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Digital Connectivity, Economic Performance, and Entrepreneurial Activity in Zambia: A Multidimensional Analysis

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ABSTRACT - SOMMARIO

This study examines the dynamic relationship between digital connectivity, entrepreneurial activity, and economic performance in Zambia using World Bank time-series data covering 2006–2022. The analysis focuses on GDP per capita, new firm density, mobile and broadband penetration, Internet adoption, and labour market dynamics. An integrated methodological approach was employed using RStudio and Jamovi, incorporating descriptive statistics, correlation analysis, moderation testing, and autoregressive distributed lag (ADL) modelling to assess both direct and conditional relationships among digital connectivity, entrepreneurship, and economic performance. The findings reveal three key patterns. First, mobile adoption is strongly and positively associated with entrepreneurial activity ($r = 0.794$, $p < 0.001$), demonstrating the catalytic role of mobile technologies in supporting entrepreneurship, particularly in contexts characterised by infrastructure constraints. Second, Internet penetration alone does not produce a statistically significant short-term effect on GDP, suggesting that connectivity does not automatically translate into immediate economic gains without complementary institutional frameworks, digital skills, and productive capabilities. Third, the findings indicate diminishing marginal returns to mobile adoption in high-Internet environments, highlighting the conditional nature of technology-driven development. The study makes a dual contribution to digital development theory and policy. Theoretically, it advances understanding of digital development by demonstrating that the relationship between connectivity, entrepreneurship, and economic performance is moderated by the broader technological and institutional environment. Empirically, it challenges linear assumptions that increased digital connectivity necessarily generates proportional economic benefits. From a policy perspective, the findings emphasise the need for balanced investments in mobile infrastructure, broadband expansion, digital literacy, skills development, supportive institutions, and entrepreneurial ecosystems. Overall, the study demonstrates that the economic benefits of digital transformation depend not only on technological access but also on the institutional, human-capital, and entrepreneurial conditions shaping its effective utilisation.

Questo studio esamina la relazione dinamica tra connettività digitale, attività imprenditoriale e performance economica in Zambia utilizzando i dati delle serie temporali della Banca Mondiale che coprono il periodo 2006–2022. L'analisi si concentra sul PIL pro capite, sulla densità di nuove imprese, sulla penetrazione di dispositivi mobili e a banda larga, sull'adozione di Internet e sulle dinamiche del mercato del lavoro. È stato adottato un approccio metodologico

integrato utilizzando RStudio e Jamovi, incorporando statistiche descrittive, analisi di correlazione, test di moderazione e modellazione autoregressiva del lag distribuito (ADL) per valutare sia le relazioni dirette che condizionali tra connettività digitale, imprenditorialità e performance economica. I risultati rivelano tre schemi chiave. Innanzitutto, l'adozione di tecnologie mobili è fortemente e positivamente associata all'attività imprenditoriale ($r = 0,794$, $p < 0,001$), dimostrando il ruolo catalizzatore delle tecnologie mobili nel supportare l'imprenditorialità, in particolare in contesti caratterizzati da vincoli infrastrutturali. In secondo luogo, la sola penetrazione di Internet non produce un effetto statisticamente significativo a breve termine sul PIL, suggerendo che la connettività non si traduca automaticamente in guadagni economici immediati senza quadri istituzionali complementari, competenze digitali e capacità produttive. In terzo luogo, i risultati indicano rendimenti marginali decrescenti dell'adozione mobile in ambienti ad alta connessione Internet, evidenziando la natura condizionata dello sviluppo guidato dalla tecnologia. Lo studio dà un doppio contributo alla teoria e alla politica dello sviluppo digitale. Teoricamente, promuove la comprensione dello sviluppo digitale dimostrando che la relazione tra connettività, imprenditorialità e performance economica è moderata dal più ampio ambiente tecnologico e istituzionale. Empiricamente, mette in discussione le assunzioni lineari secondo cui un aumento della connettività digitale generi necessariamente benefici economici proporzionali. Da un punto di vista politico, i risultati sottolineano la necessità di investimenti equilibrati nelle infrastrutture mobili, nell'espansione della banda larga, nell'alfabetizzazione digitale, nello sviluppo delle competenze, nelle istituzioni di supporto e negli ecosistemi imprenditoriali. Nel complesso, lo studio dimostra che i benefici economici della trasformazione digitale dipendono non solo dall'accesso tecnologico, ma anche dalle condizioni istituzionali, di capitale umano e imprenditoriali che ne influenzano l'utilizzo efficace.

Keywords: Digital Connectivity, New Business Density, Economic Development, Mobile Technology

1 – Introduction

The expansion of digital financial services (DFS) has emerged as a transformative force in developing countries, offering unprecedented opportunities to increase financial inclusion and promote inclusive economic growth. Digital finance-including mobile money, online banking, and fintech innovations-offers a significant opportunity to expand access to financial services, particularly for informal entrepreneurs. In Zambia, where an estimated 85% of the workforce is in the informal sector (Chibesa & Mwange, 2025), DFSs play a critical role in narrowing the financial inclusion gap. Enabled by technological innovation, DFS has become a key enabler of financial access in emerging and developing economies (Khera *et al.*, 2021), and Zambia is no exception.

Across sub-Saharan Africa, DFS regulations-including those governing mobile money-have been central to financial inclusion strategies (Kaponda & Tembo, 2018). Zambia's experience reflects this trend, with mobile money transactions increasing by 84.03 percent between 2012 and 2017 (Kaponda & Tembo, 2018). Despite these gains, however, significant gaps remain. Kaponda and Tembo (2018) note that despite the improved use of DFS, significant barriers still limit its ability to uplift the poor. This underscores the need to critically assess the factors that limit the broader economic impact of DFS.

A key structural barrier is digital financial literacy, which is widely recognized as critical to deepening financial inclusion, especially among informal entrepreneurs. Despite the growing availability of mobile and digital platforms, many informal entrepreneurs struggle to effectively use digital financial tools. This challenge is exacerbated by digital infrastructure deficits: as of 2021, only 31% of Zambians had reliable access to electricity and 37% had access to the internet (Kala, 2023). Meanwhile, mobile money penetration among informal traders has reached 76%,

but only 32% demonstrate proficiency in using advanced DFS tools (Chibesa & Mwange, 2025), highlighting a disconnect between access and effective use.

The regulatory environment is also a challenge. A comparative study of 12 developing countries by Kaponda and Tembo (2018) highlights how fragmented regulation between financial and telecommunications authorities increases operational compliance costs by 15-20%. This may explain why DFS usage in Zambia remains largely transactional (78%), with limited uptake of more advanced services such as savings or credit (Kawimbe, 2020). Zambia's adoption of risk-based, tiered regulation, which allows lower value transactions (below ZMW 10,000) to dominate (68% of DFS volume), illustrates both the potential and limitations of the current regulatory model.

