IFC International Finance Corporation
WORLD BANK GROUP

EMERGING MARKET INSIGHTS

Published by IFC's Economics and Market Research Department

Wired for Work:

How Digital Infrastructure is Powering Job Creation in Emerging Economies

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Digital infrastructure can significantly boost job creation, but it requires enabling policies and complementary investments in skills and physical infrastructure.

From mobile towers connecting remote villages to data centers powering digital economies, digital infrastructure is reshaping how firms, sectors, and countries operate. These investments are not just a symbol of modernization—they are catalysts for structural transformation and enable firms to create more jobs.[1]

Digital infrastructure contributes to job creation directly, indirectly, and through induced effects. The sector directly employs workers, but its impact is amplified in indirect activities, such as Intelsat-Coca-Cola Wi-Fi kiosks[2] in Africa, which empower local entrepreneurs, provide utility services, and foster self-employment. Likewise, app-based platforms lower barriers for small businesses and drive entry of new types of activities and jobs. The effects do not stop here. The induced effects of digital infrastructure on jobs emerge as digital technologies further penetrate sectors such as healthcare, education, and financial services. For example, technology-enabled training programs can scale firm upgrading and contribute to their ability to create jobs, as documented in a recent Emerging Market Insights note.[3]

DECEMBER 2025

FIGURE 1

Labor market outcomes

Digital technologies reshape labor markets through three broad mechanisms:

1 BOOST FIRM DYNAMICS AND PRODUCTIVITY

Connectivity enables flexible production, optimizes inputs, reduces coordination costs, and fosters innovation.

Evidence from emerging economies across continents shows significant gains in firm entry, advances in productivity[4] by up to 26%, increases in sales[5] by 36%, and higher employment[6]—including shifts toward permanent jobs.

2 STRENGTHEN WORKER SKILLS AND HUMAN CAPITAL

Faster internet and mobile coverage expand access to training and education, narrowing skill gaps.

Examples include access to satellite internet in China improving rural student outcomes and reducing urban-rural earnings gaps,[7] and facilitating workplace training[8] in Africa. Access to mobile internet contributed to increasing years of schooling[9] in Rwanda.

3 REDUCE MATCHING FRICTIONS

Digital tools improve market access and job matching by lowering search costs and expanding buyer-seller networks.

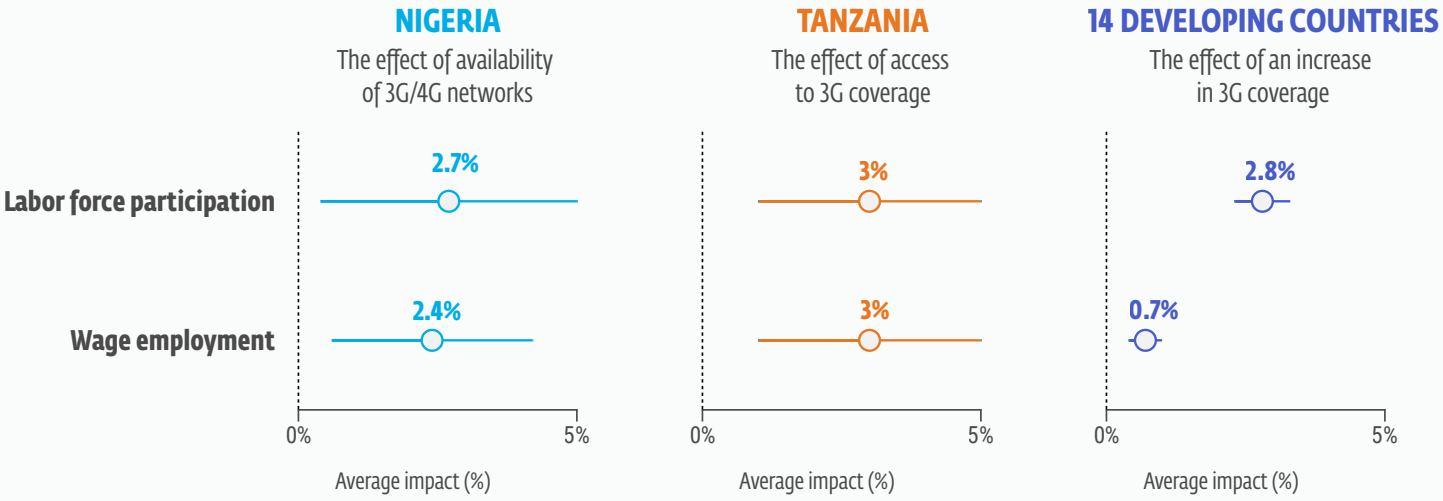
Price information systems disseminated through platforms in Africa[10] and India[11] raised farm-gate prices, while the presence of online reputation system on platforms such as Alibaba in China boosted exports[12] by 20% for top-rated sellers. Likewise, professional networking[13] in South Africa through online platforms enhanced the likelihood of firm-to-worker matching and increased employment rates from 70 to 77 percent.

Analyzing quantity-based measures, expansion of broadband, and mobile internet is associated with significant increases in employment and labor force participation. Submarine cable connections[14] in nine Sub-Saharan African countries, for example, increased employment by 13 percent[15] over three years, while mobile coverage in rural South Africa raised employment by 15 percentage points[16] over five years.

When analyzing quality-based measures, digital infrastructure is correlated with greater incidence of job formality, higher wages, and productivity. It can trigger a move away from agriculture toward wage, nonfarm self-employment, and greater participation in higher-earning sectors.

