



Is Digitalisation Enough to Promote Self-Employment? Evidence From Developing Economies on the Roles of Unemployment and Financial Development

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ABSTRACT

The research primarily focuses on the impact of digitalisation and financial development on self-employment. To conduct the study moderate multiple regression analysis is conducted and the data was collected from the World Bank's Open Data and other publicly available macroeconomic databases resulting in 300 observations covering 15 developing countries over the period 2005-2024. This study examines how digitalization and digital financial inclusion are associated with self-employment, specifically analyzing how regional digital infrastructure and institutional framework influence occupational choice. It fills a research gap by treating unemployment as not just a control variable but as a key catalyst which promotes self-employment. The result of analysis shows that digitalisation alone has an important direct effect on self-employment, but it depends on shift labour dynamics, whereas domestic financial development has negatively affected self-employment, as it leads to formal wage employment.

KEYWORDS

Digitalization, Financial Inclusion, Labour Dynamics, Self-Employment and Formal Wage Employment.

INTRODUCTION

Throughout the developing world, self-employment is standard, not exceptional. The International Labour Organization (ILO, 2024) estimates approximately 76.5% of employment in low-income countries versus roughly 10% in high-income economies. In Sub-Saharan Africa, South Asia, and much of Latin America, most working-age individuals rely on their own enterprises, however modest, rather than formal wages. For many, this represents not a voluntary expression of entrepreneurial aspiration but economic necessity. Gindling and Newhouse (2014)



demonstrate that considerable proportions of self-employed individuals outside agriculture earn less than comparable wage workers, with limited financial access ranking among the most consistent predictors of whether self-employment yields viable income or merely replaces unemployment. Accordingly, the structural conditions determining whether self-employment proves productive or merely constitutes a survival response represent among the most consequential questions in development economics. This paper investigates two such conditions, digitalization and financial sector development, and examines whether improvements in either or both can alter the trajectory of self-employment in developing economies.

Digitalization theoretically promotes self-employment at least, intuitively. The proliferation of mobile internet, digital payment infrastructure, and platform-based marketplaces diminishes transaction costs and market-access barriers that have historically rendered entrepreneurial entry challenging for workers lacking substantial capital (Röller & Waverman, 2001; Verhoef et al., 2021). Novel categories of income-generating activity, freelance digital services, micro-trade, ride-hailing, remote consultation, become feasible for individuals previously unable to access customers beyond their immediate locality. The Asian Development Bank (2022) reports that digitalization adoption among small enterprises in developing Asia enhances business performance and expands market access, while Sinha (2025) contends that digital technologies establish new self-employment and micro-enterprise development pathways precisely in economies where formal wage employment remains structurally scarce. Nevertheless, broader cross-country panel evidence regarding this relationship is considerably more cautious. Several studies indicate that digitalization's employment effects are conditional; digital access does not automatically translate into productive self-employment (Tran & Le, 2026; Sinha, 2025). This conditionality motivates the moderating framework adopted herein.

Financial development functions through a distinct yet related channel. Shaw's (1973) financial deepening theory maintains that a more liberal and accessible financial system, with deeper



credit markets and broader banking penetration, stimulates investment and activity by eliminating capital constraints. Financially developed economies should exhibit higher entrepreneurial entry rates, as prospective self-employed workers can secure borrowing to initiate and sustain their activities. Bayar et al. (2018) demonstrates that both banking sector credit and capital market positively influence early-stage entrepreneurial activity. Khera et al. (2021) contends that digital financial inclusion, the delivery of credit, savings, and payments through mobile and fintech channels, is efficacious at reaching underserved populations mostly engaging in self-employment, thereby removing capital formation barriers. However, financial deepening also facilitates formal-sector firm expansion that employs workers, which may extract individuals from necessity-driven self-employment altogether. Whether financial development reinforces or crowds out self-employment in digitally connected economies is, therefore, an empirical question and it constitutes one of the questions this paper directly examines.

Unemployment constitutes the third analytical element and has long featured in entrepreneurship literature as a potential push factor. Lucas (1978) formalized the threshold between wage employment and self-employment shifts when formal job opportunities become scarce, workers incapable of securing formal sector employment are more likely to generate their own work, irrespective of returns. Rissman (2006) connects this directly to labour market conditions, while Lim et al. (2024) situate it within the broader phenomenon of necessity entrepreneurship: the decision to become self-employed driven not by opportunity but by absence of alternatives. In developing economies, characterized by chronically thin formal labour markets and social protection systems offering limited cushion against unemployment, the push mechanism is arguably more operative than in advanced economies possessing stronger safety nets. Liu et al. (2025) advance further, arguing that in developing countries, the digital economy simultaneously displaces certain routine employment categories and generates new service-sector self-employment opportunities, meaning unemployment pressure and digital access may interact in determining who enters self-employment and for what reasons. This paper treats



unemployment not merely as a control variable but as a moderator of the digitalization-self-employment relationship, testing whether digital infrastructure functions as a more effective route into self-employment in contexts where formal employment proves harder to secure.

