International Journal of Social Science and Economic Research

ISSN: 2455-8834

Volume:11, Issue:07 "July 2026"

Dynamics of Communication Technologies and Labour Productivity Growth in Canada

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DOI: 10.46609/IJSSER.2026.v11i07.010 URL: https://doi.org/10.46609/IJSSER.2026.v11i07.010

Received: 10 June 2026 / Accepted: 5 July 2026 / Published: 15 July 2026

ABSTRACT

This study examines the contribution of communication technologies to labour productivity growth in Canada between 1990 and 2023. We decompose communication technologies into the components of information economics: landline phones, mobile phones, and internet subscriptions, and use GDP per hour worked to measure labour productivity. Time-series data from the Organisation for Economic Co-operation and Development (OECD) database, the International Telecommunication Union (ITU), and the World Telecommunication/ICT Indicators database were analysed using summary statistics, cointegration tests, the vector error correction model (VECM), and residual diagnostic tests. Summary statistics indicate that mobile phone subscriptions are the dominant means of communication, rising from about 75.5 per 100 people in 2010 to 94.14 per 100 people in 2023. This highlights the deepening digitalisation of the Canadian economy and its growing potential for economic prosperity. The VECM estimates indicate that a 1% increase in landline phone subscriptions is associated with a 0.065% increase in long-term labour productivity growth. Similarly, evidence of a significant positive effect of mobile phone subscriptions was established in both the long and short run. Specifically, a percentage increase in mobile phone subscriptions is associated with increases of 0.1003% and 0.203% in labour productivity growth in the long and short term, respectively. This finding highlights the potential of mobile connectivity to enhance labour productivity in Canada. However, the results showed that internet usage adversely affected labour productivity growth, which could be attributed to non-productive internet use, transitional and adjustment costs, and the non-specificity of productivity-based internet subscription data. Given the findings, we recommend increased government and private investment in mobile network infrastructure to provide reliable, affordable access to people, especially those in underserved areas, to sustain labour productivity growth.

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Keywords: Labour productivity, communication technologies, GDP per hour, landline, mobile phones, internet usage and Canada

JEL Classifications: J01, J24, 033, 047,

1. Introduction

Rapid improvements in communication technologies worldwide continue to attract the attention of policymakers, researchers, and practitioners. This revolution, driven by rapid productivity growth in ICT industries, has been described as a critical enabler of economic transformation in both developed and developing economies. Access to ICT mainly determines the global digital divide, making it essential to critically assess how it influences labour productivity and economic growth. Mashadihasanli & Zülfikar (2023) argue that ICT has become an important driver of economic growth, innovation, and competitiveness. It has also raised people's standard of living and accelerated the expansion of the global economy (Hanif et al., 2026). As outlined in existing literature, communication technologies improve labour productivity and boost economic growth through three channels. First, rising productivity growth in ICT industries creates opportunities for total factor productivity (TFP) growth, including labour, expanding economic opportunities for firms and households. Second, the revolution in ICT also influences economic growth through increased investment, leading to more innovative products and lower costs, thereby increasing capital per worker and reducing capital costs. Third, communication technologies have the potential to foster sustainable growth by creating new markets, products, and organisational methods through profound innovation of how goods and services are produced and distributed globally.

As critical meta-infrastructure, communication technologies facilitate the flow of information, reduce transaction costs, enable the diffusion of innovation, and foster network effects that improve the productive capacity of the labour force, promoting economic growth and development. Huang et al. (2022) posit that the prevailing use of telecommunications technology has catalysed information economics, shaping firm management, organisational operations, and economic development. This also provides pathways for sustainable growth (Foster et al., 2025; Gökgöz & Turan, 2025; Kurniawati, 2022), knowledge sharing (Odularu, 2026; Milkova, Moldoveanu & Krcil, 2025), trade relations (Mokgopha & Shambare, 2025) and improved governance quality (Sheik et al., 2026). Thus, the development of communication technologies, including mobile phones, broadband internet, landlines, and advanced data networks, has radically changed how people, businesses, and governments communicate, produce, and share information. These innovations have reduced transaction costs, improved market efficiency, promoted the spread of knowledge, and created new economic opportunities.