The primary objective of the study was to explore the interplay between digital connectivity, entrepreneurship, and economic performance in Zambia. Specifically, the study sought to determine how mobile phone and internet penetration affect new business creation, assess the impact of digital infrastructure on GDP per capita and labour market dynamics, and analyze the temporal effects of digital adoption using time series models. In doing so, the study provides a nuanced understanding of the conditions under which digital tools can promote inclusive growth in resource-constrained environments. Ultimately, this research provides a foundation for evidence-based strategies to harness digital transformation for sustainable development in Zambia and other similar economies.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on digital connectivity, entrepreneurship, and Zambia-specific studies, identifying the research gaps that this study addresses. Section 3 describes the quantitative methodology, including data sources, variable selection, and the analytical techniques employed (descriptive statistics, correlation, moderation analysis, and autoregressive distributed lag modelling) using both Jamovi and RStudio. Section 4 presents the empirical results, organised into descriptive, correlational, moderation, and time-series findings. Section 5 discusses these results in light of existing theoretical and empirical work, highlighting key insights and paradoxes. Section 6 derives the theoretical and practical implications of the findings for policy and practice. Section 7 offers specific recommendations for policymakers, private sector actors, and development partners, followed by a concluding section that synthesises the main contributions and outlines directions for future research. References and appendices complete the paper.

2 – Literature Review

2.1 – Digital Connectivity and Economic Growth

The relationship between digital connectivity and economic growth has been widely examined across different national contexts, generating valuable insights into the role of digital technologies in economic development. Evidence from advanced economies consistently demonstrates that investments in digital infrastructure contribute to economic growth, employment creation, and improvements in consumer welfare. Telecommunications and broadband infrastructure have been identified as important drivers of productivity and long-term economic performance, reinforcing the strategic importance of digital transformation. However, evidence at the firm level is less conclusive, with some studies reporting limited productivity gains from basic broadband adoption, particularly among small and medium-sized enterprises.

The transformative potential of digital connectivity to drive economic growth has been extensively documented in the global development literature. Studies in sub-Saharan Africa show that investments in digital infrastructure yield significant growth dividends, with Nchake and Shuaibu (2022) finding that ICT investments generate 0.4 to 0.7 percent growth elasticity across African subregions. Van Zanden (2023) explores the potential prospects for using mobile technology to increase financial inclusion and improve quality of life, focusing on mobile penetration rates, rural coverage, and regulatory frameworks to assess the reach and effectiveness of mobile banking. The COVID-19 pandemic dramatically accelerated digital financial inclusion globally, with Mpofu (2023) documenting a 42% increase in digital payments during the 2020 lockdown, although Africa's progress has been hampered by persistent infrastructure gaps and financial exclusion rates of 57%.

Zambia's experience reflects broader regional trends, where mobile money platforms have emerged as critical tools for financial inclusion, with transaction volumes growing by 84.03% between 2012 and 2017 (Kaponda & Tembo, 2018). However, Kala (2023) identifies critical infrastructure constraints in Zambia, including unreliable electricity (reaching only 31% of the population) and limited internet penetration (37% as of 2021), which continue to hinder digital transformation. The concept of technological "leapfrogging" through mobile solutions has shown promise, with successful implementations such as mobile banking reaching 48% of Zambian adults (Kala, 2023). Van Zanden (2023) further highlights how different mobile banking models, such as SMS-based systems and app-based platforms, vary in accessibility and effectiveness, with implications for rural financial outreach and inclusion.

Adel (2024) highlights that while digital literacy drives financial inclusion in Africa, infrastructure gaps and regional disparities require tailored policy interventions. This is consistent with Kouladoum's (2023) comprehensive study of 44 sub-Saharan African countries, which confirms that digital infrastructure promotes inclusive growth across all income groups. Kala (2023) further suggests that Zambia could increase annual GDP growth by 2-3% through strategic digital inclusion policies. Similarly, Afolabi (2023) highlights the importance of digital infrastructure, human capital, and policy stability in enabling digital transformation in 37 African countries. Building on these findings, Yangailo (2025) warns that without complementary investments in human capital and regulatory frameworks, digital dividends may remain unevenly distributed.

In addition, Alhassan and Adam (2024) find that digital inclusion strongly mediates the impact of ICTs on SDG outcomes, especially in sustainable cities, reinforcing the role of ICT use (rather than access alone) in development-according to Adam and Alhassan's (2021) earlier conclusion that use drives digital inclusion more than access in Zambia. Dakwal *et al.* (2024) also highlight the significant positive impact of the digital economy on inclusive growth, particularly in low-income African countries. Taken together, these findings underscore that Zambia's progress in digital transformation depends not only on expanding infrastructure, but also on improving usage, governance, and institutional readiness.

2.2 – Entrepreneurship in Developing Economies

Entrepreneurial activity in developing countries faces multiple barriers that digital technologies can potentially mitigate. Paliwal's (2025) examination of Zambian SMEs reveals persistent challenges, including limited access to finance, inadequate financial literacy, and a fragmented regulatory environment. The informal sector, which accounts for 85% of Zambia's workforce, is

particularly constrained, with Chibesa and Mwange's (2025) study of 350 informal traders revealing that only 32% have access to advanced digital financial tools, despite 76% mobile money penetration.

Digital financial services have emerged as a critical enabler, with Khera *et al.* (2021) documenting how fintech innovations in emerging markets can reduce financial exclusion. However, operational challenges remain, including limited agent liquidity, which affects 42% of rural transactions, and gaps in platform interoperability (Kawimbe, 2020). Anakpo *et al.* (2023) highlight that despite fintech successes such as Kenya's M-Pesa, gender inequality and digital illiteracy remain major constraints, particularly for women and marginalized groups in Zambia and other developing countries.

Institutional factors play a critical role, as Kaponda and Tembo's (2018) comparative analysis of 12 developing countries shows how Zambia's fragmented regulatory environment between the financial and telecommunications sectors creates compliance burdens that increase operator costs by 15-20 percent. Van Zanden (2023) and Adel (2024) highlight how effective regulatory frameworks and collaboration among stakeholders - including mobile operators, fintech firms, and governments - can reduce barriers and increase mobile banking adoption. Nsangu and Haabazoka (2024) introduce an important dimension by examining how mobile money services could improve tax compliance through improved transaction traceability, particularly for Zambia's informal sector.