Despite expanding individual literatures surrounding each factor, their collective influence on self-employment has received less systematic attention. Investigations examining digitalization and employment, including Acemoglu and Autor (2011), Balsmeier and Woerter (2019), and Myovella et al. (2021), tend to conceptualize financial conditions as background controls rather than moderating variables possessing independent theoretical significance. Conversely, the finance-entrepreneurship literature seldom models the digital environment in any meaningful manner. Uche et al. (2024) examines both digitalization and financial development as predictors of gender-disaggregated self-employment across developing countries utilizing dynamic panel methods, yet unemployment is more as a control rather than as a potential moderator of the digital effect. This paper contends that distinction is consequential. Digital access functions partly as a platform through which unemployed workers generate their own income when the formal sector fails to absorb them, then conceptualizing unemployment as a simple additive control will obscure a conditional relationship possessing significance both analytically and for policy purposes. The present study estimates this conditional structure across a panel of 15 developing economies from Asia, Africa, and Latin America, observed from 2005 to 2024.

This paper contributes to the literature in two principal ways. First, it furnishes panel evidence regarding the conditional nature of digitalization's relationship with self-employment, demonstrating that the effect is not uniform across economic contexts, it varies meaningfully contingent upon both the unemployment conditions workers encounter and the depth of the financial system available to them. These conditional patterns constitute the paper's central empirical finding. Second, addressing the need for context-specific insights, the study restricts



the sample to developing economies and explicitly models interactions among digitalization, financial development, and unemployment, generating insights directly applicable to policy environments where self-employment is most prevalent and its quality matters most for poverty reduction and inclusive growth. The paper is structured as follows: Section 2 reviews relevant theoretical and empirical literature; Section 3 describes data, econometric approach and discusses empirical results; Section 4 concludes with policy implications.

LITERATURE REVIEW

2.1 Conceptual Overview: Foundations of Digitalization

2.1.1 Defining Digitalization in Macroeconomic Contexts

Digitalization generates new pathways in economic and social pathways across financial, media sector, educational and infrastructural development, thus advancing economic development and human capital (Xholo et al 2024). Entailing massive transformation from analog procedures to a digitalized and simplified approach for executing business operations, production, services, commerce, and daily transactions. Incorporating various channels of digital infrastructure, such as Information and Communications Technology (ICT), internet penetration, mobile connectivity, palmtops, laptop and computers.

Digitalization increases the value of cognitive and digital skills while reducing the demand for manual tasks (Acemoglu & Autor, 2011). The primary driver of digitalization is the accumulation of information and communications technology (ICT) capital. This infrastructure generates powerful network externalities (or network effects), where the value of a macroeconomic network increases exponentially with each additional user (Röller & Waverman, 2001).



From a structural and macroeconomic perspective, digitalization is decomposed into distinct, interdependent components. These elements interact within an economic ecosystem to transform traditional, analog processes into a cohesive digital network (Verhoef et al., 2021). The core architecture of digitalization is built upon four fundamental pillars.

- I. **Digital Infrastructure (The Hardware & Network Foundation):** Digital infrastructure represents the physical and structural capital required to collect, transmit, and store data across an economy, driving optimal resource allocation and mitigating information asymmetry (Röller & Waverman, 2001).
- II. **Digital Public Infrastructure & Software (The Transactional Layer):** While hardware provides the physical pathway, the software and transactional platforms define how data is structured, utilized, and exchanged at a societal scale (Mazzucato et al., 2024).
- III. **Human Capital & Digital Capabilities (The Labour Factor):** Digital infrastructure investments are strictly bounded by the capacity of the labour force to utilize, adapt, and innovate with these technologies (Digital Literacy) (Onikosi-Alliyu & Muhammed, 2025). IMF (2023) concludes that the potential of digitalization can be explored with investments in human capital and skill development.
- IV. **Institutional, Legal, and Regulatory Frameworks (The Governance Environment):** Institutions dictate the incentive structures, property rights, and security parameters that govern digital interactions. Without robust institutional components, digital networks can face severe coordination failures or systemic vulnerabilities (Myovella et al., 2021).

2.2 The Interplay of Digitalization, Financial Inclusion, and Self-Employment Dynamics

2.2.1 Digitalization of the Financial Sector and Innovation

Digital technologies enhance financial systems effectiveness by reducing information asymmetries, enhancing credit allocation, and lowering transaction costs (Frost et al., 2019;



Thakor, 2020). The rise of fintech ecosystems - digital payments, online lending, and platform-based financial services - shows how digital infrastructure can improve access to finance, particularly for small firms and underserved groups (Philippon, 2016; Frost et al., 2019). Consequently, digitalization and financial development act as complements, supporting firm growth, entrepreneurship, and more stable employment.

Academic interest in digital technologies and financial innovation has increased to understand how digitalization affects the velocity of money and monetary circulation. Roy et al. (2021), found that debit card transactions positively and significantly increase the velocity of money in Indonesia. Similarly, Ocansey et al. (2024) revealed mobile money services and digital banking maintain significant short-run and long-run relationships with money velocity in Ghana, indicating digital financial transformation directly influences monetary circulation.

Sahay et al. (2020) argues that fintech development improves transaction efficiency, financial access, and payment speed, thereby altering money handling behaviour in developing economies. Hasan et al. (2024) demonstrated that financial technology adoption significantly modifies monetary policy transmission and liquidity behaviour by altering financial intermediation mechanisms. Likewise, Nguyen et al. (2022) emphasized that stronger and more efficient financial institutions improve monetary transmission and liquidity allocation within banking systems.

The emergence of Fintech companies is a result of the pulling of the banking sector to reap the positive effect of digitalization. According to Berger & Humphrey (1997), increased efficiency in banks leads to robust performance enhancing the banks to remain competitive within the industry. Hence an inefficient bank sector or operation can lead to low commerce & business activities affecting production and consumption in the long run. These findings encourage the nexus between the digitalization and financial inclusion concluded in the current study.



