile | Peru | |
| | Colombia | Poland | |

*Continued on the next page*

| Developing Asian Economies | Other Developing Economies | |
|---|---|---|
| | Costa Rica | Qatar |
| | Dominican Republic | Romania |
| | Ecuador | Russian Federation |
| | Egypt | Saudi Arabia |
| | El Salvador | Senegal |
| | Ghana | Serbia |
| | Guatemala | South Africa |
| | Hungary | Sudan |
| | Iran | Suriname |

Source: Authors.

## B. Variables and Measures

### Dependent Variables

We examine the influence of a country's development in digital technologies on the innovation of new entrepreneurial businesses within that country and compare the impact of DT between developing Asian economies and other developing economies. We use ***product innovation*** to capture entrepreneurs' innovation activities. It is measured by a dummy variable which takes value "1" if at least some customers of a new entrepreneurial firm consider the firm's product or service new, i.e., the product or service is not previously available in the market. The variable takes the value "0" if none of the firms' customers considers the products or services new.

### Independent Variables

We examine the impact of a set of country developments in digital technologies on entrepreneurs' product innovation across countries. The measures of the DT variables are taken from the GII database published by WIPO (Dutta et al., 2023).

***Development of digital technology*** captures the level of development of information and communication technology (ICT) in a country. It forms the infrastructure pillar of the Innovation Input Index of GII alongside the institution, human capital and research, and market and business sophistication pillars. There are four subindexes of the ICT index.

***ICT access*** is a composite index including the following four ICT indicators: (1) the share of the population covered by mobile networks; (2) mobile cellular telephone subscriptions

per 100 inhabitants; (3) international internet bandwidth per internet user; and (4) percentage of households with internet access. The final index is calculated by taking the equally weighted average of the four indicators.

***ICT use*** is a composite index taking the weighted average of the following four ICT indicators (25% each): (1) percentage of individuals using the internet; (2) fixed broadband internet subscriptions per 100 inhabitants; (3) active mobile broadband subscriptions per 100 inhabitants; and (4) mobile broadband internet traffic (gigabytes/ subscriptions).

***Government's online service*** assesses how well governments use technology to deliver public services across a country. It is a composite indicator, calculated based on five weighted subindexes: service provision (45%); technology (5%); institutional framework (10%); content provision (5%); and e-participation (35%). The overall score is calculated from the normalized values of each subindex, with its values ranging from 0 to 1, and with higher values indicating a better online service provided by a government.

***E-participation*** is a measure of citizen engagement in public policymaking through e-government programs. It assesses how well governments use online services to provide information, interact with stakeholders, and engage in decision-making. The values of the variable range from 0 to 1, with higher values indicating greater e-participation.

**Moderation Variable**

In the current study, we compare the influences of a country's DT development on innovative entrepreneurship between developing Asia and other developing economies. To facilitate this comparison, we introduce a ***developing Asia*** dummy variable in the analyses. The variable has a value of "1" if a country is a developing country in Asia and "0" if a country is classified as an emerging and developing economy based on the classification of the World Economic Outlook (World Economic Outlook Database, 2023).

**Control Variables**

We control for different factors in both individual and country analyses. For individuals, we consider the entrepreneur's demographical characteristics, including ***age***, a

continuous variable measured in years. ***Gender*** is coded as a dummy variable, with a value of 1 for males and 0 for females. ***Household income*** is measured by a categorical variable with three categories. Value 1 of this variable indicates that the individual's household belongs to the lowest household income tier in the population, value 2 indicates middle income tier, and value 3 indicates top income tier. The individual's ***education*** is also captured by a categorical variable with values ranging from 1 to 5. In ascending order, these indicate that the individual has received no education (1), primary education (2), secondary degree (3), post-secondary education (4), and graduate education (5), respectively. The individual's ***fear of failure*** dummy (1=yes) indicates whether the interviewee has responded affirmatively to the question on whether fear of failure would prevent them from starting a business. The individual's ***entrepreneurial self-efficacy*** is captured by a dummy variable (1=yes), indicating whether the individual believes they possess the necessary skills and knowledge to start a new business.