FIGURE 2

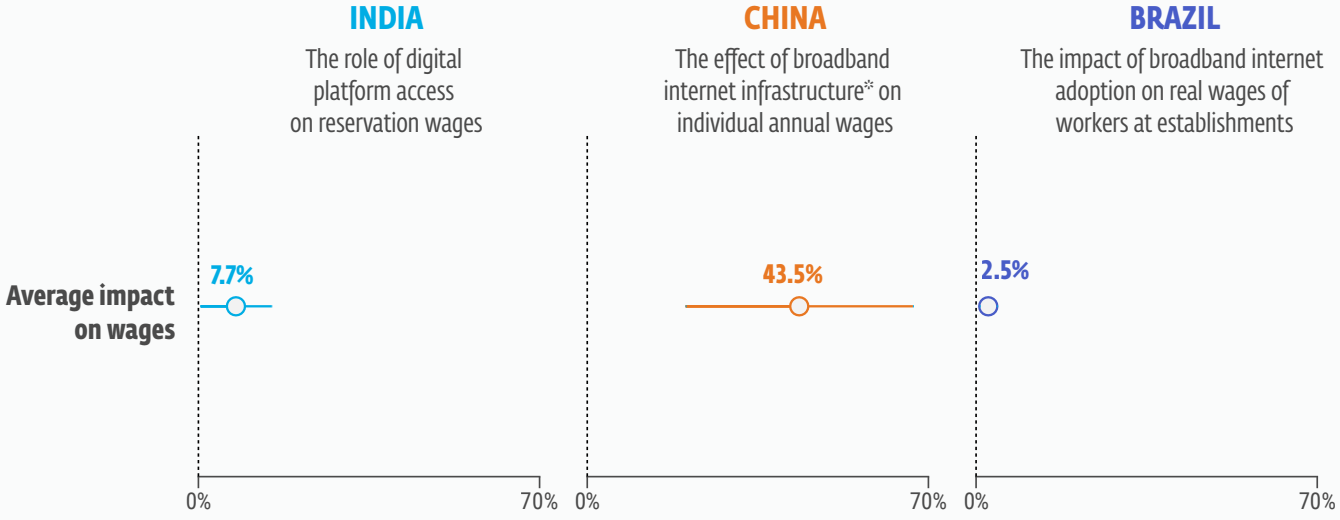
The impact of digital infrastructure on employment outcomes



NOTES: The line width represents 95 percent confidence band. Labor force participation is based on individual employment status, while wage employment is measured as the change in individual wage employment status. **SOURCES**: Nigeria: Bahia (2020),[17] Tanzania: Bahia et al. (2023),[18] 14 developing countries: Chiplunkar & Goldberg (2022).[19]

FIGURE 3

The impact of digital infrastructure on wages



* Using fixed-line teledensity as a proxy for internet infrastructure.

NOTE: The line width represents 95 percent confidence band.

SOURCES: India: Kelley et al. (2024),[20] China: Chen et al. (2019),[21] Brazil: Poliquin (2021)[22]

FIGURE 4

Access to digital infrastructure improves total jobs and job quality across a range of countries and settings

JOB QUANTITY-BASED MEASURES

Type of Digital Infrastructure	Labor Market Outcome
Faster internet (general)	Net positive job creation (Africa[23])
High-speed broadband via submarine cables	↑ Employment (9 Sub-Saharan African countries[24])
Mobile internet (3G or 4G coverage)	↑ Employment rate or share (14 developing countries,[25] Ethiopia,[26] Rwanda[27]) ↑ Workers joining the labor force (Tanzania,[28] Nigeria[29])
Mobile phone coverage	↑ Employment (rural South Africa[30])
Mobile money agent rollout	Nonfarm self-employment rate nearly doubled (rural Uganda[31])

JOB QUALITY-BASED MEASURES

Type of Digital Infrastructure	Labor Market Outcome
Internet access (general)	↑ Permanent workers (39 developing countries[32]) ↓ Reliance on routine tasks (Brazil[33])
Faster internet or ultrafast internet	↑ Wages and firm productivity (China[34])
Broadband expansion or rollout	↑ Wages by 2.2% (Brazil[35])
3G mobile broadband/coverage	↑ Salaried or wage employment (Senegal,[36] 14 developing countries,[37] Nigeria) ↑ Earnings, ↑ formal jobs (Africa,[38] Ethiopia[39]) Shift from informal to formal employment (Africa[40]) Shift from farm to wage and nonfarm self-employment (Tanzania[41])

Uneven Impact of Digital Connectivity

Digital connectivity has two competing effects that impact labor demand: automation and augmentation. As tasks are automated with digitalization, it may displace lower-skilled labor. Yet digitalization can also augment employment opportunities as it spurs firm growth by enhancing efficiency, opening access to new markets, and fostering shifts toward more competitive, digitally enabled activities[42] or entirely new activities. Digital infrastructure may have uneven impacts across sectors, firms, occupations and skills, locations, and gender—carrying significant distributional consequences.