2.2.2 The Impact of Digitalization and Financial inclusion on Self – employment

The improvement in employment level requires a simultaneous increase in labour demand and supply. Under certain conditions, the financial inclusion can expand the demand for the labour force by affecting credit, enterprises, workers, and other aspects, improving the employment level.

According to the financial deepening theory (Shaw 1973), financial inclusion has the characteristic of relaxing interest rate control compared with traditional finance. A steady and falling loan interest rate effectively stimulates the increase in loan demand, broadens financing channels, and reduces financing resistance, thus increasing corporate financing and investment and driving the investment behaviour of residents, thereby increasing the number of enterprises. The expansion of scale is also conducive to the high-quality development of the real economy, thereby creating additional job opportunities and promoting a higher employment level.

However, residents' judgement of economic conditions will be more optimistic because of financial inclusion, enhancing their marginal propensity to consume, stimulating the economy, expanding production, and expanding employment (Bo et al. 2022). A relaxed interest rate control policy leads to an increase in the real interest rate, an increase in capital costs, and an improvement in the labour force as a production factor favoured by enterprises, thus increasing the demand for labour (Boustanifar 2014).

Digital Financial Inclusion (DFI) employs digital resources to deliver financial services to the population enabling them to pursue self-employment by eliminating capital formation constraints that prevent them from scaling their activities (Khera 2021). Uche et al. (2024) demonstrated the evidence through system generalized method of moments (sys-GMM) estimation that ICT significantly influences total male and female self-employment. Their model is closely aligned with the current study's design.



2.3 Unemployment and the "Push & Pull Factor" of Self-Employment

Self-employment is mostly the result of two opposing sides – push and pull factors. Pull factors are represented by entrepreneurs who are credited with stimulating job growth and encouraging innovation and as a voluntary response to market opportunities enabled by digital access, credit access and institutional access, while push factors are represented by entrepreneurs who choose self-employment as a consequence of limited opportunities in the wage sector or become self-employed as an alternative to unemployment (Rissman, 2006, p. 14).

In economic models of entrepreneurship, the decision to become an entrepreneur is simply one of occupational choice: the wage an individual expects to earn through salaried employment is compared to expected earnings from entrepreneurship, with the probability of choosing self-employment given as a function of the occupational earnings differential. Lucas (1978) assumed people to differ in terms of (continuously distributed) innate entrepreneurial ability and showed that the most able individuals choose to become self-employed, where the ability of the “marginal entrepreneur” is just sufficient to make her or him indifferent to working as an employee and the most able entrepreneurs run the largest business.

Lim et al. (2024) provides a synthesis of necessity entrepreneurship in which the push and pull distinction is implied, due to the lack of physiological needs – unemployment pressure, poverty, financial inclusion, lack of resources, thin formal labour market, limited social protection and job dissatisfaction - making it different from opportunity entrepreneurship.

An important but often overlooked dimension of the push mechanism is the role of social rights in shaping how people respond to job loss and technological change. Golboyz (2025) argues that unemployment benefits the individuals to transition from unemployment to self-employment as it reduces the dependency on the market to survive. Capitalist labour markets have structural inequalities regarding opportunities and income while the self employed sector allows certain



economic independence from the endless wage labour cycle. Esping-Andersen (1990) builds on this by arguing that unemployment benefits "de-commodify" workers, they give workers the ability to survive economically without immediately accepting any available job. This matters for self-employment because when workers are not under immediate financial pressure, they are less likely to enter self-employment out of desperation. Golboyz (2025) applies this logic to the technology-employment relationship, arguing that the generosity of unemployment benefits shapes whether digitalization leads to better or worse employment outcomes. In societies where unemployment benefits are adequate, workers have the freedom to wait for quality employment opportunities rather than accepting low-quality work or being forced into survival self-employment. Due to the introduction of digitalization, this institutional structure of unemployment - self employment has consequential resulting in variations among the skill level and market structures.

Golboyz (2025) identifies that unemployment benefits raise workers' reservation wages, the minimum wage they are willing to accept. When reservation wages are higher, firms cannot easily fill low-wage positions and are instead pushed to create better-quality jobs. For self-employment, this means that workers in high-benefit settings are more likely to enter self-employment by choice drawn by opportunity rather than by necessity. In an addition overview

The same case is studied in Tran and le et al.(2026) demonstrating that higher ICT development in countries, lower the vulnerable employment is ,thus opportunity driven self-employment is higher. This theory states that digital platforms lower the entry barriers to opportunity entrepreneurship while also providing alternative income generation to unemployed workers. Additionally in the 16 developing countries in this study formal social protection is limited and unemployment benefits are either very low or absent entirely. As a result, unemployed workers face strong financial pressure to find income quickly. When digitalization lowers the barriers to self-employment by reducing start-up costs, expanding market access, and enabling digital



payments, unemployed workers in these countries are especially likely to enter self-employment as a survival strategy. This means that high unemployment is expected to amplify the positive effect of digitalization on self-employment. According to Liu et al. (2025) the impact of digital economy on job creation has a substitution effect on the developing countries as it explores its potential in expanding the services sector and driving economic development displaying an unemployment self employment relation between them. These findings suggest that digitalization plays as a catalyst in self-employment and new job creation in the market of developing economies. Additionally, harnessing the digitalization's potential for inclusiveness enabled digital entrepreneurship and impacted the MSMEs to scale effectively and improve job quality (Sinha 2025).