For economies, we control for the annual ***rate of business formation***, as the prevalence of business entries within a country may affect individuals' decisions to engage in entrepreneurial activities. The businesses considered here include both early stage entrepreneurial ventures and more established firms, and this proxy was taken from the GEM dataset. We control for a country's ***business regulations***, which capture the extent to which its regulatory and infrastructure environments influence the efficient establishment and operation of businesses. We measure this variable using the Business Freedom score from the Index of Economic Freedom published by the Heritage Foundation. We also control for the country's ***population size*** and ***population growth*** which are measured by the total population of the country (in millions) and the population's annual percentage growth rate. The country's economic growth rate and overall development have been shown to be positively associated with new firm entries (Kawai and Urata, 2002; Lee et al., 2011). We therefore control for the country's ***GDP per capita,*** adjusted for purchasing power parity. Due to high levels of correlation with some key institutional variables, it is coded into five quintiles with the lowest quintile as the base. We also control for ***GDP growth,*** which is measured by the annual GDP growth rate. Both variables are taken from World Bank data. We control for time fixed effects by including ***year*** dummies in the analysis.

## C. Statistical Analysis

To estimate the effect of countries' DT development on the innovation activities of entrepreneurial firms, we employ cross-level analyses (country effects on individual entrepreneurial behaviors). This is because our data has a hierarchical structure: the individuals are nested within each country each year. To account for potential within-country interdependence of the observations for each year and to factor in individual and country impacts simultaneously, we adopt multilevel modeling techniques to estimate the proposed hypotheses.

In the GEM survey, an individual is first asked if he or she is engaged in owning and managing a new business. Only if the answer is yes will he or she then be asked about product innovation activities. Therefore, there could be potential unobserved heterogeneities due to self-selection of individuals into entrepreneurship in the first stage. The factors that drive someone to become an entrepreneur could be confounded with factors leading the same person to engage in innovation activities. To account for this potential self-selection bias in the estimation, we adopt a two-stage Heckman selection model (Heckman, 1979). The first stage estimates the probability of an individual qualifying as an early stage entrepreneur as a function of individual demographics that are commonly associated with entrepreneurial entry—such as age, education, household income, fear of failure, familiarity with other entrepreneurs, and entrepreneurial self-efficacy—while controlling for country factors like population size, population growth, GDP per capita, GDP growth, and the country's overall development level of digital technologies. The second stage or the outcome model estimates the impact of the country's DT development on the product innovation of entrepreneurial businesses, while controlling for any unobserved heterogeneity in the self-selection of entrepreneurs (the inverse Mills ratio computed from the first stage model), in addition to controlling for age, gender, education, household income, fear of failure, business formation rate, business regulations, GDP per capita, GDP growth, and population size. To facilitate model identification, acquaintance with other entrepreneurs is excluded from the outcome model.

The econometric models are specified as two-level models with random intercepts, which allow both individual and country variables to affect the likelihood of innovation of

individual entrepreneurs. We use maximum likelihood algorithms to fit the models. In the regression models, the continuous independent variables are all standardized to have a mean of zero and a standard deviation of 1 for better comparability of the estimated coefficients. The key institutional variables are entered into the regression models separately to avoid potential issues of multicollinearity among countries' institutional factors.

## IV. RESULTS

### A. DT Development and Entrepreneurs' Product Innovation Activity

We first analyze the direct effects of a country's DT development on entrepreneurial businesses' innovation activities in the country. Table 2 presents the descriptive statistics for the product innovation analysis of baby businesses. Table 3 presents the correlation matrix of all variables in the product innovation analyses for baby businesses. In Table 3, we can see some strong correlations between different DT related variables, e.g., DT access, DT use, government online service, and e-participation. Such correlations are expected since they are subindexes of the overall DT development indicator. These variables are introduced into the models separately in the analyses. Otherwise, there is little concern regarding multicollinearity among independent variables in the regression analyses.

Table 4 shows the results of country DT development on product innovation activity in baby businesses. In Table 4, Model 1 is the baseline model, including only the control variables. Models 2, 3, 4, 5, and 6 test the influences of various countries' DT development conditions on the likelihood of baby businesses' product innovation.