Successful models from other developing countries, such as Kenya's risk-based, tiered KYC requirements that increased rural participation by 28% (Kawimbe, 2020), offer valuable policy lessons for Zambia's entrepreneurial ecosystem. Afolabi (2023) adds that stable economic policies and targeted reforms are needed to build digital trust and institutional support for entrepreneurs. Naveenan *et al.* (2024) further demonstrate that digital financial inclusion can positively impact health outcomes, especially when integrated with traditional financial services-underscoring the broader socioeconomic benefits of fintech-driven entrepreneurship.

2.3 – Zambia-Specific Studies

Zambia's unique economic and digital landscape has been the focus of several important studies. Sichoongwe's (2025) longitudinal analysis (2000-2020) shows that electricity generation capacity has both short-run and long-run positive effects on GDP growth, while mobile phone subscriptions have a significant short-run growth elasticity. This is consistent with Tembo's (2024) mixed-methods research in six Zambian districts, which shows that infrastructure development is 88% effective in promoting community development. The financial inclusion landscape has evolved rapidly, with Kaponda and Tembo (2018) documenting how tiered KYC implementation has resulted in 68% of DFS activity occurring in low-value transactions, particularly benefiting low-income users.

However, significant disparities remain, as Chibesa and Mwange's (2025) study shows that urban traders are 40 percent more digitally literate than their peri-urban counterparts. The volatility of the copper-dependent economy poses additional challenges, with Nsangu and Haabazoka (2024) highlighting how this affects the incentives for informal firms to formalize. Mpofu's (2024) comprehensive review of Industry 4.0 technologies in developing countries identifies Zambia's particular opportunities and challenges in digital financial inclusion, highlighting how the country's 621 million mobile money accounts (as of 2021) represent significant untapped potential.

Adam and Alhassan's (2021) global study provides important context, showing that ICT use (rather than mere access) drives digital inclusion—a finding particularly relevant to Zambia, where mobile penetration (61.19 per 100 people) far exceeds fixed broadband access (0.214 per 100). Building on this, Alhassan and Adam (2024) show how increased digital inclusion drives SDG achievement, particularly in urban development and participatory governance—highlighting Zambia's opportunity to integrate ICTs into broader development goals. Collectively, this body of research identifies critical gaps in understanding the interaction effects between different digital adoption metrics and their economic impacts, which the current study seeks to address through advanced econometric analysis.

2.4 – *Synthesis and Research Gaps*

Despite the expanding body of research on digital connectivity and economic development, several important gaps remain, particularly in relation to low-income, resource-dependent economies such as Zambia.

First, much of the existing literature focuses on the direct effects of individual dimensions of digital connectivity, such as mobile penetration or Internet usage, on economic outcomes. This approach overlooks the possibility that different forms of digital connectivity may interact in shaping economic performance, with the effectiveness of one technology depending on the availability or maturity of another. Consequently, the interconnected nature of digital adoption and its implications for entrepreneurship and economic growth remain insufficiently understood.

Second, empirical research in sub-Saharan Africa has largely relied on cross-sectional or short-panel datasets, limiting the ability to capture the long-term dynamics of digital transformation. Such approaches provide only a partial understanding of how the effects of digital investments evolve over time and often fail to account for lagged relationships, adjustment processes, and structural changes that influence economic outcomes.

Third, although entrepreneurship is widely recognised as a key driver of innovation, employment creation, and economic growth, limited empirical evidence exists on the pathways through which digital connectivity stimulates new business formation in low-infrastructure environments. This gap is particularly evident in Zambia, where the relationship between digital technologies, entrepreneurial activity, and economic performance has received relatively little systematic investigation despite the country's rapid expansion of digital infrastructure.

Addressing these gaps is essential for developing a more comprehensive understanding of how digital connectivity contributes to sustainable economic development. It also provides a stronger empirical foundation for designing policies that integrate digital infrastructure, entrepreneurship, and institutional capacity to maximise the developmental benefits of digital transformation.

3 – Methodology

This study uses a quantitative research design to examine the dynamic relationship between economic performance and digital access indicators in Zambia. It uses secondary annual data from the World Bank's World Development Indicators (WDI) database. The full dataset covers the period from 2006 to 2023 and includes key economic and technological variables such as GDP per capita (current US\$), new business density (new business registrations per 1,000 working-age people), mobile phone subscriptions (per 100 people), fixed broadband

subscriptions (per 100 people), individuals using the Internet (% of population), and labor force participation rate (% of population aged 15-64). These indicators were chosen to reflect key dimensions of economic activity, digital connectivity, and employment dynamics in a lower-middle-income sub-Saharan African context.

This study employs a dual-platform analytical strategy, leveraging the complementary strengths of Jamovi and RStudio to ensure both accessibility and methodological rigor. The choice of this integrated approach was motivated by the need to balance user-friendly data exploration with advanced econometric modelling capabilities.

Data preparation and preliminary analysis were performed using Jamovi version 2.6.44, an open-source statistical platform designed for ease of use. Descriptive statistics were generated to assess the central tendencies and variability of each variable, while Pearson correlation analysis examined the strength and direction of linear relationships between the selected indicators. Moderation analysis, conducted through the General Linear Model (GLM) module, tested whether Internet usage moderates the relationship between mobile subscriptions and GDP per capita providing insights into the interactive effects of digital infrastructure on economic outcomes.

To validate these findings and to assess dynamic relationships over time, the study employed Autoregressive Distributed Lag (ADL) modeling using RStudio, focusing specifically on the period 2006 to 2022 due to the availability of continuous and complete time series data. Two ADL(1,1) models were developed. The first model estimates new business density as a function of its own lag as well as current and lagged values of GDP per capita and Internet usage. The second model estimates GDP per capita as a function of its own lag, as well as current and lagged values of new business density, Internet usage, and mobile phone subscriptions. These regressions were implemented using R's `lm()` and interactions packages, which allow for advanced regression diagnostics and interaction visualizations.

Data were cleaned and temporally aligned for all variables. Missing values were handled using pairwise deletion in both correlation and regression analyses to maintain sample size while ensuring statistical power. Standard diagnostic procedures-such as the Augmented Dickey-Fuller (ADF) test for stationarity and checks for autocorrelation-were used to assess model validity and the appropriateness of the ADL framework. The use of lagged variables also helped to control for endogeneity and to estimate both short-run and long-run effects.

By combining descriptive, correlation, moderation, and ADL time series analyses, this methodological framework offers both analytical clarity and empirical rigor, effectively capturing Zambia's evolving digital economic dynamics and supporting robust hypothesis testing on the interplay between mobile and Internet connectivity and economic performance.

4 –Results

4.1 – *Descriptive Analysis*

Table 1 presents key descriptive statistics for several economic and technological indicators in Zambia that provide valuable insights into the country's business environment, labor market dynamics, economic performance, and digital connectivity.