2.4 Empirical Dynamics of Digital Finance in Selected Developing Economies

The IMF (2023) documents the Asian economies including Bangladesh, India, Malaysia, Philippines, and Vietnam which have benefited from technological development and ICT infrastructure improvement, reducing the productivity gaps in emerging economies. Digitalization adoption has an effect on business performance, profitability, and sustainability. Furthermore, providing accessibilities to new and small ventures and reducing the assets by enabling outsourcing the activities (ADB 2022) . This establishes the effects of digitalization on self -employment which are hypothesized in this study.

For Vietnam, Nguyen et al.(2021) provides empirical results that Internet usage increases the probability of self-employment in the non-farm sector by 11.8%. In other Asian developing countries, the effects of financial inclusion on economic growth are more positive than developed countries however vary depending on the income levels (Hussain 2024).The literature on the African continent has emphasized on the potentials and constraints of digitalization and self- employment. Ndoyo et al. (2022) finds ICT developments reduce the spread of informal employment implying a landscape of self-employment in regions of Nigeria, Kenya, and South



Africa where informal employment is dominant. The youth unemployment scenario is quite acute in Africa and according to the review of Mariette (2025) focused on Nigeria and South Africa finds that digital space fosters youth entrepreneurship and self-employment opportunities by providing market barriers, low entry barriers and digital divide gaps.

In Latin America, post covid 19 pandemic digitalization mitigated the shock of job loss as it generated gender – differentiated employment effects, while digital self – employment among women in Brazil, Columbia, and Mexico increased (IMF 2024). The nation's digitalization strategies enabled digital entrepreneurship and adoption of digital inclusion in business (Andonova 2023).

2.5 Research Gap

A major research focus has been the effect of digitalisation on employment. However, Oumbé et al. (2023) broadened this by examining the long-term interplay between ICT, economic complexity, GDP per capita, government spending, and natural resources. Although comprehensive, this study did not consider the PULL and PUSH effects of unemployment as a catalyst for self-employment.

While Uche et al (2024) is the most prominent paper which discusses digitalization and financial development also being predictors of self-employment in developing countries differing from previous papers making it the direct methodological predecessor of the present study however it takes unemployment as a control variable. Lim et al. (2024) provides theoretical synthesis on the push mechanism on self-employment however lacks any cross-country panel. Golboyz (2025) provides important theoretical grounding mechanisms of unemployment benefits and technology-employment relationships, but focuses on developed economies rather than self-employment in developing countries. Golboyz (2025) institutional framework shows that where social protection is weak as in most of the 15 developing economies in this study the push



mechanism operates with greater force, amplifying the digitalization-unemployment interaction. This study addresses this gap of interaction between the self-employment and unemployment with implications of digitalization and financial resources on self-employment across the 15 different developing countries spanning from Asia (Bangladesh, India, Indonesia, Malaysia, Pakistan, Philippines, Vietnam), Africa (Egypt, Kenya, Nigeria, South Africa), Latin America (Brazil, Columbia, Peru) and North America (Mexico) enabling different region specificity analysis of the hypothesis.

Moreover, limited attention has been given to the moderating role of banking efficiency in the relationship between digitalization and money velocity. Therefore, this study extends the existing literature by investigating the effect of digitalization on money velocity in emerging economies while examining the moderating role of banking efficiency.

Kananurak (2020) investigates financial inclusion and self-employment without incorporating digitalization. Similarly, Haini (2022) studies internet penetration and financial access concerning new businesses but not self-employment as an outcome. Few cross-regional studies, such as Adel (2024) and Ayaz (2025), focus on economic growth, financial inclusion, and employment rates, rather than self-employment. Thus, the present study seeks to address the gap by positioning self-employment as a macroeconomic concept and an outcome variable.

METHODOLOGY

3.1 Research Design and Data

This study adopts a quantitative approach design using panel data to examine the relationship between digitalisation, self-employment & to investigate whether unemployment and financial development plays an impact role on digitalisation on self-employment.



The study adopts a panel dataset of 15 developing countries over the period of 2005 – 2024 resulting in 300 observations. The sample countries include: Indonesia, India, Malaysia, Vietnam, Philippines, Pakistan, Bangladesh, Egypt, Kenya, Nigeria, South Africa, Brazil, Mexico, Colombia, and Peru.

These countries were adopted from different continents showing a wide range of developing characteristics which suits our research tenet showing varying levels of digital transformation, financial development, labor market & economic plight.

The data were collected from the World Bank open data. The panel dataset was structured using country identifiers & annual observation.

3.2 Variable Measurement

The dependent variable of the study is self-employment (Self_emp), measured as the percentage of total employment represented by self-employed workers. The key explanatory variable is digitalization (digital_index), while domestic credit (domestic_cre), banking development (bank), unemployment (unem), GDP per capita (gdppc), urbanization (urban), and labor force participation (labor_force) are included as control variables.

Furthermore, two interaction variables were constructed to test moderating effects:

1. Digitalization $\times$ Unemployment (dig_unem)
2. Digitalization $\times$ Domestic Credit (dig_credit)

These interaction terms capture whether unemployment and financial development strengthen or weaken the relationship between digitalization and self-employment.