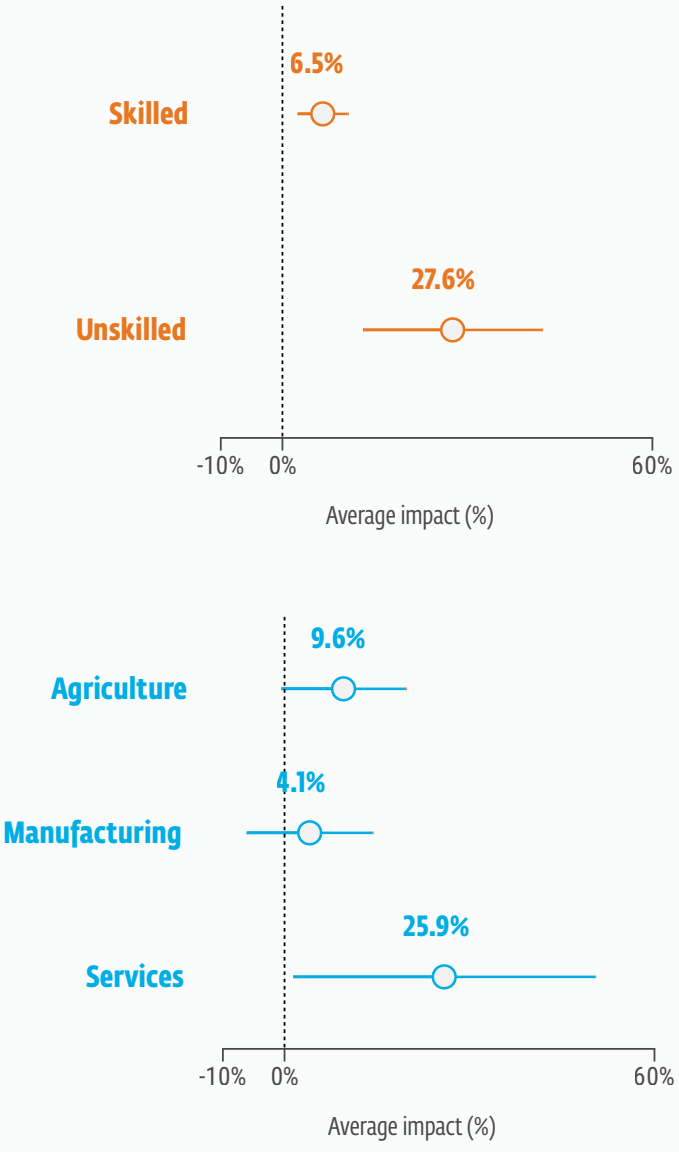
Occupations and Skills: While digital infrastructure in advanced economies[43] has tended to reinforce[44] generational and skill divides,[45] evidence from emerging and developing economies is more positive. Firms with more educated and younger workers gained most[46] from high-speed internet in China, mirroring patterns seen in advanced economies, while studies from Rwanda and Tanzania find mobile internet[47] boostingng employment for both skilled and unskilled workers.[48]

Sectors: Internet-enabled technologies often deliver larger benefits to services and skill-intensive industries, supporting structural transformation. For example, in Rwanda, improved 3G coverage shifted jobs[49] toward services as well as high-value-added industries.

Firms: Given high upfront costs, larger, more productive firms[50] and those with stronger management can adopt new technologies[51] more readily. In Kenya, fiber-optic rollout primarily benefited larger firms, enabling them to expand buyer and supplier networks, while smaller firms struggled to invest in complementary capacity.

FIGURE 5

Uneven impact of increase in 3G/4G on labor-force participation by skills and sectors in Rwanda



NOTE: The line width represents 95 percent confidence band.
SOURCE: Caldarola et al. (2023)[52]

Locations: Regions with superior broadband[53] exhibit labor market resilience,[54] have higher business activity,[55] and improve educational outcomes. It is not surprising then that internet expansion in poorer nations had stronger effects in reducing frictional unemployment[56] and in supporting catchup growth.[57]

Gender: When digital connectivity improves, more women[58] join the labor force. However:

- Benefits are larger for high-skilled women,[59] suggesting that lower skill levels limit their ability to fully leverage the advantages of digital infrastructure.
- The gender wage gap may widen, possibly due to lower average education and skills among women, or social norms that inhibit occupational mobility.
- Women may shift toward lower value-added activities,[60] such as unpaid agricultural roles and small businesses, which is partly explained by women taking up roles left by men transitioning to wage jobs. This contrasts with evidence from the impact of mobile money in Kenya that helped shift women from agriculture to higher-earning work.

FIGURE 6

Gendered effects of digital infrastructure adoption

OUTCOME MEASURED	IMPACT
Female Employment (absolute, shares, participation rates)	**Increased** (Viet Nam,[61] India,[62] Mexico,[63] Nigeria,[64] Jordan,[65] rural South Africa,[66] and a study using data from 14 developing countries[67])
Skill Premium	**Benefited high-skilled women** (Tanzania,[68] Türkiye[69])
Gender Wage Gap	**Sustained or increased within firm** (Türkiye,[70] Viet Nam[71])
Shift Across Sectors	**Toward less dynamic sectors and activities** (Republic of Korea[72] (non-IT services), a study using data from 14 developing countries,[73] Tanzania)[74];
	From agriculture to higher-earning work via mobile money (Kenya[75])

The Way Forward

Nearly 68 percent of the global population is online, but only 27 percent of the population in low-income countries use the internet, risking exclusion[76] from future job opportunities. Although developing countries have expanded digital infrastructure coverage,[77] they still lag advanced economies in coverage and usage.

INVESTMENTS

Investments in submarine cables and so-called last-mile infrastructure, which connects the internet to workplaces and homes, can reduce prices by up to 21 percent and hasten digital adoption.[78] However, closing the digital divide requires more than cables and towers.

Tailor Technology: Investments should be tailored to the level of development of the country or region. Although policies are often technology neutral, the choice between technologies can be critical, particularly due to their cost implications. For example, depending on capacity needs, the cost of achieving the UN's goal of universal broadband in developing countries over the next decade ranges from $520 billion for 4G to $940 billion for 5G non-standalone digital connectivity, a hybrid upgrade from 4G that leverages existing infrastructure. The choice of technology depends on whether a country faces challenges with high traffic demand or the need to cover large, sparsely populated areas. Countries with high traffic demand, such as Pakistan, may benefit from 5G non-standalone digital connectivity to handle the load, while countries with wide geographic areas and low population density, such as Malawi, may find 4G a more cost-effective[79] solution.