Starting with new business density, Zambia records an average of 0.977 new business registrations per 1,000 working-age individuals (15-64), with a relatively low standard deviation of 0.319, indicating moderate variation over time. The median of 1.028 is close to the mean, suggesting a roughly symmetrical distribution. However, the minimum value of 0 indicates

periods of stagnation in entrepreneurial activity, while the maximum value of 1.560 reflects intermittent improvements. These fluctuations may reflect structural barriers to entrepreneurship, such as regulatory challenges or macroeconomic instability.

The labor force participation rate averages 59.47%, with minimal variability ($SD = 0.621$) and a narrow range between 58.65% and 61.18%. This suggests relative stability in labor market engagement, possibly underpinned by persistent informal employment as the formal sector remains underdeveloped.

GDP per capita averages \$1,366, with modest variability ($SD = 245$). The median of \$1,353 indicates a balanced distribution; however, the range-from \$951 to \$1,821-underscores significant volatility, likely due to fluctuations in commodity prices, particularly copper. Despite periods of growth, Zambia's economic performance remains vulnerable to external shocks.

Table 1 – Descriptive statistics for several economic and technological indicators in Zambia

	Mean	Median	SD	Minimum	Maximum
New business density (new registrations per 1,000 people ages 15-64)	0.977	1.028	0.319	0.0000	1.560
Labor force participation rate, total (% of total population ages 15-64) (modeled ILO estimate)	59.467	59.350	0.621	58.6540	61.184
GDP per capita (current US\$)	1366.355	1353.115	245.095	951.6443	1820.719
Fixed broadband subscriptions (per 100 people)	0.214	0.136	0.171	0.0193	0.480
Mobile cellular subscriptions (per 100 people)	61.185	69.684	31.792	0.0000	103.975
Individuals using the Internet (% of population)	12.022	7.650	11.311	1.6000	33.000

Indicators of digital access show marked disparities. Fixed broadband subscriptions are extremely limited, averaging just 0.214 per 100 people, with a minimum of 0.019, highlighting significant infrastructure and affordability constraints. In contrast, mobile subscriptions average 61.19 per 100 people, but show high variability ($SD = 31.792$), ranging from 0 to 104. This indicates uneven coverage and rapid, recent expansion in certain areas. Internet usage averages 12.02%, with a large standard deviation (11.311) and a range of 1.6% to 33%, indicating uneven access that is heavily skewed toward urban and higher-income populations.

In summary, Zambia faces notable challenges in promoting entrepreneurship, achieving stable economic growth, and expanding digital inclusion. While labor force participation appears stable, low business density and GDP volatility highlight structural constraints. The stark contrast between minimal broadband access and uneven mobile penetration underscores the need for strategic investments in digital infrastructure to support inclusive and sustainable development.

4.2 – Correlation Analysis

The correlation matrix in Table 2 examines the relationships between key economic and technological variables in Zambia, revealing both expected and surprising relationships.

New business density has a very strong positive correlation ($r = 0.794$, $p < 0.001$) with mobile phone subscriptions, suggesting that higher mobile phone penetration may facilitate entrepreneurship, possibly through digital financial services (e.g. mobile money) or improved communication. However, the density of new businesses is not significantly related to labor force participation ($r = 0.027$, $p = 0.916$), GDP per capita ($r = 0.296$, $p = 0.233$), or internet usage ($r = 0.039$, $p = 0.877$). This implies that while mobile access may support business creation, broader economic conditions and workforce engagement do not directly drive new registrations.

Labor force participation has a moderate positive correlation with Internet usage ($r = 0.593$, $p = 0.009$) and fixed broadband subscriptions ($r = 0.502$, $p = 0.034$), suggesting that digital connectivity may increase employment opportunities or that employed individuals are more likely to adopt technology. Surprisingly, it has a significant negative correlation with GDP per capita ($r = -0.553$, $p = 0.017$), suggesting that as Zambia's economy grows, labor participation declines slightly - possibly due to increased enrollment in education, early retirement, or shifts to the informal sector.

Table 2 – Correlation Matrix for several economic and technological indicators

		New business density (new registrations per 1,000 people ages 15-64)	Labor force participation rate, total (% of total population ages 15-64) (modeled ILO estimate)		GDP per capita (current US\$)	Fixed broadband subscriptions (per 100 people)		Mobile cellular subscriptions (per 100 people)	Individuals using the Internet (% of population)
New business density (new registrations per 1,000 people ages 15-64)	Pearson's r	—							
	df	—							
	p-value	—							
Labor force participation rate, total (% of total population ages 15-64) (modeled ILO estimate)	Pearson's r	0.027	—						
	df	16	—						
	p-value	0.916	—						
GDP per capita (current US\$)	Pearson's r	0.296	-0.553	*	—				
	df	16	16		—				
	p-value	0.233	0.017		—				

		New business density (new registrations per 1,000 people ages 15-64)	Labor force participation rate, total (% of total population ages 15-64) (modeled ILO estimate)		GDP per capita (current US\$)	Fixed broadband subscriptions (per 100 people)		Mobile cellular subscriptions (per 100 people)	Individuals using the Internet (% of population)
Fixed broadband subscriptions (per 100 people)	Pearson's r	0.030	0.502	*	-0.224	—			
	df	16	16		16	—			
	p-value	0.906	0.034		0.371	—			
Mobile cellular subscriptions (per 100 people)	Pearson's r	0.794 ***	0.244		0.100	0.525 *	—		
	df	16	16		16	16	—		
	p-value	< .001	0.329		0.693	0.025	—		
Individuals using the Internet (% of population)	Pearson's r	0.039	0.593 **		-0.259	0.920 ***	0.433	—	
	df	16	16		16	16	16	—	
	p-value	0.877	0.009		0.300	< .001	0.072	—	
Note. * $p < .05$, ** $p < .01$, *** $p < .001$									

GDP per capita shows no strong correlations with technological indicators, except for a negative (but weak) relationship with labor force participation ($r = -0.553$). The lack of significant relationships with internet usage ($r = -0.259$, $p = 0.300$) or mobile phone subscriptions ($r = 0.100$, $p = 0.693$) suggests that Zambia's economic growth is not yet strongly driven by digital expansion and may be more dependent on traditional sectors such as mining.

Fixed broadband subscriptions are strongly correlated with Internet usage ($r = 0.920$, $p < 0.001$), confirming that broadband access is a key enabler of Internet adoption. They are also positively correlated with mobile subscriptions ($r = 0.525$, $p = 0.025$), suggesting that mobile and fixed Internet services may grow in tandem. However, broadband shows no significant relationship with GDP ($r = -0.224$, $p = 0.371$), confirming that Zambia's digital infrastructure is not yet a major driver of economic growth. Mobile subscriptions have a moderate positive relationship with internet usage ($r = 0.433$, $p = 0.072$), although this is only marginally significant. Given that mobile penetration is much higher than fixed broadband, this suggests that mobile networks are a primary, but not yet fully optimized, gateway to Internet access.