3.3 Construction of the Digitalization Index

Before constructing the composite digitalization index, the internet usage and mobile subscription variables were standardized using z-score transformation to eliminate scale



differences. Principal Component Analysis (PCA) was then applied to extract the common digitalization dimension from the two indicators.

The PCA results indicate that the first principal component has an eigenvalue of 1.733 and explains approximately 86.6% of the total variance, suggesting that the two indicators strongly capture a single underlying digitalization factor. Both standardized variables exhibit equal factor loadings of 0.707 on the first principal component, indicating that internet usage and mobile subscriptions contribute equally to the construction of the digitalization index.

Based on these results, the composite digitalization index was generated using the first principal component as follows:

Table 2. Principal Component Analysis (PCA) Results for the Digitalization Index

Panel A. Total Variance Explained				
Component	Eigenvalue	Difference	Proportion	Cumulative
Comp1	1.733	1.466	0.866	0.866
Comp2	0.267	—	0.134	1.000
Panel B. Principal Component Loadings				
Variable	Comp1	Comp2	Unexplained	
z_internet	0.707	0.707	0	
z_Mobile	0.707	-0.707	0	

Notes: The digitalization index was constructed using Principal Component Analysis (PCA) based on standardized internet usage and mobile cellular subscription variables. The first



principal component (Comp1) explains approximately 86.6% of the total variance and was therefore used to generate the composite digitalization index. Both indicators load positively and equally on the first principal component, indicating that internet usage and mobile subscriptions contribute similarly to the measurement of digitalization.

$$\text{Digital Index} = 0.7071(Z_{\text{internet}}) + 0.7071(Z_{\text{mobile}}).... (1)$$

3.4 Treatment of Missing Data

Several variables contained a limited number of missing observations. In particular, the domestic credit variable had some missing values for several countries across a few years. In addition, a very small number of missing observations appeared in some control variables for one or two years only.

To maintain the balanced panel structure and avoid unnecessary data loss, the missing observations were replaced using the previous year's value (last observation carried forward approach). The study assumes that these limited replacements do not materially influence the overall estimation results because the proportion of missing data is relatively small compared to the full sample size.

3.5 Econometric Model Specification

To examine the determinants of self-employment, we use a baseline fixed effects model specified as follows:

$$\text{SelfEmp}_{it} = \beta_0 + \beta_1 \text{DigitalIndex}_{it} + \beta_2 \text{DomesticCre}_{it} + \beta_3 \text{Bank}_{it} + \beta_4 \text{Unem}_{it} + \beta_5 \text{GDPpc}_{it} + \beta_6 \text{Urban}_{it} + \beta_7 \text{LaborForce}_{it} + \mu_i + \varepsilon_{it}.... (2)$$

In the baseline model, self-employment is modeled as a function of digitalization, financial development, unemployment, and several macroeconomic control variables. Specifically,



self-employment ($SelfEmp_{it}$) in country i at time t is explained by the composite digitalization index ($DigitalIndex_{it}$), domestic credit to the private sector ($DomesticCre_{it}$), banking development ($Bank_{it}$), unemployment ($Unem_{it}$), GDP per capita ($GDPpc_{it}$), urbanization ($Urban_{it}$), and labor force participation ($LaborForce_{it}$). The model also includes country-specific fixed effects (μ_i) to control for country characteristics that remain constant over time, while ε_{it} represents the random error term. This allows the study to estimate the within-country effects of digitalization and other variables on self-employment across the sample period.

To test the effects of unemployment and financial development, the study estimates the following interaction model:

$$SelfEmp_{it} = \beta_0 + \beta_1 DigitalIndex_{it} + \beta_2 DomesticCre_{it} + \beta_3 Unem_{it} + \beta_4 (DigitalIndex \times Unem)_{it} + \beta_5 (DigitalIndex \times DomesticCre)_{it} + \beta_6 Bank_{it} + \beta_7 GDPpc_{it} + \beta_8 Urban_{it} + \beta_9 LaborForce_{it} + \mu_i + \varepsilon_{it} \dots (3)$$

The terms allow the study to examine whether unemployment acts as a “push factor” that strengthens digital entrepreneurship and whether financial development facilitates or weakens digitalization–self-employment relationships.

3.6 Estimation Technique

The study estimated both Fixed Effects (FE) and Random Effects (RE) panel models. To determine the most appropriate estimation method, the Hausman specification test was conducted. The test produced a chi-square statistic of 23.51 with a probability value of 0.0006. Since the p-value is statistically significant at the 1% level, the null hypothesis of no systematic difference between FE and RE estimators was rejected. Therefore, the Fixed Effects model was selected as the preferred estimation approach.



Overall, the use of Fixed Effects with Driscoll–Kraay standard errors provide more reliable and robust coefficient estimates for analyzing the relationship between digitalization, unemployment, financial development, and self-employment across developing economies.