As shown in Model 2 of Table 4, the impact of a country's overall DT development (0.3, $p<0.05$) shows a significant positive effect on the likelihood of an entrepreneur's product innovation activities, as we expected. Looking at each of the four subindexes of DT development, we find that government online service (0.267, $p<0.001$) and e-participation (0.26, $p<0.05$) show significant and positive effects on the likelihood of an entrepreneur's product innovation activities, as shown in Models 5 and 6 in Table 4. However, we do not find any significant impact of DT access and DT use on the likelihood of an entrepreneur's

product innovation activities, as shown in Models 3 and 4 in Table 4. These results strongly support our assumption which posits that a country's DT development level is positively associated with the innovation potential of its entrepreneurial businesses.

## B. Differential Impact of DT Development Between Developing Asia and Other Developing Economies

We then examine whether the effects of DT development on entrepreneurs' product innovation differ between developing Asian economies and the rest of the developing countries. We test the interaction terms between the developing Asia dummy variable and the overall index and the four subindexes of DT development variables separately in Models 7, 8, 9, 10, and 11 in Table 4. The results show a consistent pattern that the impacts of DT development (-0.422, $p<0.05$), DT access (-0.466, $p<0.01$), DT use (-0.389, $p<0.05$), government online service (-0.444, $p<0.01$), and e-participation (-0.223, $p<0.1$) on entrepreneurs' product innovation are stronger in the other developing economies than in developing Asia.

**Table 2. Descriptive Statistics**

| Variable | Observation | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| New product (yes=1) | 46,577 | 0.43 | 0.49 | 0 | 1 |
| Gender (male=1; female=0) | 46,577 | 0.57 | 0.50 | 0 | 1 |
| Age | 46,577 | 36.44 | 11.14 | 18 | 64 |
| Household income | 46,577 | 28,948 | 32,639 | 33 | 68,100 |
| Education | 46,577 | 948.57 | 565.39 | 0 | 1,720 |
| Fear of failure (yes=1) | 46,577 | 0.32 | 0.47 | 0 | 1 |
| Self-efficacy (yes=1) | 46,577 | 0.85 | 0.36 | 0 | 1 |
| Business formation rate (%) | 46,577 | 0.29 | 0.11 | 0.05 | 0.57 |
| Population size (millions) | 46,577 | 144.00 | 311.00 | 0.28 | 1,420 |
| Population growth (%) | 46,577 | 1.19 | 0.85 | -2.65 | 5.11 |
| GDP per capita PPP (5 quintiles) | 46,577 | 1.90 | 1.09 | 1 | 5 |
| GDP growth (%) | 46,577 | 3.28 | 3.85 | -17.67 | 15.84 |
| Business regulation | 46,577 | 64.89 | 10.34 | 37.3 | 93.5 |
| Digital technology (DT) | 46,577 | 52.41 | 18.56 | 13.1 | 90.2 |
| DT access | 46,577 | 56.52 | 16.54 | 17.4 | 98.2 |
| DT use | 46,577 | 37.73 | 20.99 | 1.1 | 83.7 |

*Continued on the next page*

| Variable | Observation | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Government online service | 46,577 | 61.34 | 18.61 | 15 | 95.1 |
| E-participation | 46,577 | 54.03 | 27.20 | 0 | 98 |
| Developing Asia (Yes=1) | 46,577 | 0.21 | 0.41 | 0 | 1 |
| Year | 46,577 | 2,016 | 2.88 | 2,013 | 2,022 |

GDP = gross domestic product, PPP=purchasing power parity.
Source: Authors' calculations.