Mobile connectivity appears to be playing a significant role in fostering new business creation in Zambia, likely through the proliferation of mobile money platforms and digital service delivery. The accessibility and affordability of mobile technologies have enabled entrepreneurs to overcome traditional barriers, facilitating business operations even in underserved areas.

Internet use in Zambia is closely linked to broadband access, but mobile networks continue to serve as a critical, albeit secondary, channel for digital connectivity. While broadband

infrastructure remains limited, the widespread adoption of mobile technology suggests that mobile networks can be further leveraged to expand Internet access.

Interestingly, higher GDP per capita does not yet appear to be strongly associated with digital expansion. This suggests that Zambia's economic growth is still largely driven by traditional, non-digital sectors, such as mining and agriculture, rather than innovation-driven or knowledge-based industries.

Labour market dynamics present a more complex picture. Increased Internet use is associated with higher labour force participation, possibly reflecting improved access to job information and digital work opportunities. However, GDP growth is correlated with slightly lower participation, a paradox that warrants further investigation to understand the underlying drivers, such as jobless growth or structural shifts in employment patterns.

Overall, Zambia's digital economy shows considerable promise, particularly in the area of mobile-enabled entrepreneurship. However, the broader integration between digital development and economic growth remains limited. To unlock inclusive and sustainable growth, policymakers should prioritize investment in broadband infrastructure and continue to leverage mobile networks as catalysts for economic participation and innovation.

4.3 – Moderation Analysis of Digital Indicators on GDP per Capita in Zambia

The moderation analysis presented in Tables 3 and 4 provides important insights into how mobile subscriptions and Internet usage interact to influence GDP per capita in Zambia. Table 3 shows that mobile subscriptions have a significant positive main effect on GDP per capita (Estimate = 4.729, $p = 0.002$), indicating that higher mobile penetration is generally associated with higher economic output. However, the negative coefficient on Internet use (Estimate = -11.671, $p = 0.003$) suggests that higher Internet use alone is correlated with lower GDP per capita, a counterintuitive finding that warrants closer examination.

Table 3 – Moderation Estimates

	Estimate	SE	Z	p
Mobile cellular subscriptions (per 100 people)	4.729	1.539	3.07	0.002
Individuals using the Internet (% of population)	11.671	3.880	-3.01	0.003
Mobile cellular subscriptions (per 100 people) * Individuals using the Internet (% of population)	0.341	0.107	-3.17	0.002

The interaction term between mobile subscriptions and Internet use (estimate = -0.341, $p = 0.002$) is statistically significant and negative, indicating that the relationship between mobile penetration and GDP per capita changes depending on the level of Internet use. This moderating effect is further clarified by a simple slope analysis in Table 4. At average levels of Internet penetration, mobile subscriptions retain a positive and significant relationship with GDP per capita (estimate = 4.729, $p = 0.008$). However, this relationship strengthens significantly when Internet usage is low (Estimate = 8.473, $p < 0.001$), while becoming statistically insignificant when Internet usage is high (Estimate = 0.984, $p = 0.589$).

Table 4 – Simple Slope Estimates

	Estimate	SE	Z	p
Average	4.729	1.77	2.666	0.008
Low (-1SD)	8.473	2.56	3.315	< .001
High (+1SD)	0.984	1.82	0.540	0.589
Note. shows the effect of the predictor (Mobile cellular subscriptions (per 100 people)) on the dependent variable (GDP per capita (current US\$)) at different levels of the moderator (Individuals using the Internet (% of population))				

4.4 – Simple Slope Analysis

These results suggest a complex dynamic between digital access and economic performance in Zambia. The strong positive effect of mobile subscriptions in contexts of low internet penetration may reflect how basic mobile services (such as mobile money and communication) can provide substantial economic benefits in under-connected environments. The diminishing returns at higher levels of internet penetration could indicate either saturation effects or potential mismatches between digital access and productive use - where increased internet penetration without complementary investment in digital skills or relevant content does not translate into economic benefits. The negative main effect of internet use could be due to the timing of the measurement (if internet expansion is initially concentrated among unproductive users), or it could signal that Zambia's current internet ecosystem is not yet optimized for economic productivity.

From a policy perspective, these results highlight that Zambia's mobile revolution has likely contributed more to recent economic growth than Internet expansion alone. The findings suggest that policymakers should consider:

- 1) ensuring that mobile-based services continue to reach underserved populations where they have the greatest marginal impact, while
- 2) addressing potential barriers that prevent higher Internet usage from yielding proportional economic benefits, possibly through targeted digital literacy programs or local content development.

The non-linear relationships revealed in this analysis caution against assuming uniform benefits from digital expansion and underscore the need for nuanced, context-specific digital development strategies in Zambia's evolving economic landscape.

4.5 – Econometric Time-Series Analysis

The analysis presented in the following tables is based on annual time series data from 2006 to 2022.

Table 5 provides a summary of the descriptive statistics and trend patterns over the study period. New business density ranged from a minimum of 0.61 to a maximum of 1.56, with a median of 1.05, and showed a generally increasing trend from 2006 to 2022. Labor force participation showed a relatively stable but slightly declining trend, fluctuating between 58.65% and 61.18%, with a median of 59.33%. GDP per capita was more volatile over the period, ranging

from \$951.64 to \$1,820.72, with a median of \$1,375.50. In contrast, growth in digital infrastructure was characterized by rapid expansion. Fixed broadband subscriptions grew significantly, ranging from a low of 0.019 to a high of 0.480 per 100 people. Similarly, mobile subscriptions increased from 13.89 to 103.97 per 100 people. Internet usage also increased dramatically, from 1.6% to 33% of the population.

Table 5 – Summary Statistics (2006–2022)

Variable	Min	Median	Max	Trend (2006–2022)
New business density	0.61	1.05	1.56	Increasing
Labor force participation	58.65%	59.33%	61.18%	Slight decline
GDP per capita (USD)	951.64	1375.50	1820.72	Volatile
Fixed broadband	0.019	0.113	0.480	Rapid growth
Mobile subscriptions	13.89	64.27	103.97	Rapid growth
Internet users (%)	1.6%	8.8%	33%	Rapid growth

4.6 – Autoregressive Distributed Lag (ADL) Model Analysis

To explore the determinants and dynamics among these variables, two autoregressive distributed lag (ADL) models were estimated. Model 1 used new business density as the dependent variable. The ADL specification included lagged new business density, current and lagged GDP per capita, and current and lagged Internet usage as explanatory variables. As shown in Table 6, only current GDP per capita had a statistically significant effect on new business density, with a coefficient of 0.000417 ($p = 0.010$).