Table 3. Descriptive Statistics of the Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Self emp	300	50.014	20.008	14.129	91.605
digital index	300	0	1.316	-2.747	2.709
domestic cre	300	49.219	33.699	7.923	142.422
bank	300	9.412	4.46	2.656	21.171
unem	300	6.676	6.171	.398	34.007
gdppc	300	4375.611	2978.356	739.204	11883.791
urban	300	54.498	19.748	25.477	87.896
labor force	300	63.379	9.736	41.616	82.566



Table 2 represents the descriptive statistics indicate substantial variation across developing countries in both self-employment and digitalization levels during the study period. The average self-employment rate was 50.01%, with values ranging from 14.13% to 91.61%, suggesting considerable differences in labor market structures among countries. The digitalization index recorded a mean of 0 and a standard deviation of 1.316, with values ranging between -2.747 and 2.709, reflecting uneven digital development across the sample. Financial development also showed strong disparities, as domestic credit averaged 49.22% of GDP but ranged from only Table 2 represents the descriptive statistics indicate substantial variation across developing countries in both self-employment and digitalization levels during the study period. The average self-employment rate was 50.01%, with values ranging from 14.13% to 91.61%, suggesting considerable differences in labor market structures among countries. The digitalization index recorded a mean of 0 and a standard deviation of 1.316, with values ranging between -2.747 and 2.709, reflecting uneven digital development across the sample. Financial development also showed strong disparities, as domestic credit averaged 49.22% of GDP but ranged from only

Table 4. Pairwise Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) Self_emp	1.000							
(2) digital_index	-0.500*	1.000						



	(0.000)							
(3) domestic_cre	-0.525*	0.517*	1.000					
	(0.000)	(0.000)						
(4) bank	-0.327*	0.274*	0.019	1.000				
	(0.000)	(0.000)	(0.742)					
(5) unem	-0.493*	0.227*	0.402*	0.172*	1.000			
	(0.000)	(0.000)	(0.000)	(0.003)				
(6) gdppc	-0.701*	0.578*	0.417*	0.524*	0.207*	1.000		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)			
(7) urban	-0.526*	0.502*	0.189*	0.539*	0.242*	0.877*	1.000	
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)		
(8) labor_force	0.449*	0.063	-0.047	-0.214*	-0.371*	0.023	0.203*	1.000
	(0.000)	(0.280)	(0.422)	(0.000)	(0.000)	(0.692)	(0.000)	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The pairwise correlation results reveal several important relationships among the study variables. Self-employment is negatively correlated with digitalization (-0.500), domestic credit (-0.525), unemployment (-0.493), GDP per capita (-0.701), and urbanization (-0.526), while it is positively associated with labor force participation (0.449). These findings suggest that higher-income and more urbanized economies tend to exhibit lower levels of self-employment, possibly due to the expansion of formal wage employment opportunities. Digitalization is positively correlated with domestic credit (0.517), GDP per capita (0.578), and urbanization (0.502), indicating that more digitally advanced economies also tend to have stronger financial systems and higher levels of economic development. The strongest correlation appears between GDP per capita and urbanization (0.877), which is relatively high and may indicate potential multicollinearity concerns. However, since the correlation remains below the common threshold of 0.90, the variables can still be retained with additional multicollinearity diagnostics such as VIF testing. Overall, the correlation matrix provides preliminary evidence supporting the interconnected relationship between digitalization, financial development, labor market conditions, and self-employment in developing economies.



Table 5. Fixed Effects Baseline Regression Results

Self_emp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
digital_index	-.015	.16	-0.09	.925	-.33	.3	
domestic_cre	-.042	.011	-3.86	0	-.063	-.021	***
bank	-.477	.055	-8.74	0	-.585	-.37	***
unem	.174	.059	2.93	.004	.057	.292	***
gdppc	0	0	-1.39	.164	-.001	0	
urban	-.496	.051	-9.76	0	-.596	-.396	***
labor_force	.183	.048	3.84	0	.089	.277	***
Constant	72.317	3.797	19.05	0	64.843	79.792	***

Mean dependent var	50.014	SD dependent var	20.008
R-squared	0.718	Number of obs	300
F-test	100.911	Prob > F	0.000
Akaike crit. (AIC)	1042.445	Bayesian crit. (BIC)	1072.075

*** $p < .01$, ** $p < .05$, * $p < .1$

Table 5 represents the fixed-effects regression results indicate that digitalization does not exert a statistically significant direct effect on self-employment in developing economies, as the coefficient of the digitalization index is negative but insignificant ($\beta = -0.015$, $p = 0.925$). In contrast, domestic credit shows a significant negative relationship with self-employment ($\beta = -0.042$, $p < 0.01$), suggesting that greater credit expansion may be associated with a shift toward formal employment sectors rather than self-employment activities. Similarly, banking development has a strong negative effect ($\beta = -0.477$, $p < 0.01$), reinforcing the possibility that more developed financial systems encourage formal labor market participation. Unemployment, however, positively affects self-employment ($\beta = 0.174$, $p < 0.01$), implying that individuals may turn to self-employment as a necessity-driven response during



periods of limited wage employment opportunities. Urbanization also exhibits a significant negative association with self-employment ($\beta = -0.496$, $p < 0.01$), while labor force participation positively influences self-employment levels ($\beta = 0.183$, $p < 0.01$). GDP per capita does not show a statistically significant effect. Overall, the model demonstrates strong explanatory power, with an R^2 value of 0.718 and a highly significant F-statistic (0.001), indicating that the explanatory variables collectively account for a substantial proportion of the variation in self-employment across developing countries.