## Table 3. Correlations of Variables

| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 New product (yes=1) | 1 | | | | | | | | | | | | | | | | | | | | |
| 2 Gender (male=1; female=0) | 0.01* | 1 | | | | | | | | | | | | | | | | | | | |
| 3 Age | -0.02* | -0.01 | 1 | | | | | | | | | | | | | | | | | | |
| 4 Household income | 0.03* | 0.08* | -0.003 | 1 | | | | | | | | | | | | | | | | | |
| 5 Education | 0.07* | 0.02* | -0.11* | 0.20* | 1 | | | | | | | | | | | | | | | | |
| 6 Fear of failure (yes=1) | -0.02* | -0.06* | 0.04* | -0.03* | -0.00 | 1 | | | | | | | | | | | | | | | |
| 7 Self-efficacy (yes=1) | 0.03* | 0.14* | 0.01 | 0.10* | 0.07* | -0.14* | 1 | | | | | | | | | | | | | | |
| 8 Business formation rate (%) | -0.06* | -0.10* | 0.01* | -0.08* | -0.13* | 0.01 | -0.01* | 1 | | | | | | | | | | | | | |
| 9 Business regulation | 0.05* | 0.07* | 0.07* | 0.05* | 0.20* | -0.02* | 0.06* | -0.29* | 1 | | | | | | | | | | | | |
| 10 Population size (millions) | -0.003 | -0.04* | -0.04* | 0.02* | -0.06* | 0.08* | -0.11* | -0.10* | -0.42* | 1 | | | | | | | | | | | |
| 11 Population growth (%) | 0.07* | 0.0002 | -0.06* | -0.05* | -0.11* | -0.06* | 0.03* | 0.25* | -0.23* | -0.10* | 1 | | | | | | | | | | |
| 12 GDP development stage (2nd quintile) | 0.04* | 0.00* | 0.06* | 0.01* | -0.03* | -0.02* | 0.03* | -0.09* | 0.20* | 0.03* | -0.16* | 1 | | | | | | | | | |
| 13 GDP development stage (3rd quintile) | -0.03* | -0.01* | 0.04* | -0.00* | -0.01* | 0.03* | -0.04* | -0.03* | 0.26* | -0.13* | -0.14* | -0.25* | 1 | | | | | | | | |
| 14 GDP development stage (4th quintile) | -0.04* | -0.02* | 0.01 | -0.05* | 0.07* | 0.00 | -0.06* | -0.07* | -0.003 | -0.15* | -0.10* | -0.25* | -0.25* | 1 | | | | | | | |
| 15 GDP development stage (5th quintile) | -0.03* | 0.02* | -0.01* | 0.04* | 0.16* | 0.04* | -0.04* | -0.24* | 0.23* | -0.22* | -0.08* | -0.25* | -0.25* | -0.25* | 1 | | | | | | |
| 16 GDP growth (%) | 0.08* | 0.002 | -0.01* | 0.02* | 0.002 | 0.01 | -0.01* | -0.05* | -0.12* | 0.20* | 0.10* | -0.13* | 0.04* | 0.10* | -0.10* | 1 | | | | | |
| 17 Digital technology (DT) | 0.01 | 0.05* | 0.07* | 0.07* | 0.19* | 0.06* | 0.06* | -0.24* | 0.48* | -0.13* | -0.38* | 0.15* | 0.28* | 0.06* | 0.35* | -0.29* | 1 | | | | |
| 18 DT access | -0.02* | 0.08* | 0.06* | 0.05* | 0.21* | 0.04* | 0.07* | -0.30* | 0.47* | -0.32* | -0.36* | 0.15* | 0.30* | 0.12* | 0.43* | -0.26* | 0.85* | 1 | | | |
| 19 DT use | -0.03* | 0.06* | 0.06* | 0.04* | 0.21* | 0.06* | 0.07* | -0.21* | 0.46* | -0.27* | -0.36* | 0.07* | 0.31* | 0.10* | 0.45* | -0.29* | 0.90* | 0.91* | 1 | | |
| 20 Government online service | 0.03* | 0.03* | 0.06* | 0.08* | 0.15* | 0.06* | 0.03* | -0.23* | 0.42* | 0.05* | -0.34* | 0.19* | 0.22* | 0.03* | 0.23* | -0.23* | 0.89* | 0.58* | 0.65* | 1 | |
| 21 E-participation | 0.03* | 0.01* | 0.05* | 0.08* | 0.13* | 0.06* | 0.04* | -0.14* | 0.39* | 0.01 | -0.29* | 0.13* | 0.19* | 0 | 0.19* | -0.25* | 0.91* | 0.60* | 0.68* | 0.88* | 1 |
| 22 Developing Asia (yes=1) | 0.05* | -0.00* | 0.01* | -0.01* | -0.02* | 0.05* | -0.08* | -0.002 | -0.23* | 0.55* | -0.15* | -0.13* | 0.02* | -0.07* | -0.11* | 0.27* | -0.26* | -0.34* | -0.28* | -0.18* | -0.15* |

GDP= gross domestic product.
* Indicates correlation coefficients significant at 5% or better.
(Number of observations = 46,577).
Source: Authors' calculations.