Table 6 – ADL Model Results (New Business Density)

Variable	Coefficient	Std. Error	t-value	p-value	Significance
(Intercept)	0.239	0.166	1.441	0.180	Not significant
Lagged New Business Density	0.156	0.329	0.474	0.645	Not significant
Current GDP per capita	0.000417	0.000131	3.176	0.010	Significant
Lagged GDP per capita	-0.0000529	0.000186	-0.284	0.782	Not significant
Current Internet Users	-0.000240	0.0127	-0.019	0.985	Not significant
Lagged Internet Users	0.0170	0.0162	1.051	0.318	Not significant

This suggests that a \$1 increase in GDP per capita is associated with a 0.0004 increase in new business density. Other variables, including both current and lagged Internet usage, as well as lagged values of business density and GDP, were not statistically significant. Diagnostic tests indicated the presence of serial correlation (Durbin-Watson test $p = 0.0056$), suggesting a violation of the OLS assumption of uncorrelated errors. However, the Breusch-Pagan test for heteroskedasticity ($p = 0.757$) showed no evidence of non-constant variance in the residuals.

Model 2 examined GDP per capita as the dependent variable, including lagged GDP per capita, current and lagged new business density, Internet usage, and mobile phone subscriptions. Table 7 shows that the most significant predictor was current new business density, with a coefficient of 1155.10 ($p = 0.012$), meaning that a one-unit increase in business density leads to a \$1,155 increase in GDP per capita. Although current Internet usage had a negative effect (coefficient = -52.63), it was only marginally significant ($p = 0.086$), possibly due to multicollinearity with mobile phone subscriptions. Lagged values and mobile subscriptions did not show statistically significant effects, suggesting that digital connectivity and its relationship with economic output may be more complex and possibly mediated by other variables.

Table 7 – GDP per Capita Model Results

Variable	Coefficient	Std. Error	t-value	p-value	Significance
(Intercept)	328.13	389.98	0.841	0.425	Not significant
Lagged GDP per capita	-0.163	0.354	-0.461	0.657	Not significant
Current New Business Density	1155.10	359.84	3.210	0.012	Significant
Lagged New Business Density	-7.67	642.48	-0.012	0.991	Not significant
Current Internet Users	-52.63	26.91	-1.956	0.086	Not significant
Lagged Internet Users	9.60	28.57	0.336	0.745	Not significant
Current Mobile Subscriptions	4.57	7.54	0.606	0.561	Not significant
Lagged Mobile Subscriptions	4.18	8.73	0.478	0.645	Not significant

Taken together, these findings point to a strengthening relationship between economic growth and business creation. Rising GDP per capita appears to support new business creation, and higher business density, in turn, contributes significantly to higher GDP per capita. Internet and mobile technologies, despite their explosive growth during the period, did not directly influence these variables in a statistically significant way in the estimated models, possibly due to overlapping effects or lag structures not captured in the current specifications.

4.7 – ICT Index (PCA) and Extended Models

Principal component analysis (PCA) was used to construct an information and communication technology (ICT) index that aggregates three core indicators of digital infrastructure: fixed broadband subscriptions, mobile subscriptions, and Internet users. This composite index was then incorporated into extended ADL models to examine its relationship with GDP per capita and new business density.

In the first extended model (Model 1) as presented in Table 8, GDP per capita was regressed on the ICT index, lagged GDP per capita and labor force participation. The regression results are presented in Table 4. The coefficient on lagged GDP per capita was positive (0.511) and not statistically significant with a p-value of 0.061, and both the current and lagged ICT index values were not statistically significant with p-values of 0.428 and 0.435, respectively. This suggests that, in the short run, aggregate ICT development as measured by the index does not

significantly explain GDP fluctuations. Labor force participation also had a statistically insignificant negative coefficient (-234.43, $p = 0.065$).

Table 8 – ICT Index on GDP per capita

Variable	Coefficient	Std. Error	t-value	p-value	Significance
(Intercept)	7364.89	8284.12	0.889	0.395	Not significant
Lagged GDP per capita	0.511	0.243	2.106	0.061	Not significant
Current ICT Index	-180.17	217.85	-0.827	0.428	Not significant
Lagged ICT Index	192.17	236.20	0.814	0.435	Not significant
Current Labor Force	-234.43	112.89	-2.077	0.065	Not significant

The second model (Model 2) as presented in Table 9 used new business density as the dependent variable, with current GDP per capita and the lagged ICT index as predictors. In this model, GDP per capita remained a statistically significant and positive determinant of business density, with a coefficient of 0.000392 and a p-value of 0.017. This confirms the findings from previous models that economic prosperity facilitates the creation of new businesses. However, the ICT index again did not show a statistically significant effect on business density ($p = 0.201$), although the positive direction of the coefficient (0.178).

Table 9 – ICT Index and GDP on New Business Density

Variable	Coefficient	Std. Error	t-value	p-value	Significance
(Intercept)	0.519	0.212	2.452	0.034	Significant
Current GDP per capita	0.000392	0.000138	2.853	0.017	Significant
Lagged ICT Index	0.178	0.130	1.371	0.201	Not significant

The results underscore that while the ICT index itself does not show direct or statistically significant effects on either GDP or new business creation, its constituent variables-especially Internet users and mobile phone subscriptions-have shown explosive growth over the study period. This rapid digital expansion points to the long-term strategic value of investing in digital infrastructure, even if the short-term statistical effects are not yet visible in the models.

From a policy perspective, the evidence supports the conclusion that economic growth remains a key driver of entrepreneurship.

Thus, macroeconomic policies that increase GDP-such as investment in infrastructure, education, and market liberalization-can indirectly stimulate new business creation. Moreover, despite their current statistical insignificance, ICT developments can have transformative effects over time.

Therefore, policies aimed at improving digital access, affordability and use should be maintained, recognizing their latent potential to support economic dynamism and innovation in the medium to long term.

5 – Discussion

This study provides critical insights into the relationship between digital connectivity, economic performance, and entrepreneurial activity in Zambia. The findings underscore a dual reality: while digital infrastructure, particularly mobile technology, has demonstrated its potential to stimulate entrepreneurship and economic dynamism, structural and institutional barriers persist, limiting broad-based benefits. This contrasts with previous studies, such as Kaponda and Tembo (2018), which highlight the rapid growth of mobile money transactions in Zambia, suggesting significant potential for economic transformation. However, our study reveals that despite these gains, the enabling environment remains insufficient to fully capitalize on these opportunities.