Table 6. Fixed Effects Regression with Driscoll–Kraay Standard Errors (Baseline Model)

Variables	Coefficient	Driscoll–Kraay Std. Error	t-value	p-value	Significance
digital_index	-0.015	0.134	-0.110	0.912	
domestic_cre	-0.042	0.009	-4.410	0.000	***
bank	-0.477	0.062	-7.690	0.000	***
unem	0.174	0.072	2.420	0.026	**
gdppc	-0.000	0.000	-0.800	0.432	
urban	-0.496	0.058	-8.610	0.000	***
labor_force	0.183	0.042	4.380	0.000	***
Constant	72.317	2.113	34.220	0.000	***
Model Statistics					



Statistic	Value
Number of Observations	300
Number of Countries	15
Within R-squared	0.718
F-statistic	911.10
Prob > F	0.000
Estimation Method	Fixed Effects with Driscoll–Kraay Standard Errors
Maximum Lag	2

Notes: Dependent variable: Self-employment.

Standard errors are corrected using Driscoll–Kraay estimators to account for heteroskedasticity, serial correlation, and cross-sectional dependence.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 6 represents the regression results using fixed effects with Driscoll–Kraay standard errors confirm that digitalization alone does not have a statistically significant direct effect on self-employment in developing economies ($\beta = -0.015$, $p = 0.912$). This finding suggests that improvements in digital infrastructure and connectivity may not automatically translate into higher self-employment opportunities without supportive economic conditions. In contrast, domestic credit exerts a significant negative effect on self-employment ($\beta = -0.042$, $p < 0.01$), while banking development also shows a strong negative relationship ($\beta = -0.477$, $p < 0.01$). These results may indicate that more developed financial systems tend to support formal-sector expansion rather than informal or self-employment activities. Unemployment has a positive and statistically significant impact on self-employment ($\beta = 0.174$, $p < 0.05$), implying that individuals may engage in self-employment as a survival or necessity-driven strategy during periods of weak labor market conditions. Urbanization negatively affects self-employment ($\beta = -0.496$, $p < 0.01$), whereas labor force participation positively contributes to it ($\beta = 0.183$, $p < 0.01$). GDP per capita remains statistically insignificant. Overall, the model demonstrates substantial explanatory power, with a within R^2 of 0.718 and a highly significant F-statistic. Moreover, the use of



Driscoll–Kraay standard errors enhances the robustness of the findings by correcting for heteroskedasticity, serial correlation, and cross-sectional dependence across countries.

Table 7. Moderating Fixed Effects Regression Results

Self_emp	Coef.	St.Err.	t-value	p-value	[95% Conf Interval]	Sig
digital_index	.23	.199	1.15	.249	-.162 .622	
domestic_cre	-.012	.011	-1.10	.273	-.034 .01	
unem	.216	.06	3.63	0	.099 .333	***
dig_unem	.072	.014	5.09	0	.044 .1	***
dig_credit	-.021	.003	-7.18	0	-.026 -.015	***
bank	-.513	.05	-10.16	0	-.612 -.413	***
gdppc	0	0	0.66	.511	0 .001	
urban	-.486	.049	-9.99	0	-.582 -.39	***
labor_force	.249	.045	5.56	0	.161 .337	***
Constant	64.366	3.713	17.34	0	57.057 71.675	***
Mean dependent var	50.014		SD dependent var	20.008		
R-squared	0.763		Number of obs	300		
F-test	98.804		Prob > F	0.000		
Akaike crit. (AIC)	993.680		Bayesian crit. (BIC)	1030.718		

*** $p < .01$, ** $p < .05$, * $p < .1$



Table 7 represents the interaction model and provides important evidence regarding the conditional effect of digitalization on self-employment in developing economies. Unlike the baseline model, the coefficient of digitalization becomes positive (0.230), although it remains statistically insignificant (0.249), indicating that digitalization alone is insufficient to directly stimulate self-employment. However, the interaction terms reveal significant moderating effects. The interaction between digitalization and unemployment is positive and highly significant ($\beta = 0.072$, $p < 0.01$), suggesting that higher unemployment strengthens the positive role of digitalization in promoting self-employment. This finding supports the idea of “push entrepreneurship,” where unemployed individuals increasingly rely on digital platforms and technologies to create self-employment opportunities when formal jobs are limited. In contrast, the interaction between digitalization and domestic credit is negative and statistically significant ($\beta = -0.021$, $p < 0.01$), implying that higher levels of financial development may weaken the contribution of digitalization to self-employment. One possible explanation is that advanced credit systems tend to favor formal businesses and wage employment rather than informal or individual entrepreneurial activities. Additionally, unemployment continues to exert a positive direct effect on self-employment, while banking development and urbanization maintain significant negative effects. Labor force participation remains positively associated with self-employment. The interaction model also improves the explanatory power of the analysis, as the R^2 increases from 0.718 in the baseline model to 0.763, indicating that the moderating variables substantially enhance the model’s ability to explain variations in self-employment across countries.

Table 8. Moderating Fixed Effects Regression with Driscoll–Kraay Standard Errors

Variables	Coefficient	Driscoll–Kraay Std. Error	t-value	p-value	Significance
digital_index	0.230	0.257	0.900	0.382	



Variables	Coefficient	Driscoll–Kraay Std. Error	t-value	p-value	Significance
domestic_cre	-0.012	0.013	-0.960	0.351	
unem	0.216	0.069	3.110	0.006	***
dig_unem	0.072	0.028	2.610	0.017	**
dig_credit	-0.021	0.003	-6.060	0.000	***
bank	-0.513	0.033	-15.640	0.000	***
gdppc	0.000	0.000	0.360	0.720	
urban	-0.486	0.043	-11.420	0.000	***
labor_force	0.249	0.049	5.080	0.000	***
Constant	64.366	4.029	15.980	0.000	***

Model Statistics

Statistic	Value
Number of Observations	300
Number of Countries	15
Within R-squared	0.763
F-statistic	773.32
Prob > F	0.000
Estimation Method	Fixed Effects with Driscoll–Kraay Standard Errors



Statistic	Value
Maximum Lag	2

Notes: Dependent variable: Self-employment.