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Across the globe, including Asia and North America, communication technologies have continued to revolutionise, shifting from analogue to digital systems. In particular, Canada has seen significant improvements in communication technologies over the past two decades, driven by advances in high-speed broadband, fibre-optic networks, and fifth-generation (5G) wireless technology. These innovations have facilitated the growth of the digital economy, including e-commerce, cloud computing, and digital platforms, thereby shaping economic outcomes, especially labour productivity and economic growth. Data from the International Telecommunication Union (ITU) and the World Bank indicate notable progress in broadband internet usage and mobile phone subscriptions in Canada, highlighting the increasing adoption of communication technologies across the country. However, controversies have surrounded the extent to which these innovations drive labour productivity. Previous studies have examined the impact of ICT on economic growth, highlighting its role as a catalyst for productivity improvements and innovation. However, the specific context of Canada has been largely underexplored, providing the basis for this study. This study provides insight into the sectoral contribution of communication technologies to labour productivity in Canada, disaggregating the components into broadband internet usage, mobile phone subscriptions, and landline phone subscriptions. This will advance the existing literature by providing specific insights into each technology's contribution to Canada's labour productivity growth. This study is also based on the economy-wide aggregate of labour productivity, as measured by GDP per hour worked, distinguishing it from other previous studies (Mazorodze, 2026; Nouffeussie et al., 2025; Abdullahi, Nor & Mahmud, 2025; Zhu et al., 2025; Amador & Silva, 2025) that limited their scope to specific sectors. This paper is structured into five sections. Given the introduction, the following sections will focus on the related literature, methodology, results, conclusion, and policy insights.

2. Literature Review

Endogenous growth theory, credited to Romer (1986, 1990) and Lucas (1988), provides the theoretical foundation for analysing how communication technologies drive economic growth. The theory assumes that growth emerges from endogenous factors within the economic system through investment in knowledge, human capital, and innovation. Romer (1990) argues that technological change primarily stems from deliberate efforts by firms and individuals, particularly through R&D spending. Similarly, Lucas (1988) emphasises the importance of developing human capital through education and training for boosting productivity and economic growth. Grossman & Helpman (1991) extend this framework by incorporating international trade and knowledge as additional enablers of innovation and growth.

Improvements in communication technologies such as the internet, mobile networks, and digital platforms are believed to facilitate innovation by enabling faster information exchange,

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collaboration, and knowledge creation. These reduce R&D costs and accelerate the spread of ideas, supporting Romer's (1990) focus on knowledge-driven growth. Again, digital communication tools boost education, skill development, and capacity building through e-learning and information access, supporting Lucas's (1988) assertion that human capital development drives long-term growth. Additionally, this study draws on Rogers' (1962) Diffusion of Innovations Theory, which assumes that new technology spreads gradually through social interaction and communication channels, following a systematic, predictable pattern across user categories. By focusing on adoption processes, communication channels, and network effects, the theory explains the mechanisms through which technological advancements translate into productivity gains and long-term economic development. Its emphasis on diffusion dynamics makes it particularly suitable for this study, highlighting how communication technologies transition from limited use to widespread adoption and create opportunities for sustained economic growth.

Empirically, many studies have examined information economics in recent years, offering varied insights into how ICTs contribute to labour productivity. Most of these studies are country-based, while others span multiple countries and yield mixed empirical evidence. For instance, Nouffeussie et al. (2025) use an instrumental-variables Tobit model applied to data from the Enterprise Survey, a sample of 361 manufacturing firms, to explore the role of ICTs in driving labour productivity in Cameroon. The findings showed that the use of two or more ICT tools comprising the email-mobile money, email-website, mobile money-email-website, positively and significantly affects workers' productivity. This highlights the effectiveness of combining several ICT tools to enhance labour productivity. Roth & Mitra (2025) employed growth regressions to investigate the critical role of intangible assets in labour productivity growth in 14 European Union (EU) member countries and the UK between 1995 and 2019, distinguishing between ICT and non-ICT tangibles. The findings indicate that Research and Innovation (R&I) are crucial for labour productivity growth. The results also show that labour productivity growth in the goods sector benefited most from non-ICT tangibles.

Gökgöz & Turan (2025) employed annual panel data and used fixed-effects (FE), random-effects, fully modified ordinary least squares, dynamic ordinary least squares and generalised method of moments (GMM) estimators to investigate the link between ICT adoption and economic growth across all Organisation for Economic Cooperation and Development (OECD) countries between 2000 and 2018. The findings indicate that ICTs and non-ICT (NICT) capital services and employment significantly improved economic growth, highlighting the important role of communication technologies in driving economic growth and productivity.