## Table 4. Effects of Digital Technology Development on Entrepreneurs' Product Innovation

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Developing Asia=1; Other developing economies=0 | 0.077 | 0.108 | 0.073 | 0.083 | 0.104 | 0.114 | 0.083 | 0.003 | 0.006 | 0.126 | 0.126 |
| | (0.190) | (0.194) | (0.188) | (0.190) | (0.197) | (0.193) | (0.187) | (0.186) | (0.195) | (0.185) | (0.188) |
| DT development (overall) | | 0.300* | | | | | 0.356** | | | | |
| | | (0.133) | | | | | (0.130) | | | | |
| DT access | | | -0.081 | | | | | 0.018 | | | |
| | | | (0.124) | | | | | (0.124) | | | |
| DT use | | | | 0.104 | | | | | 0.176 | | |
| | | | | (0.123) | | | | | (0.128) | | |
| Government online service | | | | | 0.267** | | | | | 0.336*** | |
| | | | | | (0.090) | | | | | (0.092) | |
| E-participation | | | | | | 0.260* | | | | | 0.294** |
| | | | | | | (0.106) | | | | | (0.106) |
| Developing Asia x DT development | | | | | | | -0.422* | | | | |
| | | | | | | | (0.170) | | | | |
| Developing Asia x DT access | | | | | | | | -0.466** | | | |
| | | | | | | | | (0.160) | | | |
| Developing Asia x DT use | | | | | | | | | -0.389* | | |
| | | | | | | | | | (0.193) | | |
| Developing Asia x government online service | | | | | | | | | | -0.444** | |
| | | | | | | | | | | (0.148) | |
| Developing Asia x e-participation | | | | | | | | | | | -0.223+ |
| | | | | | | | | | | | (0.134) |
| Inverse Mills ratio | 0.635*** | 0.628*** | 0.636*** | 0.633*** | 0.629*** | 0.629*** | 0.629*** | 0.637*** | 0.633*** | 0.628*** | 0.629*** |
| | (0.106) | (0.106) | (0.106) | (0.106) | (0.106) | (0.105) | (0.106) | (0.106) | (0.106) | (0.106) | (0.105) |
| Gender (male=1, female=0) | -0.080* | -0.079* | -0.080* | -0.080* | -0.079* | -0.079* | -0.080* | -0.080* | -0.080* | -0.079* | -0.079* |
| | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) | (0.032) |
| Age | -0.059*** | -0.060*** | -0.059*** | -0.059*** | -0.060*** | -0.060*** | -0.060*** | -0.059*** | -0.059*** | -0.060*** | -0.060*** |
| | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) | (0.014) |
| Income1 (middle 33% tier) | -0.021 | -0.021 | -0.021 | -0.021 | -0.021 | -0.021 | -0.021 | -0.021 | -0.021 | -0.022 | -0.021 |
| | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) |
| Income2 (upper 33% tier) | -0.091+ | -0.090+ | -0.091+ | -0.090+ | -0.090+ | -0.090+ | -0.090+ | -0.090+ | -0.090+ | -0.091+ | -0.090+ |
| | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) | (0.053) |
| Education1 (some secondary) | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 |
| | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) | (0.056) |
| Education2 (secondary) | 0.150** | 0.151** | 0.151** | 0.150** | 0.151** | 0.151** | 0.150** | 0.150** | 0.150** | 0.151** | 0.151** |
| | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) | (0.049) |