Expand Digital Hardware: To realize the benefits of infrastructure investments, they must be matched with investments in affordable devices. Access[80] to mobile devices[81] enables the use of digital platforms[82] that addresses matching frictions and reduces[83] price differences across space and sectors. Thus, they critically contribute to improved marketing decisions and resource allocation, and bolster nonfarm employment and entrepreneurship.

Build Specialized Digital Software and Skills: Digital platforms create new tasks and opportunities[84] for micro and small businesses deploying specialized apps and digital platforms. To expand their use, three aspects are worth considering.

- *Develop targeted and tailored platforms*. For example, a mobile phone-based matching platform that connects agricultural buyers and sellers[85] in Uganda reduced transaction level search costs by 21 percent, facilitating price convergence between regions. Job matching platforms such as Upwork and Freelancer expanded access[86] to employment opportunities across borders, offering flexible arrangements[87] especially beneficial to women and youth.
- *Upskill workers*. The new occupations[88] that will emerge in the coming years are such that equipping workers with new or improved digital, social, and emotional skills will be essential to prevent labor-market bottlenecks. In this context, instruments such as retraining[89] subsidies can ease the transition[90] of displaced workers to new roles.[91]
- *Upgrade businesses*. Training in the use of complementary technology tools and organizational practices,[92] as well as R&D, will be essential to reduce the digital divide among large and small firms, for example.

Coordinate with Physical Infrastructure: The impact of digital infrastructure is amplified by complementary investments in road infrastructure,[93] as estimated in Africa, where employment benefits can increase by 22 percent. Digital connectivity[94] is critically dependent on energy infrastructure,[95] implying that better electricity access[96] boosts usage and attracts FDI[97] in digital infrastructure. Multilateral development banks can forge innovative partnerships integrating energy and internet access to address the demand for reliable electricity and high-speed internet. For example, simultaneous investments[98] in Fenix International and Lumos brought together mobile money with solar home systems in Africa.

FIGURE 7

Investments and policies to leverage digital infrastructure for job creation

INVESTMENTS

- **Tailor technology choice** to country context, costs, and deployment capabilities
- **Expand digital hardware** in computers, affordable mobile handsets
- **Build productive digital software** (e.g., sector and context specific such as bike rider app, retail service); and **Skills of workers and firms** (e.g., digital, socio-emotional)
- **Coordinate with physical infrastructure** (e.g., roads, energy)

REGULATIONS

- **Streamline regulations to reduce cost**: infrastructure sharing, spectrum management auctions, streamlined licensing
- **Harmonize laws to facilitate diffusion**: e-transaction laws, data protection, cybersecurity, etc.
- **Optimize financing models to mobilize capital**: mobilize private financing or public-private partnerships, based on infrastructure type

REGULATIONS

Developing countries pay more[99] and get lower-quality digital services than richer countries. For example, costs are 39 percent higher in Sub-Saharan Africa and 27 percent higher in Latin America. Three distinct areas of regulations are critical for cost, diffusion, and financing of digital infrastructure.

Streamline Regulations to Reduce Costs: Infrastructure sharing,[100] for example, reduces duplication and can save on capital and operational costs[101] by 15 to 72 percent. Effective spectrum management[102] balances efficiency with equity. Streamlined licensing with long-term spectrum licenses provide regulatory certainty, whereas universal service funds help reach underserved areas.[103]

Harmonize Laws to Facilitate Diffusion: Accessibility, security, and trust in digital use require harmonized regulations that enable secure online transactions,[104] protection of data flows, and cybersecurity.[105] Stronger policies are also needed to address anti-competitive practices[106] in digital markets. Market integration can help reduce the prices of goods, services, and labor, which are essential to leverage potential gains from digital infrastructure.

Optimize Financing Models to Mobilize Capital: Financing digital infrastructure can leverage private, public, and public-private partnership models, contingent on regulatory simplification. For example, first-mile (submarine cables, data centers) can possibly be commercially viable through private-led

investment (e.g., Google's Equiano cable); middle-mile (national fiber backbones) could be more amenable to PPPs, such as with India's BharatNet, which includes subsidies to attract private participation to expand rural broadband;[107] while last-mile (rural and underserved areas) might need public financing to address viability gaps.[108]

Unlocking the full potential of digital infrastructure—and the jobs it can create—hinges on mobilizing private investment. Forward-looking reforms that leverage digital collateral and, where appropriate, public guarantees and blended finance, are essential instruments to attract private investment. With these tools, emerging markets can leapfrog old limitations and ignite lasting job growth ■

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Cover Photo: Banking kiosk in Borlai village, India. Photo © IFC

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Endnotes

1 Grover, Arti. "Which Firms Create More Jobs?" August 2025. Emerging Market Insights. Washington, DC: International Finance Corporation, World Bank Group. https://www.ifc.org/en/insights-reports/2025/which-firms-create-more-and-better-jobs.

2 Krishnamurthy, Aparna, Namita Datta, Georges V. Houngbonon, and Todd Cotts. "Broadband Access Spurs Jobs in Hard-to-Reach Areas." August 24, 2020. Washington, DC: World Bank Blogs. https://blogs.worldbank.org/en/jobs/broadband-access-spurs-jobs-hard-reach-areas?

3 Grover, Arti. "Upgrading Businesses for More and Modern Jobs." September 2025. Emerging Market Insights. Washington, DC: International Finance Corporation, World Bank Group. https://www.ifc.org/en/insights-reports/2025/upgrading-businesses-for-more-and-modern-jobs.

4 Jung, Juan, and Enrique López-Bazo. "On the regional impact of broadband on productivity: The case of Brazil." February 2020. Telecommunications Policy, Volume 44, No. 1. https://www.sciencedirect.com/science/article/pii/S0308596118302118.