Using panel-corrected standard errors (PCSE) and feasible generalised least squares (FGLS) estimators, Abdi et al. (2026) analysed the influence of information and communications

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technology (ICT) on productivity and energy consumption in the East African Community (EAC) to formulate initiatives that foster sustainable growth. The findings indicate a positive and statistically significant relationship between digital advancement and economic growth. In particular, disaggregated ICT metrics show that mobile subscriptions, telephone usage, and internet penetration each positively influence economic development, with internet usage having the greatest impact. Based on these findings, the study recommends that the EAC prioritise investment in enhancing ICT infrastructure without compromising sustainability.

Similarly, Sultanova & Naser (2026) analysed a panel data set of 110 countries from 2000 to 2019, using the GMM estimator to evaluate the short- and long-term impacts of ICT on these economies. The study also investigates how ICT and human capital together influence export concentration. Results show that ICT development significantly promotes export diversification in developing nations, aligning their export profiles with global standards. The interaction between ICT and human capital positively affects export concentration, suggesting that higher human capital levels amplify ICT's influence. The study concludes that ICT not only fosters human capital development but also provides developing countries with the skills necessary to explore new markets, produce high-value goods, and compete globally.

Using panel data from 134 countries spanning 2012 to 2020, Sarsar & Echaoui (2026) employ a quantile regression approach to examine the moderating role of digital transformation in the effect of the energy transition on economic growth. The results indicate that digital transformation greatly enhances the positive growth impacts of the renewable energy transition, especially in higher-growth quantiles. These findings highlight the need for coordinated energy and digital policies. Based on this, the study suggests that policymakers prioritise investments in digital infrastructure and capabilities, particularly in low- and middle-income countries. In a related study, Mohammed & Yacine (2025) employed a system GMM to examine how digitalisation influences economic growth across the MENA region, utilising balanced panel data from 15 countries spanning 2001-2023. The findings indicate that digital transformation, as measured by internet penetration, ICT investment, and digital skills, positively and significantly impacts economic growth. These results highlight the need for comprehensive policy approaches that integrate technological investments with educational reforms, institutional development, and regional collaboration.

Kurniawati (2022) studied the causal relationship between ICT and economic growth across 25 Asian countries from 2000 to 2018, focusing on high- and middle-income nations. The results indicate that increased Internet penetration has contributed significantly to economic development in high-income Asian countries. The study also found that higher penetration of telephone lines and mobile phones can promote economic growth in middle-income Asian countries. Similarly, Hunady, Demeova, and Chylakova (2025) utilised Granger causality tests

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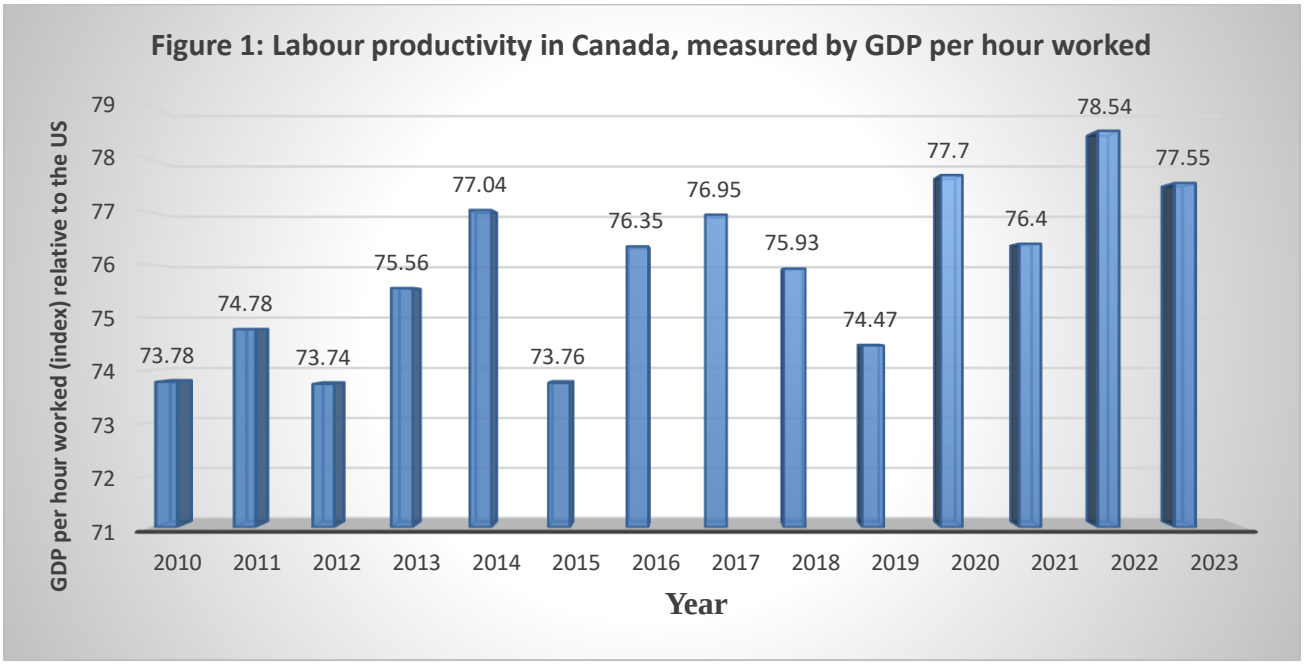
and panel data regression to examine how digital skills and labour productivity interact, accounting for the impact of business digitalisation in the EU. Their findings reveal a bidirectional causal link between productivity and digital skills, with a two-year lag specifically in e-commerce. The panel regression further indicates that general digital skills positively affect labour productivity, although this was not observed for advanced digital skills or R&D spending. The study emphasises that the strength of the relationship between digital transformation and labour productivity varies based on skill types and employees' capacity to adapt to new technologies.