Descriptive statistics reveal persistent challenges identified in previous research. For example, the density of new businesses remains low (an average of 0.977 per 1,000 working-age individuals), consistent with Paliwal's (2025) findings on Zambia's limited entrepreneurial activity. This points to systemic constraints such as regulatory hurdles and macroeconomic volatility, echoing the findings of Chibesa and Mwange (2025), who argue that informal sector entrepreneurs face numerous barriers, particularly in financial literacy and access to digital tools. Similarly, labor force participation has remained stable at 59.47 percent, indicating a predominantly informal employment base amid weak formal sector absorption, consistent with Kaponda and Tembo's (2018) observation of the dominance of the informal sector in Zambia.

GDP per capita, as in previous studies by Khera *et al.* (2021) and Kaponda and Tembo (2018), shows considerable volatility (ranging from USD 951 to USD 1,821), largely due to Zambia's reliance on commodity exports, particularly copper. This economic dependence makes the country vulnerable to global price shocks, reinforcing earlier warnings by Kouladoun (2023) and Afolabi (2023) about the volatility inherent in resource-dependent economies.

Digital inclusion remains uneven, a key finding consistent with earlier research by Kaponda and Tembo (2018) and Kala (2023), which highlights the gap between mobile subscriptions (61.19 per 100 people) and fixed broadband access (0.214 per 100). This digital divide persists across socioeconomic lines, particularly between urban and rural areas, reinforcing the need for targeted digital inclusion policies, as highlighted by Adam and Alhassan (2021). Internet usage, at an average of 12.02%, remains highly variable, with skewed access favoring urban and higher income users, highlighting the need for policies aimed at broadening digital access.

The correlation analysis underscores the transformative potential of mobile connectivity. A strong positive relationship between mobile subscriptions and new business density ($r = 0.794$, $p < 0.001$) supports the argument that mobile technologies, especially mobile money, can facilitate entrepreneurial activity, as suggested by Khera *et al.* (2021). However, GDP per capita and labor force participation show no significant correlation with business density, suggesting that macroeconomic performance alone does not drive entrepreneurship. This finding contrasts with research by Paliwal (2025), which links improved access to finance to entrepreneurial success in Zambia. In this study, mobile technology appears as an independent enabler of economic agency, independent of macroeconomic performance.

Interestingly, labor force participation is positively correlated with Internet usage ($r = 0.593$, $p = 0.009$) and fixed broadband ($r = 0.502$, $p = 0.034$), suggesting that digital connectivity may expand access to labor markets or create new forms of digital employment. This is consistent with Adel's (2024) findings that digital literacy can improve labor market outcomes. However, the negative correlation between labor force participation and GDP per capita ($r = -0.553$, $p =$

0.017) suggests possible structural shifts, as noted by Yangailo (2025), in which informal work becomes more prevalent during periods of economic expansion.

The moderation analysis reveals a nuanced digital economic dynamic. Mobile penetration significantly increases GDP per capita (estimate = 4.729, $p = 0.002$), echoing the findings of Van Zanden (2023), but this effect diminishes as Internet usage increases, becoming statistically insignificant at higher levels (estimate = 0.984, $p = 0.589$). This interaction suggests that mobile technologies yield the highest economic returns in low connectivity environments, similar to the findings of Naveenan *et al.* (2024). However, as internet penetration increases, the marginal returns to mobile access decrease, highlighting the need for complementary investments in digital infrastructure.

Time series analysis using ADL models further validates these relationships. GDP per capita has a statistically significant short-term effect on business density (coefficient = 0.000417, $p = 0.010$), and new business creation significantly boosts GDP (coefficient = 1,155.10, $p = 0.012$), consistent with Yangailo's (2025) argument that entrepreneurial activity can be a catalyst for economic growth.

However, digital indicators, including internet and mobile phone subscriptions, do not show direct short-term effects, reinforcing the time lag observed in previous studies by Mpofu (2023), suggesting that the impact of digital infrastructure on economic outcomes is often long-term.

In conclusion, this study has explored the interdependencies between digital connectivity, entrepreneurial activity, and economic performance in Zambia, providing important insights into the mechanisms and limits of digital transformation. While mobile technology has emerged as a critical enabler of entrepreneurship, as evidenced by its strong positive correlation with new business density, it has not yet translated into broad-based economic gains in the short term.

Moderation and time-series analyses also suggest that mobile connectivity has its greatest economic impact in low-connectivity environments, helping to overcome infrastructure gaps. However, as internet penetration increases, the marginal returns to mobile access decline, suggesting that complementary investments in digital infrastructure, skills and content are needed to sustain the impact.

The relationship between entrepreneurship and GDP per capita is bidirectional and significant, highlighting the potential for a virtuous cycle of business creation and economic growth, as suggested by Sichoongwe (2025). However, broader digital indicators - such as internet usage and fixed broadband - do not show direct short-term effects on either entrepreneurship or GDP, highlighting a time lag between digital infrastructure development and economic outcomes. Moreover, while labor force participation is positively related to digital access, it has a paradoxical negative association with GDP per capita, raising questions about the inclusiveness of economic growth and the structure of job creation.

These findings suggest that Zambia's digital transformation is at a formative stage, characterized by uneven access and limited immediate macroeconomic returns. To fully realize the development potential of ICTs, digital policy must go beyond access and affordability to encompass ecosystem-wide reforms, including regulatory frameworks, human capital development, innovation capacity, and institutional coordination. A sequenced and inclusive digital development strategy, anchored in both mobile and broadband technologies, is essential to support sustainable entrepreneurial growth, economic diversification and structural transformation.

6 – Theoretical and Practical Implications

6.1 – *Theoretical Implications*

This study makes a significant contribution to the growing literature on digital transformation, economic development, and entrepreneurship, particularly in the context of low-income, resource-dependent economies such as Zambia. Using panel and time series data between 2006 and 2023 (with time series analysis from 2006 to 2022), the study provides robust empirical evidence that the relationship between digital access and economic performance is both context dependent and non-linear.

The strong correlation between mobile penetration and new business density supports theories that highlight mobile technologies as critical enablers of entrepreneurship - especially in regions lacking formal financial and infrastructure systems. However, the lack of a consistent short-term relationship between Internet usage and GDP growth challenges the assumption that digital connectivity alone guarantees economic progress. Instead, it confirms that digital dividends require complementary investments in institutional capacity, human capital, and relevant digital content.