*Continued on the next page*

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Education3 (post-secondary) | 0.270*** | 0.270*** | 0.270*** | 0.269*** | 0.270*** | 0.271*** | 0.269*** | 0.269*** | 0.269*** | 0.270*** | 0.270*** |
| | (0.057) | (0.057) | (0.058) | (0.058) | (0.057) | (0.057) | (0.058) | (0.058) | (0.058) | (0.057) | (0.057) |
| Education4 (graduate experience) | 0.375*** | 0.375*** | 0.376*** | 0.375*** | 0.376*** | 0.376*** | 0.374*** | 0.374*** | 0.374*** | 0.376*** | 0.376*** |
| | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) | (0.088) |
| Fear of failure (yes=1) | 0.135** | 0.134** | 0.135** | 0.135** | 0.134** | 0.134** | 0.134** | 0.135** | 0.135** | 0.134** | 0.134** |
| | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) | (0.045) |
| Self-efficacy (yes=1) | -0.176* | -0.172* | -0.177* | -0.175* | -0.173* | -0.173* | -0.173* | -0.177* | -0.176* | -0.172* | -0.173* |
| | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) | (0.077) |
| Rate of business | -0.131* | -0.128* | -0.143* | -0.128* | -0.138* | -0.149* | -0.143* | -0.140* | -0.125* | -0.173** | -0.159** |
| | (0.063) | (0.063) | (0.068) | (0.064) | (0.061) | (0.061) | (0.062) | (0.067) | (0.063) | (0.061) | (0.061) |
| Business regulation | -0.063 | -0.127+ | -0.058 | -0.069 | -0.149* | -0.138+ | -0.107 | -0.017 | -0.041 | -0.148* | -0.136+ |
| | (0.074) | (0.075) | (0.074) | (0.073) | (0.074) | (0.077) | (0.078) | (0.079) | (0.078) | (0.073) | (0.077) |
| Population size | 0.060 | 0.010 | 0.048 | 0.066 | -0.042 | -0.025 | -0.006 | 0.018 | 0.053 | -0.058 | -0.030 |
| | (0.077) | (0.074) | (0.084) | (0.078) | (0.078) | (0.080) | (0.072) | (0.084) | (0.078) | (0.075) | (0.079) |
| Population growth (%) | 0.091+ | 0.117* | 0.082 | 0.105+ | 0.100+ | 0.100+ | 0.143* | 0.120* | 0.127* | 0.129* | 0.110* |
| | (0.054) | (0.056) | (0.052) | (0.054) | (0.055) | (0.056) | (0.056) | (0.054) | (0.055) | (0.055) | (0.056) |
| GDP development stage (2nd quintile) | -0.029 | -0.172 | 0.018 | -0.082 | -0.132 | -0.105 | -0.142 | 0.030 | -0.073 | -0.121 | -0.087 |
| | (0.154) | (0.154) | (0.153) | (0.165) | (0.150) | (0.151) | (0.153) | (0.154) | (0.164) | (0.148) | (0.150) |
| GDP development stage (3rd quintile) | -0.059 | -0.280 | 0.018 | -0.152 | -0.224 | -0.142 | -0.233 | 0.048 | -0.137 | -0.167 | -0.130 |
| | (0.295) | (0.319) | (0.310) | (0.324) | (0.307) | (0.304) | (0.305) | (0.293) | (0.311) | (0.291) | (0.300) |
| GDP development stage (4th quintile) | -0.145 | -0.378 | -0.082 | -0.226 | -0.370 | -0.269 | -0.394 | -0.121 | -0.253 | -0.423+ | -0.270 |
| | (0.248) | (0.261) | (0.259) | (0.264) | (0.260) | (0.249) | (0.248) | (0.250) | (0.251) | (0.250) | (0.241) |
| GDP development stage (5th quintile) | 0.292 | -0.034 | 0.384+ | 0.154 | 0.032 | 0.140 | -0.141 | 0.201 | 0.018 | -0.074 | 0.104 |
| | (0.205) | (0.241) | (0.225) | (0.260) | (0.216) | (0.211) | (0.246) | (0.239) | (0.273) | (0.219) | (0.213) |
| GDP growth (%) | 0.138 | 0.176+ | 0.125 | 0.153+ | 0.167+ | 0.152+ | 0.169* | 0.121 | 0.156+ | 0.158+ | 0.149+ |
| | (0.088) | (0.090) | (0.090) | (0.092) | (0.087) | (0.084) | (0.086) | (0.087) | (0.089) | (0.082) | (0.083) |
| Year dummies yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes | yes |
| var(_cons[country-year]) | 0.813*** | 0.790*** | 0.811*** | 0.810*** | 0.777*** | 0.784*** | 0.775*** | 0.790*** | 0.800*** | 0.758*** | 0.778*** |
| | (0.109) | (0.110) | (0.108) | (0.108) | (0.110) | (0.110) | (0.106) | (0.103) | (0.105) | (0.107) | (0.108) |
| Constant | -0.367 | -0.544+ | -0.287 | -0.419 | -0.418 | -0.497+ | -0.504+ | -0.276 | -0.394 | -0.374 | -0.486+ |
| | (0.273) | (0.288) | (0.317) | (0.283) | (0.270) | (0.276) | (0.288) | (0.313) | (0.284) | (0.269) | (0.275) |
| Observations | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 | 46,577 |
| Number of groups | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 | 271 |
| Log likelihood | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 | -26412 |

DT= digital technology, GDP=gross domestic product
Robust standard errors in parentheses; *** p<0.001, ** p<0.01, * p<0.05, + p<0.1.
Source: Authors' calculations.