2.1 Stylised Facts on Labour Productivity and Communication Technologies in Canada

Over the past two decades, Canada has witnessed changes in labour productivity and communication technologies, highlighting the country's pace of economic transformation, as shown in Figures 1 and 2.



Source: Authors' compilation of data from the OECD's (2025) Database

Figure 1 depicts Canada's labour productivity (measured as GDP per hour worked relative to the U.S.) from 2010 to 2023. The trend shows that GDP per hour worked experienced several short-term fluctuations during the study period (2010 – 2023). It increased from 73.78 in 2010 to 77.04 in 2014, indicating increased labour productivity and efficiency in the Canadian labour market. The GDP per hour worked declined to 73.76 in 2015, suggesting a decrease in relative economic efficiency and undermining convergence with U.S. productivity levels. Labour productivity

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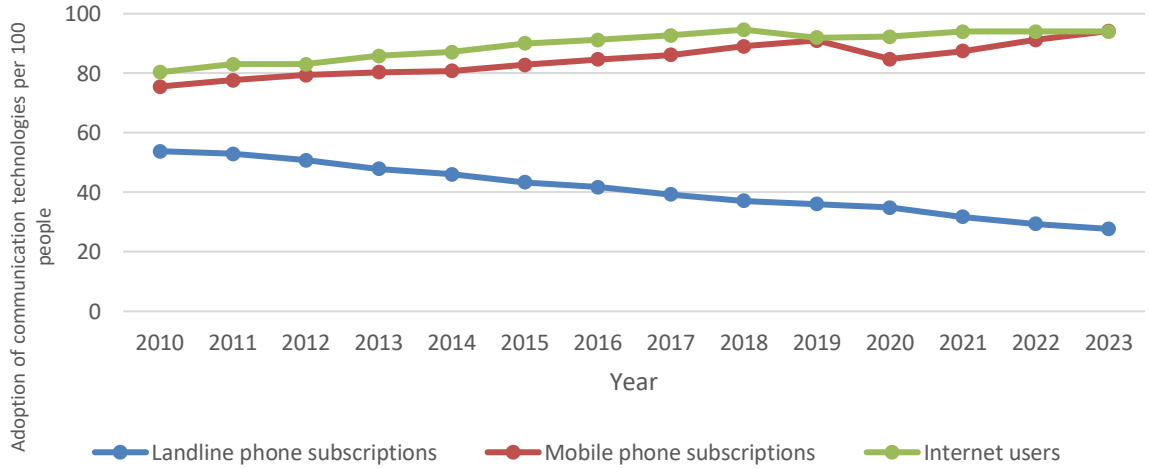
increased from 76.35 in 2016 to 79.35 in 2017, before declining marginally to 75.37 and 74.47 in 2018 and 2019, respectively. These variations suggest evidence of instability in labour productivity growth during the period. However, there is a larger upward trend in GDP per hour worked from 2020 to 2022, with growth reaching a record high level of 78.54 in 2022. This reveals improved labour productivity. A marginal decline in GDP per hour worked was observed in 2023, but the productivity level remains higher than in most of the previous periods. In sum, GDP per hour worked for each of the selected periods (2010 – 2023) is less than 100, indicating that Canada's labour productivity growth is lower than that of the United States of America.