The interaction terms capture the moderating roles of unemployment and financial development on the relationship between digitalization and self-employment.

Standard errors are corrected using Driscoll–Kraay estimators to address heteroskedasticity, serial correlation, and cross-sectional dependence.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Table 8 presents the moderating regression results using fixed effects with Driscoll–Kraay standard errors. The findings show that the direct effect of digitalization on self-employment becomes positive but statistically insignificant ($\beta = 0.230$, $p = 0.382$) suggesting that digitalization alone may not be sufficient to stimulate self-employment across developing economies. However, the interaction between digitalization and unemployment (dig_unem) is positive and statistically significant at the 5% level ($\beta = 0.072$, $p = 0.017$). This result indicates that unemployment strengthens the positive impact of digitalization on self-employment. In other words, higher unemployment may push individuals to utilize digital technologies and online platforms as alternative income-generating opportunities, supporting the “push factor” argument in entrepreneurship theory.

In contrast, the interaction between digitalization and financial development (dig_credit) is negative and highly significant ($\beta = -0.021$, $p = 0.000$). This finding implies that financial development weakens the relationship between digitalization and self-employment. One possible explanation is that in financially developed environments, individuals may prefer formal wage employment or established business sectors rather than small-scale self-employment activities. The results also show that unemployment has a positive direct effect on self-employment ($\beta =$



0.216, $p = 0.006$), while banking development ($\beta = -0.513$, $p = 0.000$) and urbanization ($\beta = -0.486$, $p = 0.000$) negatively affect self-employment. Labor force participation remains positively associated with self-employment ($\beta = 0.249$, $p = 0.000$). Overall, the model demonstrates strong explanatory power with a within R-squared of 0.763, indicating that the moderating variables substantially improve the model compared to the baseline specification.

POLICY RECOMMENDATIONS

1. Improving Digital Infrastructure and Internet Access:

Governments should expand internet access and strengthen digital infrastructure, particularly in rural and underserved areas. Affordable and reliable connectivity can increase participation in digital employment, online businesses, and financial services, promoting inclusive economic growth.

2. Expanding Digital Financial Inclusion

Digital banking, online payments, and lending services should be made more accessible, especially for small businesses and self-employed individuals. Improved access to digital finance can reduce barriers to credit, support entrepreneurship, and encourage business expansion.

3. Supporting Startups and Small Businesses

Governments should provide financial support, simplify business registration, and encourage digital adoption among startups and MSMEs. Greater participation in e-commerce can help small enterprises reach wider markets, improve sustainability, and create employment opportunities.



4. Promoting Digital Skills and Education

Investment in digital literacy and technical training is essential for adapting to a technology-driven economy. Training programs should focus on youth, women, and unemployed individuals to improve employability and encourage entrepreneurial activities.

5. Strengthening Regulatory and Security Frameworks

Strong cybersecurity, consumer protection, and data privacy regulations are necessary to build trust in digital platforms. Effective regulatory frameworks can reduce fraud, protect users, and ensure the safe and fair use of digital technologies.

6. Region-Specific Strategic Interventions

Region	Contextual Finding from Literature	Specific Policy Recommendation
Asia (e.g., Vietnam, India, Indonesia)	Internet usage significantly boosts non-farm self-employment; fintech adoption increases velocity and transmission efficiency.	Aggressive Tech Adoption: Scale up existing mobile banking frameworks and incentivise rural internet penetration to move labor away from low-productivity agriculture into digital service sectors.



Africa (e.g., <i>Nigeria, Kenya, South Africa</i>)	Acute youth unemployment ; dominant informal employment sectors.	Formalization through Digitalization: Use low-barrier digital marketplaces and mobile money ecosystems to formalize informal MSMEs, providing youth entrepreneurs with lower market entry barriers and basic social protection.
Latin America (e.g., <i>Brazil, Mexico, Colombia</i>)	Post-pandemic digital self-employment expanded rapidly, showing distinct gender-differentiated resilience.	Gender-Targeted Digital Inclusion: Formulate national digitalization strategies tailored directly to female-led micro-enterprises. Provide targeted financial literacy and digital grants to sustain the economic shock absorption capacity of female self-employment.

CONCLUSION

Self-Employment is considered as the backbone of the job market. This study highlights that digitalisation alone does not drive self-employment. It suggests that stronger credit markets naturally create a way for formal wage sector expansion attracting people from informal entrepreneurship to structured jobs. As self-employment is negatively correlated with digitalization, domestic credit, unemployment, GDP, per capita, and urbanization, while it is



positively associated with labour force participation . These findings show that higher-income and more urbanized economies tend to exhibit lower levels of self-employment, possibly due to the expansion of formal wage employment opportunities. Digitalization is positively correlated with domestic credit. However the findings rely on macro level observational panel data, we must emphasize that the relationships represent empirical associations rather than casual pathways. But, we cannot rule out the possibility that missing variables are skewing our findings.

Therefore, the government must move from generic technology and should focus more on targeted digital literacy programs. By doing so, developing nations can effectively optimize digital technology to stabilize employment.

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