Importantly, the moderation effects observed - in particular, the diminishing impact of mobile connectivity on GDP as internet penetration increases - extend moderation theory and suggest diminishing marginal returns to digital infrastructure in the absence of systemic digital ecosystem development. These findings are consistent with endogenous growth theory, highlighting the mutually reinforcing relationship between entrepreneurship and economic growth, while also echoing institutional economics perspectives on the enabling role of policy and governance.

6.2 – *Practical Implications*

The findings of this study have several important practical implications for policymakers, development practitioners, entrepreneurs, and international partners working to advance Zambia's digital and economic development agenda. One of the clearest findings is that mobile connectivity serves as a powerful enabler of entrepreneurship, particularly in regions where traditional infrastructure is weak or absent. The strong correlation between mobile subscriptions and new business density suggests that mobile-first approaches-such as mobile money, SMS-based services, and mobile business platforms-are highly effective in stimulating economic activity in underserved areas. However, this impact is not automatic or uniformly transformative. While mobile access has improved, Internet use has not yet translated into significant GDP growth, suggesting that connectivity must be coupled with investments in digital literacy, relevant content creation, and institutional readiness to realize its full benefits.

The study also highlights the digital divide between urban and rural Zambia, where the lack of fixed broadband infrastructure continues to limit economic inclusion. This infrastructure gap hinders the growth of digital sectors that require stable and high-speed connectivity, such as e-commerce, fintech, telemedicine, and distance learning. Public-private partnerships are essential to overcome these barriers, with coordinated investments targeting last-mile connectivity and localized content development. Equally important is the promotion of digital literacy programs that equip citizens with the skills needed to navigate and benefit from the digital economy, especially among youth and women, who often face systemic exclusion.

The low density of new businesses, despite increasing mobile access, points to deeper regulatory and institutional challenges. Administrative inefficiencies, complex business registration processes, and limited support for formalization hinder entrepreneurial growth. Simplifying these processes and creating a supportive policy environment for start-ups and SMEs is critical to unlocking Zambia's entrepreneurial potential. The study also highlights the need to embed digital tools into government systems, such as e-government services and digital identity frameworks, to improve efficiency, transparency, and citizen engagement.

Finally, the broader macroeconomic context underscores Zambia's continued vulnerability to commodity price shocks, particularly due to its dependence on copper exports. Promoting ICT-enabled diversification is therefore a strategic imperative. Sectors such as agritech, digital logistics, and remote services can offer resilient and inclusive pathways to growth. In this context, technology is not just a tool to improve existing processes, but a critical pathway for structural transformation and long-term economic resilience.

6.3 – Recommendations

In light of these practical insights, the study makes several recommendations aimed at strengthening Zambia's digital transformation and economic resilience.

It is essential for the Zambian government and policymakers to prioritize the expansion of affordable mobile connectivity. This includes subsidizing mobile data costs, encouraging telecom investment in rural areas, and promoting mobile-based services such as mobile banking and mobile health. But mobile connectivity alone is not enough. The government should also invest in complementary infrastructure, particularly broadband deployment, while embedding digital skills training in educational and vocational institutions. These efforts need to be supported by the development of locally relevant digital content to ensure that the benefits of the Internet are maximized across different sectors and user groups.

The regulatory environment also needs to be reformed to encourage entrepreneurship. Streamlining the business registration process, reducing the cost of formalization, and offering tax incentives for start-ups that use digital tools can significantly boost the creation of new businesses. In addition, the creation of digital innovation hubs and incubators equipped with Internet access and business support services would provide a much-needed platform for emerging entrepreneurs.

To reduce economic dependence on copper and other primary commodities, Zambia should actively pursue diversification through ICT-enabled sectors. This includes supporting the development of the digital services industry, remote business process outsourcing, and technology-enabled agricultural services. At the same time, social protection systems need to be strengthened to mitigate potential labour market disruptions that may occur during digital and structural transitions.

International development partners also have an important role to play. They should provide financial and technical support for digital inclusion initiatives such as public Wi-Fi networks, rural technology hubs, and mobile financial services. These partners can also support capacity-building initiatives and fund longitudinal research to monitor the long-term impact of digital transformation on households, businesses, and institutions in Zambia.

For the private sector and entrepreneurs, the key recommendation is to develop mobile-first business models that are optimized for low-bandwidth environments. Offline-capable mobile applications and bundled services with telecom providers can help overcome connectivity

constraints and expand market reach. Entrepreneurs should also engage in policy dialogue to advocate for reforms that remove barriers to digital innovation and business growth.

In a nutshell, a coordinated, multisectoral strategy-combining infrastructure investment, digital skills development, policy reform, and institutional strength-is essential for Zambia to fully reap the benefits of digital transformation. By implementing these recommendations, the country can foster a more inclusive, innovative, and resilient economy driven by technology and entrepreneurship.

7 – Conclusion

This study provides a nuanced understanding of how digital access-specifically, mobile and Internet connectivity-interacts with entrepreneurship and economic development in Zambia. By analyzing data from 2006 to 2023 and applying both static and dynamic econometric techniques, the study highlights key relationships that challenge simplistic assumptions about the automatic benefits of ICT adoption in developing contexts. While mobile phone penetration is strongly correlated with increased entrepreneurial activity, Internet use alone does not show a consistent short-term impact on GDP, suggesting that digital infrastructure must be complemented by human capital development, institutional frameworks, and relevant content to contribute meaningfully to economic growth.

Importantly, the moderation analysis shows that the benefits of mobile connectivity diminish as Internet penetration increases, suggesting non-linear and context-specific returns to digital investments. These findings enrich the theoretical discourse on technology adoption, entrepreneurial ecosystems, and endogenous growth, while providing timely, actionable insights for policymakers, businesses, and development agencies. Zambia's digital journey underscores the importance of a holistic approach to digital transformation-one that integrates infrastructure development, digital skills, regulatory reform, and sectoral diversification.

The bidirectional relationship between new business density and GDP also supports the premise that entrepreneurship not only benefits from economic growth, but is a key driver of that growth. As such, fostering entrepreneurship through digital platforms, particularly mobile-based innovations in finance, agriculture, and retail, offers a resilient and inclusive development path. The study's methodological approach-combining Jamovi's user-friendly analytics with RStudio's advanced time series modeling-also demonstrates a replicable framework for similar research in other sub-Saharan countries.

In conclusion, Zambia's experience illustrates that digital transformation is not just about expanding access to technology, but about strategically embedding that access in an enabling environment for innovation, productivity, and inclusive growth. Policymakers and stakeholders must act decisively to align infrastructure, skills, and governance if the full promise of digitalization is to be realized.

7.1 – Authors' contributions and Declarations

Tryson Yangailo was solely responsible for the conceptualization, methodology, writing, review, and editing of the manuscript.

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APPENDICES

Simple Slope Plot