Figure 2: Time series trend of communication technologies adoption in Canada, 2010 - 2023



Source: Authors' compilation of data from the International Telecommunication Union (ITU), and World Telecommunication/ICT Indicators Database

Figure 2 presents the time-series trend in the adoption of communication technologies in Canada between 2010 and 2023, measured per 100 people, with emphasis on landline, mobile phone, and internet subscriptions. Broadly, the trends indicate that Canada has successfully embraced digital transformation, with a decrease in reliance on landlines and significant growth in mobile phone and internet usage. This transition suggests a more connected, technologically advanced economy, where digital communication infrastructure is crucial for boosting productivity, innovation, and economic growth. In particular, **landline phone subscriptions steadily declined from about 53.8 per 100 people in 2010 to 27.7 per 100 people in 2023. This gradual decline underscores the obsolescence of fixed-line telephony, as subscribers increasingly prefer more flexible and convenient options. It also signals a structural departure from traditional infrastructure, diminishing the role of landlines in Canada's communication network. On**

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the other hand, mobile phone subscriptions rose from about 75.5 per 100 people in 2010 to 94.14 per 100 people in 2023, with marginal fluctuations. Growth was notably strong from 2010 to 2018, indicating increased penetration. A marginal decline was observed between 2019 and 2020, which could be attributed to market distortions, but the subsequent recovery highlights the resilience and dominance of mobile technology. This suggests that mobile connectivity has become the primary communication method, enabling mobility, digital services, and economic activities. Similarly, internet usage has increased consistently, rising from about 80.3 users per 100 people in 2010 to over 93.95 users per 100 people in 2023. This steady upward trend, with only marginal downturns, highlights the deepening digitalisation of the Canadian economy. High and growing internet usage is a pointer to improved access to information, digital services, and online economic opportunities, reinforcing productivity and innovation in Canada.

3. Methodology

3.1 Data and Variable Descriptions

Given the adoption of an ex post facto research design, time-series data on GDP per hour worked, landline phone subscriptions, mobile phone subscriptions, and internet usage were obtained from the OECD, the International Telecommunication Union (ITU), and the World Telecommunication/ICT Indicators database. In particular, GDP per hour worked served as the basis for measuring labour productivity growth in this study and describes the effectiveness of workers in using their time to produce goods and services. This index is adjusted for Purchasing Power Parity to account for price differences across countries, sets the U.S. level of GDP per hour worked to 100, and uses it as a basis for comparison with other countries. An index greater than 100 indicates greater labour productivity than in the U.S. and vice versa. On the other hand, Landline phone subscriptions indicate the total active fixed-line telephone connections that rely on wired infrastructure for voice communication services. It is measured by the number of subscriptions per 100 people. Additionally, mobile phone subscriptions are subscriptions to a public mobile telephone service that provides access to the Public Switched Telephone Network (PSTN) using cellular technology. It includes the number of postpaid subscriptions and active prepaid accounts. It is also measured by the number of mobile phone subscribers per 100 people. Internet users define individuals who have used the Internet in the last 3 months, regardless of location, and are measured as the number of internet users per 100 people.

3.2 Model Specification

Following the endogenous growth theory and previous studies such as Abdi et al. (2026), Hunady, Demeova & Chylakova (2025), and Meka'a et al. (2025), we employ a vector error

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correction model (VECM) to capture how communication technologies contribute to labour productivity. The functional specification of the model is as follows:

LPG = f (LPS, MPS, ITU) (1)

Where: LPG = labour productivity growth, LPS = landline phone subscriptions, MPS = mobile phone subscriptions, and ITU = internet usage.

The VECM representation of equation (1) is as follows:

$$\Delta In\, LPG_t = C_1 + \sum_{i=1}^{k} \beta_{11} \Delta InLPG_{t-i} + \sum_{i-1}^{k} \beta_{12} \Delta InLPS_{t-i} + \sum_{i=1}^{k} \beta_{13} \Delta InMPS_{t-i} + \sum_{i-1}^{k} \beta_{14} \Delta InITU_{t-i} + \theta_1 ECT_{t-1} + U_{1t} \quad (2)$$

$$\Delta In\, LPS_t = C_2 + \sum_{i=1}^{k} \beta_{21} \Delta InLPG_{t-i} + \sum_{i-1}^{k} \beta_{22} \Delta InLPS_{t-i} + \sum_{i=1}^{k} \beta_{23} \Delta InMPS_{t-i} + \sum_{i-1}^{k} \beta_{24} \Delta InITU_{t-i} + \theta_2 ECT_{t-1} + U_{2t} \quad (3)$$