5 Cariolle, Joel, Maëlan Le Goff, and Olivier Santoni. "Digital Vulnerability and Performance of Firms in Developing Countries." March 1, 2019. Banque de France Working Paper, Working Paper No. 709. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3345014.

6 Viollaz, Mariana. "Information and communication technology adoption in micro and small firms: Can internet access improve labour productivity?" September 2019. Development Policy Review, Volume 37, Issue 5, pp. 692-715. https://onlinelibrary.wiley.com/doi/abs/10.1111/dpr.12373.

7 Bianchi, Nicola, Yi Lu, and Hong Song. "The effect of computer-assisted learning on students' long-term development." December 2020. National Bureau of Economic Research, Working Paper No. 28180. https://www.nber.org/papers/w28180.

8 Hjort, Jonas, and Jonas Poulsen. "The Arrival of Fast Internet and Employment in Africa." March 2019. American Economic Review, Volume 109, No. 3, pp. 1,032-1,079. https://www.aeaweb.org/articles?id=10.1257/aer.20161385.

9 Caldarola, Bernardo, Marco Grazzi, Martina Occelli, and Marco Sanfilippo. "Mobile internet, skills and structural transformation in Rwanda." 2023. International Labour Organization. ILO Working Paper 60. https://researchrepository.ilo.org/esploro/outputs/encyclopediaEntry/995218861502676.

10 Aker, Jenny C. "Information from Markets Near and Far: Mobile Phones and Agricultural Markets in Niger." July 2010. American Economic Journal, Volume 2, No. 3, pp. 46-59. https://www.aeaweb.org/articles?id=10.1257%2Fapp.2.3.46.

11 Jensen, Robert. "The Digital Provide: Information (Technology), Market Performance, and Welfare in the South Indian Fisheries Sector." August 2007. The Quarterly Journal of Economics, Volume 122, No. 3, pp. 879-924. https://www.jstor.org/stable/25098864?seq=1.

12 Chen, Maggie X., and Min Wu. "The Value of Reputation in Trade: Evidence from Alibaba." December 2021. The Review of Economics and Statistics, MIT Press, Volume 103, Issue 5, pp. 857-873. https://ideas.repec.org/a/tpr/restat/v103y2021i5p857-873.html.

13 Wheeler, Laurel, Robert Garlick, Eric Johnson, Patrick Shaw, and Marissa Gargano. "LinkedIn(to) Job Opportunities: Experimental Evidence from Job Readiness Training." April 2022. American Economic Journal: Applied Economics, American Economic Association, Volume 14, No. 2, pp. 101-125. https://www.aeaweb.org/articles?id=10.1257/app.20200025.

14 Silue, Tarna, Valerie Mueller, Davide Strusani, and David Harrison. "The Undersea Infrastructure Bringing More People Online in Emerging Markets." July 2025. Emerging Market Insights. Washington, DC: International Finance Corporation, World Bank Group. https://www.ifc.org/en/insights-reports/2025/undersea-infrastructure-bringing-more-people-online-in-emerging-markets?

15 Hjort and Poulsen, "The Arrival of Fast Internet and Employment in Africa."

16 Klonner, Stefan, and Patrick J. Nolen. "Cell Phones and Rural Labor Markets: Evidence from South Africa." 2010. Proceedings of the German Development Economics Conference, Hannover 2010 56, Verein für Socialpolitik, Research Committee Development Economics. https://ideas.repec.org/p/zbw/gdec10/56.html?

17 Bahia, Kalvin, Pau Castells, Genaro Cruz, Takaaki Masaki, Xavier Pedrós, Carlos Rodríguez-Castelán, Hernán Winkler, and Tobias Pfutze. "The Welfare Effects of Mobile Broadband Internet: Evidence from Nigeria." May 7, 2020. Policy Research Working Paper, No. 9230. Washington, DC: The World Bank. https://openknowledge.worldbank.org/entities/publication/c7b2bf6d-e12f-5792-9082-78f193962f85.

18 Bahia, Kalvin, Pau Castells, Genaro Cruz, Takaaki Masaki, Carlos Rodríguez-Castelán, and Viviane Sanfelice. "Mobile Broadband, Poverty, and Labor Outcomes in Tanzania." May 2023. The World Bank Economic Review, Volume 37, Issue 2, pp. 235-256. https://academic.oup.com/wber/article/37/2/235/7028405.

19 Chiplunkar, Gaurav, and Pinelopi Koujianou Goldberg. "The employment effects of mobile internet in developing countries." December 2022. National Bureau of Economic Research, NBER Working Paper No. 30741. https://www.nber.org/system/files/working_papers/w30741/w30741.pdf.

20 Kelley, Erin M., Christopher Ksoll, and Jeremy R. Magruder. "How do digital platforms affect employment and job search? Evidence from India." 2024. Journal of Development Economics, Volume 166. https://ideas.repec.org/a/eee/deveco/v166y2024ics0304387823001323.html.

21 Chen, Shiyi, Wanlin Liu, and Hong Song. "Broadband internet, firm performance, and worker welfare: Evidence and mechanism." November 5, 2019. Economic Inquiry, Volume 58, Issue 3, pp. 1,146-1,166. https://onlinelibrary.wiley.com/doi/abs/10.1111/ecin.12854.

22 Poliquin, Christopher W. "The wage and inequality impacts of broadband internet." Dec. 11, 2018. University of California, Los Angeles. https://scholar.google.com/citations?view_op=view_citation&hl=en&user=WHvJ-90AAAAJ&citation_for_view=WHvJ-90AAAAJ:Tyk-4Ss8FVUC.