## V. CONCLUSION

While large corporations such as Alibaba, Tencent, Baidu, and Samsung often dominate the headlines, SMEs are the true backbone of Asia's economy. More than 96% of all Asian businesses are SMEs (Yoshino and Hesary, 2018). These SMEs play a crucial role in economic development, especially in middle income and developing countries. Unlike entrepreneurs in developed nations, many entrepreneurs in these regions start businesses out of necessity rather than opportunity (World Bank, 2024). Whereas opportunity-driven entrepreneurship tends to foster innovation and value creation, necessity-driven entrepreneurs often struggle to create significant economic value or achieve substantial growth (Baumol, 1990; Wong et al., 2005; Audretsch, 2018; Acs and Szerb, 2007; Valliere and Peterson, 2009).

Digitalization offers SMEs the opportunity to overcome traditional barriers and push toward the technological frontier. It not only reduces economic costs and entry barriers but also enables entrepreneurs to scale their operations and compete more effectively with larger businesses and globally (Fariselli et al., 1999; Goldfarb and Tucker, 2019). These 'digital dividends', or the broader development benefits of leveraging digital technologies (World Bank, 2016), open up new avenues for growth even in resource-limited settings like those of developing economies (Mishrif and Khan, 2023). Beyond cost reduction and efficiencies, digital technologies can drive disruptive innovations, allowing entrepreneurs to bypass traditional stages of development or even surpass established businesses (Xiong et al., 2021; Christensen, 1997). Given this, we expect that the development of digital technologies positively influences entrepreneurial innovation.

It seems logical to assume that digitalization would naturally boost entrepreneurial innovativeness in new product innovation. After all, access to digital tools should make it easier for businesses to innovate and grow. While this assumption is reasonable, it is essential to test it empirically, as not all regions experience the same impact from digitalization. Factors such as infrastructure, access, and the local entrepreneurial ecosystem can significantly shape how much digitalization contributes to innovation across different areas.

To explore this, we undertake a data-driven and region-specific analysis to examine the relationship between digital technology development and entrepreneurs' product innovation activity, with a focus on comparing developing Asia to other developing regions. Our findings reveal that a country's overall DT development positively influences entrepreneurs' product innovation activities. Moreover, the effectiveness of governments' technology use in delivering public services and engaging citizens through e-government programs has a positive impact on the likelihood of product innovation for new businesses. These results support our first objective of assessing the general impact of digital development on entrepreneurial innovation.

In terms of our second objective—comparing how this impact varies between developing Asia and other developing regions—our analysis shows an intriguing pattern. Surprisingly, the positive effects of digital development on new business innovation are consistently stronger in other developing economies compared to developing Asia. This suggests that while digital tools are beneficial across the board, they may be more transformative in regions outside developing Asia. A plausible explanation is that businesses in these regions may have started with lower levels of digitalization or were at an earlier stage of digital infrastructure development, making digital tools more impactful. In contrast, in developing Asia, where digital technologies are already more integrated, the impact may be incremental rather than transformative.

Our findings indicate that policymakers should prioritize enhancing the development of DT and supporting entrepreneurial initiatives in both developing Asia and other developing economies. In regions where DT has proven transformative, efforts should focus on expanding access to these technologies and encouraging wider adoption.

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## The Impact of Digitalization on Entrepreneurial Innovation

*A Comparative Analysis Between Developing Economies in Asia and in Other Regions*

This paper explores the relationship between digitalization and entrepreneurial innovation across developing economies. Using data from the Global Entrepreneurship Monitor (2013–2022) and the Global Innovation Index along with its subindexes, it finds that digital technology development generally boosts entrepreneurial innovation. However, the results reveal a significant regional variation. The impact on product innovation is significantly stronger in developing economies from other regions compared to those in Asia. This suggests that while digitalization supports innovation generally, its effects may be more transformative in regions outside Asia. These findings offer valuable insights for policymakers seeking to leverage digitalization to drive innovation and economic growth.

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