$$\Delta In\, MPS_t = C_3 + \sum_{i=1}^{k} \beta_{31} \Delta InLPG_{t-i} + \sum_{i-1}^{k} \beta_{32} \Delta InLPS_{t-i} + \sum_{i=1}^{k} \beta_{33} \Delta InMPS_{t-i} + \sum_{i-1}^{k} \beta_{34} \Delta InITU_{t-i} + \theta_3 ECT_{t-1} + U_{3t} \quad (4)$$

$$\Delta In\, ITU_t = C_4 + \sum_{i=1}^{k} \beta_{41} \Delta InLPG_{t-i} + \sum_{i-1}^{k} \beta_{42} \Delta InLPS_{t-i} + \sum_{i=1}^{k} \beta_{43} \Delta InMPS_{t-i} + \sum_{i-1}^{k} \beta_{44} \Delta InITU_{t-i} + \theta_4 ECT_{t-1} + U_{4t} \quad (2)$$

The matrix representation of equations (1) to (5) is as follows:

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$$\begin{bmatrix} \Delta InLPG_t \\ \Delta InLPS_t \\ \Delta InMPS_t \\ \Delta InITU_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \\ C_4 \end{bmatrix} + \sum_{i=1}^{k} In\Delta \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} \\ \beta_{31} & \beta_{32} & \beta_{33} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix} \begin{bmatrix} LPG_{t-i} \\ LPS_{t-i} \\ MPS_{t-i} \\ ITU_{t-i} \end{bmatrix} + \begin{bmatrix} \theta_1 ECT_{t-1} \\ \theta_2 ECT_{t-1} \\ \theta_3 ECT_{t-1} \\ \theta_4 ECT_{t-1} \end{bmatrix} + \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \\ U_{4t} \end{bmatrix} \quad (5)$$

Where: C_1-C_4 = vector of constant parameters, β_{11} - β_{44} = slope parameters, θ_1 - θ_4 = error correction coefficients (speed of adjustments), ECT = error correction term, U_{1t} - U_{4t} = slope parameters, In = natural log notation, Δ = first difference notation and K = optimal lag notation

3.3 Estimation Techniques

The least squares method was used to estimate the VECM, providing insights into the long-run relationships and short-run dynamics. The motivation for estimating a VECM followed the evidence of cointegration among the I(1) series. It also provides an error correction coefficient, which measures how quickly variables return to equilibrium after a shock. Summary statistics were also employed to analyse the distribution of each variable during the study period. Additionally, the Kwiatkowski, Phillips, Schmidt & Shin (KPSS, 1992) unit root test was applied in this study, while the Johansen (1988) cointegration test served as the basis for the long-run relationship test. Residual diagnostics tests, including tests for serial correlation and heteroskedasticity, were applied in this study to validate the reliability and efficiency of the estimated VECM.

4. Results and Discussion

4.1 Descriptive Statistics

The summary statistics for each variable are presented in Table 1.

Table 1: Summary statistics for each variable

Statistic	LPG	LPS	MPS	ITU
Mean	79.09088	52.24412	52.21822	59.52541
Median	78.44000	55.25000	59.25430	72.80000
Maximum	85.56000	67.70000	94.14970	94.64000
Minimum	73.74000	27.70000	2.110719	0.361000
Std. Dev.	3.623838	11.58275	32.88690	35.22190
Jarque-Bera	2.474415	2.984430	3.624377	4.651064
Probability	0.290193	0.224874	0.163296	0.097731

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Observations	34	34	34	34

Source: E-views output

As shown in Table 1, labour productivity growth averaged 79.09 with minimum and maximum values of 73.74 and 85.56, respectively. This indicates that workers' productivity in Canada was lower than in the USA during the study period. The standard deviation for labour productivity growth shows that the observations converged around the mean. The summary statistics further showed that landline phone and mobile phone subscriptions averaged 52.244 and 52.21 subscribers per 100 people, while internet usage averaged 59.52 users per 100 people. This indicates that internet usage dominated the adoption of communication technologies in Canada during the study period. The standard deviations for landline, mobile phone, and internet subscriptions indicate that their observations converged around their respective means. The p-values of the Jarque-Bera statistics indicate that the observations for each variable are normally distributed at the 5% significance level, indicating the absence of outliers in the data distribution.

4.2 Unit Root Test

As previously stated, the KPSS was employed for the unit root test. The results are presented in Table 2.