23 Begazo, Tania, Moussa P. Blimpo, and Mark A. Dutz. "Digital Africa: Technological Transformation for Jobs." May 18, 2022. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/7bc68e4b-c73d-42bd-8c71-4e96b2ec03dd.

24 Hjort and Poulsen, "The Arrival of Fast Internet and Employment in Africa."

25 Hjort and Poulsen, "The Arrival of Fast Internet and Employment in Africa."

26 Choi, Jieun, Kaleb Abreha, Hyun Ju Kim, Woubet Kassa, and Maurice Kugler. "Mobile Access Expansion and Price Information Diffusion: Firm Performance after Ethiopia's Transition to 3G in 2008." 2021. Policy Research Working Paper Series 9752, Washington, DC: The World Bank. https://openknowledge.worldbank.org/entities/publication/99dab416-9019-5e54-a97f-097fee92f2d3.

27 Caldarola et al., "Mobile internet, skills and structural transformation in Rwanda."

28 Bahia et al., "Mobile Broadband, Poverty and Labor Outcomes in Tanzania.".

29 Bahia et al., "The Welfare Effects of Mobile Broadband Internet: Evidence from Nigeria."

30 Klonner and Nolen, "Cell Phones and Rural Labor Markets."

31 Wieser, Christina, Johannes Kinzinger, Christian Ruckteschler, Soren Heitmann, Miriam Bruhn. "The Impact of Mobile Money on Poor Rural Households: Experimental Evidence from Uganda."

2019. The World Bank, Policy Research Working Paper, No. 8913. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/a9d2abd1-22eb-5e88-b882-708ad9a721d6.

32 Cariolle et al., "Digital Vulnerability and Performance of Firms in Developing Countries."

33 Almeida, Rita K., Carlos H.L. Conseuil, and Jennifer Poole. "The Impact of Digital Technologies on Worker Tasks: Do Labor Policies Matter?" 2017. CESifo Working Paper, No. 6798, Center for Economic Studies and ifo Institute, Munich. https://www.ifo.de/en/cesifo/publications/2017/working-paper/impact-digital-technologies-worker-tasks-do-labor-policies-matter.

34 Chen, et al., "Broadband internet, firm performance, and worker welfare."

35 Almeida et al., "The Impact of Digital Technologies on Worker Tasks."

36 Masaki, Takaaki; Rogelio Granguillhome Ochoa, Carlos Rodriguez-Castelan. 2020. "Broadband Internet and Household Welfare in Senegal." 2020. The World Bank, Policy Research Working Paper, No. 9386. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/9d7b0765-b3d2-510c-91fd-18444766fd39.

37 Chiplunkar and Goldberg, "The employment effects of mobile internet in developing countries."

38 Begazo et al., "Digital Africa."

39 Choi et al. "Mobile Access Expansion and Price Information Diffusion."

40 Begazo et al., "Digital Africa."

41 Bahia et al., "Mobile Broadband, Poverty and Labor Outcomes in Tanzania."

42 Jung and López-Bazo, "On the regional impact of broadband on productivity."

43 Card, David, and John E. DiNardo. "Skill Biased Technological Change and Rising Wage Inequality: Some Problems and Puzzles." February 2002. National Bureau of Economic Research, Working Paper 8769. https://www.nber.org/papers/w8769.

44 Goos, Maarten, Alan Manning, and Anna Salomons. "Explaining Job Polarization: Routine-Biased Technological Change and Offshoring." August 2014. American Economic Review, Volume 104, No. 8, August 2014, pp. 2,509-2,526. https://www.aeaweb.org/articles?id=10.1257/aer.104.8.2509.

45 Akerman, Anders, Ingvil Gaarder, and Magne Mogstad. "The Skill Complementarity of Broadband Internet." November 2015. The Quarterly Journal of Economics, Volume 130, Issue 4, pp. 1,781-1,824. https://academic.oup.com/qje/article/130/4/1781/1916342.

46 Bianchi et al., "The effect of computer-assisted learning on students' long-term development."

47 Caldarola et al., "Mobile internet, skills and structural transformation in Rwanda."

48 Bahia et al., "The Welfare Effects of Mobile Broadband Internet: Evidence from Nigeria."

49 Caldarola at al., "Mobile internet, skills and structural transformation in Rwanda."

50 Grover, Arti, Leonardo Iacovone, and Pavel Chakraborty. "Management Practices in Croatia: Drivers and Consequences for Firm Performance." November 22, 2019. World Bank Policy Research Working Paper, No. 9067. Washington, DC: World Bank Group. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3492150.

51 Cirera, Xavier, Diego Adolfo Comin, Marcio Jose Vargas da Cruz. "Bridging the Technological Divide: Technology Adoption by Firms in Developing Countries (English). Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/099825106302219640. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099825106302219640/p1708809e255d0b40bbf40847e1e110f67.

52 Caldarola et al., "Mobile internet, skills and structural transformation in Rwanda."

53 Caldarola et al., "Mobile internet, skills and structural transformation in Rwanda."

54 Isley, Catherine, and Sarah A. Low. "Broadband adoption and availability: Impacts on rural employment during COVID-19." August 2022. Telecommunications Policy, Volume 46, Issue 7. https://www.sciencedirect.com/science/article/pii/S0308596122000143?via%3Dihub.

55 Sun, Tao. "Digital Banking Support to Small Businesses amid COVID-19: Evidence from China." June 29, 2021. IMF Global Financial Stability Notes, No. 2021-002. Washington, DC: International Monetary Fund. https://www.imf.org/en/Publications/global-financial-stability-notes/Issues/2021/06/29/Digital-Banking-Support-to-Small-Businesses-amid-COVID-19-460500.