Table 2: KPSS unit root test results

Variable	LM stat. at levels	LM stat. at 1st diff.	5% critical value	Order of Integration
LOG(LPG)	0.151	0.113	0.146	I(1)
LOG(LPS)	0.550	0.046	0.146	I(1)
LOG(MPS)	0.206	0.135	0.146	I(1)
LOG(ITU)	0.189	0.135	0.146	I(1)

Source: E-views output

Table 2 shows the KPSS unit root test results conducted at the 5% significance level. The results showed that none of the variables is stationary. This is because the LM statistics at the levels exceed the 5% critical value. Thus, we cannot reject the null hypothesis of a unit root for each variable. Consequently, the variables were subjected to the first-difference test, and the results showed that the variables are stationary at the first difference, indicating that they are integrated of order one (I(1). Given the evidence of all I(1) series, a cointegration test was conducted using Johansen's (1988) method.

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4.3 Cointegration Test

The cointegration test results are shown in Table 3.

Table 3: Summary of Johansen cointegration test results

Trace Test Results		
Null Hypothesis	Trace statistic	5% critical value
r =0	64.29***	47.86
r ≤ 1	36.16***	29.79
r ≤ 2	13.308	15.49
r ≤ 3	1.42	3.841
Maximum Eigenvalue Test Results		
Null Hypothesis	Max-Eigen statistic	5 per cent critical value
r =0	28.14**	27.584
r ≤ 1	22.85**	21.13
r ≤ 2	11.89	14.265
r ≤ 3	1.423	3.841

Source: E-views output

Note: ***. ** and ** indicate statistically significant at 1%, 5% and 10% levels respectively

As shown in Table 3, both the trace test and the maximum eigenvalue test indicated evidence of two cointegrating equations. This finding necessitates rejecting the null hypothesis of no cointegration, indicating that labour productivity growth has a long-run relationship with communication technologies. This is consistent with the findings of Meka'a, Njiepue Nouffeussie, & Nzepang (2025), Benedicta & Lacheheb (2022) and Kurt & Kurt (2015), who established that ICT tools have a long-run predictive ability for labour productivity growth.

4.4 Model Estimation

Following a cointegrating relationship among the I(1) series, the VECM was estimated using the least squares method. The results are presented in Table 4.

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Table 4: Summary of VECM results

Dependent variable: LPG			
Cointegrating Equation			
Variable	**Coefficients**	Standard error	t-statistic
LOG(LPS)	0.065**	0.019	3.341
LOG(MPS)	0.1003***	0.0198	5.062
LOG(ITU)	-0.056***	0.0105	-5.327
Short-run Dynamics			
ECT	-0.865**	0.262	-3.299
D(LOG(LPG(-1)))	0.123	0.215	0.569
D(LOG(LPS(-1)))	-0.157	0.102	-1.523
D(LOG(MPS(-1)))	0.203**	0.086	2.370
D(LOG(ITU(-1)))	0.0146	0.025	0.581
C	-0.0315**	0.0092	-3.421
R-squared	0.422008	F-statistic	3.7966

Source: E-views output

Note: ***. ** and ** indicate statistically significant at 1%, 5% and 10% levels respectively

The long-run results showed that landline phone subscriptions have a positive and significant effect on labour productivity growth. A 1% increase in landline phone subscriptions is associated with a 0.065% increase in labour productivity growth. This finding is consistent with theoretical expectations and with previous studies by Abdi et al. (2026) and Hunady, Demeova & Chylakova (2025), who reported a positive long-run growth implication of ICT tools and digitalisation for labour productivity. Similarly, the results indicated that mobile phone subscriptions significantly increased labour productivity growth in the long run. The estimated parameter indicates that labour productivity growth increases by 0.1003% due to a percentage increase in mobile phone subscriptions in Canada. This finding supports the endogenous growth theory, which underscores the role of technology and innovation in driving sustained productivity improvements. It also corroborates the findings of Gökgöz & Turan (2025) and Roth & Mitra (2025), who reported that ICT infrastructure, particularly mobile technology, is growth-enhancing in EU and OECD countries. The long-run results further showed that internet usage has a positive and significant effect on labour productivity growth. A 1% increase in

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internet usage is associated with a 0.056% decrease in long term labour productivity growth. This finding is contrary to the theoretical expectations and the findings of Kurniawati (2022) and Mohammed & Yacine (2025), who found that increased internet penetration bolstered productivity growth. The short-run dynamics showed that only mobile phone subscriptions have a significant positive effect on labour productivity. A percentage increase in mobile phone subscriptions is associated with a 0.203% increase in labour productivity growth. However, landline phone subscriptions and internet usage do not significantly affect short-run labour productivity growth. More importantly, the error-correction coefficient is negative and significant, indicating that about 86.5% of the **disequilibrium is corrected each year.** This further shows that labour productivity growth quickly returns to the long-run equilibrium after short-run shocks. The R-squared of 0.422 indicates that the variables moderately explain 42.2% of the total variation in labour productivity growth. Similarly, the F-statistic (3.7966) also attests to the statistical reliability of the estimated model, indicating that the regressors are jointly significant in explaining changes in labour productivity growth.