56 Zouaidi, Marwane, and Daniel Lederman. "Incidence of the Digital Economy and Frictional Unemployment: International Evidence." 2020. World Bank Policy Research Working Paper, No. 9170. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/fc540c08-e14d-5952-be92-8ad1a2bc85de.

57 Vivarelli, Marco. "Globalization, Structural Change, and Technological Change in Emerging Economies: The Impact on Employment and Skills." March 2021. "New Perspective on Structural Change: Causes and Consequences of Structural Change in the Global Economy," Chapter 25, pp. 596-621. https://academic.oup.com/book/39572/chapter/339467829.

58 Chiplunkar and Goldberg, "The employment effects of mobile internet in developing countries."

59 Bahia et al., "Mobile Broadband, Poverty and Labor Outcomes in Tanzania."

60 Chiplunkar and Goldberg, "The employment effects of mobile internet in developing countries."

61 Chun, Natalie, and Heiwai Tang. "Do Information and Communication Technologies Empower Female Workers? Firm-Level Evidence from Viet Nam." May 2018. Asian Development Bank. ADB Economics Working Paper Series, No. 545. https://www.adb.org/publications/do-ict-empower-female-workers-viet-nam.

62 Ho, Lisa, Suhani Jalota, and Anahita Karandikar. "Bringing Work Home: Flexible Arrangements as Gateway Jobs for Women in West Bengal." January 1, 2024. STEG Working Paper Series. https://steg.cepr.org/publications/bringing-work-home-flexible-arrangements-gateway-jobs-women-west-bengal.

63 Juhn, Chinhui, Gergely Ujhelyi, and Carolina Villegas-Sanchez. "Trade Liberalization and Gender Inequality." May 2013. American Economic Review, Volume 103, No. 3, pp. 269-273. https://www.aeaweb.org/articles?id=10.1257%2Faer.103.3.269.

64 Bahia et al., "The Welfare Effects of Mobile Broadband Internet: Evidence from Nigeria."

65 Viollaz, Mariana, and Hernán Winkler. "Does the Internet Reduce Gender Gaps? The Case of Jordan." September 24, 2021. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/a27ce626-2eff-5738-8087-338fa28e881e.

66 Klonner and Nolen, "Cell Phones and Rural Labor Markets."

67 Chiplunkar and Goldberg, "The employment effects of mobile internet in developing countries."

68 Bahia et al., "Mobile Broadband, Poverty and Labor Outcomes in Tanzania."

69 Demir, Banu, Grover, Arti. and Javorcik, Beata. "Work, Wages, and Wires: Gendered Impacts of Digital Infrastructure." Unpublished mimeo.

70 Demir et al., "Work, Wages, and Wires."

71 Chun and Tang, "Do Information and Communication Technologies Empower Female Workers?"

72 Yrjola, Seppo. "Technology Antecedents of the Platform-Based Ecosystemic Business Models beyond 5G." April 2020. 2020 IEEE Wireless Communications and Networking Conference Workshops. https://ieeexplore.ieee.org/document/9124823.

73 Chiplunkar and Goldberg, "The employment effects of mobile internet in developing countries."

74 Bahia et al., "Mobile Broadband, Poverty and Labor Outcomes in Tanzania."

75 Suri, Tavneet, and William Jack. "The long-run poverty and gender impacts of mobile money." December 9, 2016. Science, Volume 354, Issue 6317, pp. 1,288-1,292. https://www.science.org/doi/full/10.1126/science.aah5309.

76 The World Bank, "The World Bank Annual Report 2022." Alper, C. Emre, and Michal Miktus. "Bridging the Mobile Digital Divide in Sub-Saharan Africa: Costing under Demographic Change and Urbanization." November 2019. IMF Working Paper No. 19/249. https://ssrn.com/abstract=3523121.

77 Begazo et al., "Digital Africa."

78 International Finance Corporation. "IFC Annual Report 2024: Accelerating Impact – Mobilizing Investment at Scale." 2024. Washington, DC: The World Bank Group. https://openknowledge.worldbank.org/entities/publication/ca4a252f-8f57-4bfe-977e-8340d186c873.

79 Oughton, Edward J., Niccolo Comini, Vivien Foster, and Jim W. Hall. "Policy Choices Can Help Keep 4G and 5G Universal Broadband Affordable." March 4, 2021. The World Bank, Policy Research Working Paper, No. 9563. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/a47d7636-8eb6-50cd-b535-deda24ac800f.

80 Krell, Natasha, Frank Davenport, Laura Harrison, William Turner, Seth Peterson, Shraddhanand Shukla, Jessica Marter-Kenyon, Greg Husak, Tom Evans, and Kelly Caylor. 2022. "Using real-time mobile phone data to characterize the relationships between small-scale farmers' planting dates and socio-environmental factors." Climate Risk Management, Volume 35. https://www.sciencedirect.com/science/article/pii/S2212096322000031?via%3Dihub.

81 Mittal, Surabhi, and Mamta Mehar. "How Mobile Phones Contribute to Growth of Small Farmers? Evidence from India." August 2012. Quarterly Journal of International Agriculture, Volume 51, No. 3, pp. 1-18. https://ideas.repec.org/a/ags/qjiage/155478.html.

82 Fafchamps, Marcel, and Bart Minten. "Impact of SMS-Based Agricultural Information on Indian Farmers." 2012. The World Bank Economic Review, Volume 26, Issue 3, pp. 383-414. Washington, DC: The World Bank. https://openknowledge.worldbank.org/entities/publication/ab5b7613-f789-5827-9761-a510b21b6d30.