Table 5: Residual diagnostics test results

a. VEC Residual Serial Correlation LM Tests						
Null hypothesis: No serial correlation at lag h						
1	10.33085	16	0.8488	0.624707	(16, 58.7)	0.8510
2	10.04781	16	0.8641	0.606251	(16, 58.7)	0.8661
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	10.33085	16	0.8488	0.624707	(16, 58.7)	0.8510
2	21.53995	32	0.9192	0.621101	(32, 56.9)	0.9261
b. VEC Residual Heteroskedasticity Tests (Levels and Squares)						
Joint test:						
Chi-sq		Df		Prob.		
96.945		100		0.5679		

Source: E-views output

As shown in Table 5, the VEC residual serial correlation LM test indicates that the null hypothesis of no serial correlation cannot be rejected at either the individual or joint lag levels, since the test statistics' p-values exceed 0.05. This indicates that the residuals are free from serial correlation, thereby affirming the reliability of the results. Similarly, the VEC residual heteroskedasticity test based on levels and squares shows that the null hypothesis of homoskedasticity cannot be rejected at the 5% level. This is because the p-value (0.568) of the

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Chi-square statistic (96.945) is greater than 0.05. This confirms that the residuals have constant variance, supporting the conclusion that the model is free from heteroskedasticity and that the estimated parameters are both efficient and reliable.

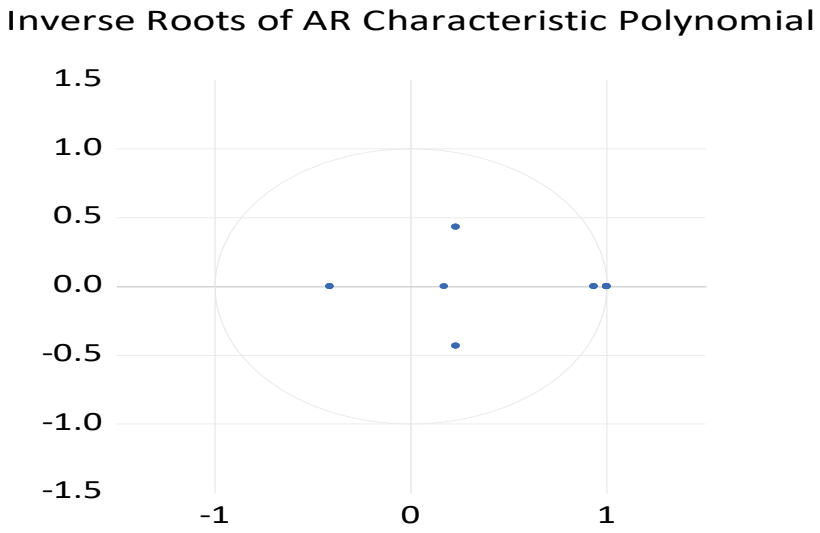

Figure 3: Plots of inverse roots for stability test

Figure 3 presents the inverse roots plot used in the stability test. The results indicate that all inverse roots of the AR characteristic polynomial lie inside the unit circle, thereby confirming the stability of the estimated VECM. This indicates that the system will return to equilibrium following short-term shocks, thereby supporting the reliability of the estimated results.

5. Conclusion and Policy Insights

In this study, we provide insights into the labour productivity implications of adopting communication technologies in Canada by analysing how landline, mobile, and internet subscriptions affect GDP per hour worked. The findings indicate that landline phone subscriptions significantly improved labour productivity growth in the long run. Similarly, evidence of a significant positive effect of mobile phone subscriptions was established in both the long and short run. This finding highlights the potential of mobile connectivity to enhance labour productivity in Canada. However, the results showed that internet usage adversely affected labour productivity growth. This suggests that high and growing internet usage does not translate into productivity gains, possibly due to non-productive internet use, transitional and adjustment costs, and the non-specificity of productivity-based internet subscription data. Given the findings, we conclude that mobile connectivity is an outstanding enabler of labour productivity growth in the Canadian economy. Thus, we recommend increased government and

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private investment in mobile network infrastructure to provide reliable and affordable access to people, especially those in underserved areas. Again, stakeholders in the communication sector should collaborate to improve employees' digital skills and to focus workplace training on internet use to enhance productivity.

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