83 Mitra, Sandip, Dilip Mookherjee, Maximo Torero, and Sujata Visaria. "Asymmetric Information and Middleman Margins: An Experiment with Indian Potato Farmers." March 2018. The Review of Economics and Statistics, Volume 100, No. 1, pp. 1-13. https://ideas.repec.org/a/tpr/restat/v100y2018i1p1-13.html.

84 The World Bank Group. "World Bank East Asia and the Pacific Economic Update, October 2024: Jobs and Technology." October 7, 2024. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/034dfb5a-339e-4551-89de-b533062b9a1b.

85 Bergquist, Lauren F., Craig McIntosh, and Meredith Startz. "Search Costs, Intermediation, and Trade: Experimental Evidence from Ugandan Agricultural Markets." December 2024. National Bureau of Economic Research. Working Paper No. 33221. https://www.nber.org/papers/w33221.

86 The World Bank. "The World Bank Annual Report 2019: Ending Poverty, Investing in Opportunity." October 1, 2019. Washington, DC: The World Bank Group. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/156691570147766895/the-world-bank-annual-report-2019-ending-poverty-investing-in-opportunity.

87 Kuek, Siou Chew, Cecilia Paradi-Guilford, Toks Fayomi, Saori Imaizumi, Panos Ipeirotis, Patricia Pina, and Manpreet Singh. "The Global Opportunity in Online Outsourcing." June 2015. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/27669e15-dd9d-59ec-a32c-b3b2ce4f6906.

88 Behuria, Pritish, and Tom Goodfellow. "Leapfrogging Manufacturing? Rwanda's Attempt to Build a Services-Led 'Developmental State.' " July 2019. The European Journal of Development Research, Volume 31, No. 3, pp. 581-603. https://ideas.repec.org/a/pal/eurjdr/v31y2019i3d10.1057_s41287-018-0169-9.html.

89 Schmidpeter, Bernhard, and Rudolf Winter-Ebmer. "Automation, unemployment, and the role of labor market training." 2021. European Economic Review, Volume 137. https://ideas.repec.org/a/eee/eecrev/v137y2021ics0014292121001549.html.

90 Bürgisser, Reto. "Policy Responses to Technological Change in the Workplace." 2023. Center for Open Science. https://ideas.repec.org/p/osf/socarx/kwxn2.html?

91 Humlum, Anders. "Robot Adoption and Labor Market Dynamics." November 2019. The University of Chicago. https://www.semanticscholar.org/paper/Robot-Adoption-and-Labor-Market-Dynamics-Humlum/9c546d533fcb3fodf9974dc78332b94a53a629cf.

92 Bresnahan, Timothy F., Erik Brynjolfsson, and Lorin M. Hitt. "Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence." February 2002. The Quarterly Journal of Economics, Volume 117, No. 1, pp. 339-376. https://www.jstor.org/stable/2696490.

93 Lebrand, Mathilde, Arcady Mongoue, Roland Pongou, and Fan Zhang. "Does Africa Need More Roads in the Digital Age?: Evidence of Complementarities in Infrastructure." 2024. The World Bank, Policy Research Working Paper, No. 10730. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/dabed8ed-7f45-4f82-9c76-d41aae1d07af.

94 Van Heddeghem, Ward, Sofie Lambert, Bart Lannoo, Didier Colle, Mario Pickavet, and Piet Demeester. "Trends in worldwide ICT electricity consumption from 2007 to 2012." September 2014. Computer Communications, Volume 50, No. 1, pp. 64-76. https://www.sciencedirect.com/science/article/abs/pii/S0140366414000619.

95 Lin, Boqiang, and Chenchen Huang. "How will promoting the digital economy affect electricity intensity?" February 2023. Energy Policy, Volume 173. https://www.sciencedirect.com/science/article/abs/pii/S0301421522005602?casa_token=fvBYFoeE9VsAAAAA%3AflFfGAKKhq_Rue8hg5WU3ZlDKRi-yUytZnx6KtK8uRDI_eLYoMgHDNWwn1QzyfMVeqOBImSxoQuH%22+%5Cl+%22bib9.

96 Houngbonon, Georges V., Erwan Le Quentrec, and Stefania Rubrichi. "Access to electricity and digital inclusion : evidence from mobile call detail records." July 14, 2021. Humanities and Social Sciences Communications, Volume 8, No. 170. https://www.nature.com/articles/s41599-021-00848-0.

97 Mensah, Justice Tei, and Nouhoum Traore. "Infrastructure Quality and FDI Inflows Evidence from the Arrival of High-Speed Internet in Africa." The World Bank, Policy Research Working Paper, No. 9946. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/f572328f-5ffa-5aee-80c8-e5e31ce1c41a.

98 The World Bank Group. "Off-Grid Solar Market Trends Report 2022: Outlook." October 14, 2022. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/97ae6fbe-3373-5f10-8d3d-a82be5481eca.

99 Cruz, Marcio, and editors. "Digital Opportunities in African Businesses." May 16, 2024. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/cadfc37b-e2ff-4ff9-a79b-b8b7245a296c.

100 Oladejo, Sunday Oladayo, and Olabisi Emmanuel Falowo. "Latency-Aware Dynamic Resource Allocation Scheme for Multi-Tier 5G Network: A Network Slicing-Multitenancy Scenario." 2020. IEEE Access, Volume 8. https://ieeexplore.ieee.org/document/9072146/similar#similar.

101 Oughton et al., "Policy Choices Can Help Keep 4G and 5G Universal Broadband Affordable."

102 Cave, Martin, and Neil Pratt. "Taking account of service externalities when spectrum is allocated and assigned." October 2016. Telecommunications Policy, Volume 40, Issues 10-11, pp. 971-981. https://www.sciencedirect.com/science/article/abs/pii/S0308596116300301.

103 OECD. "Education at a Glance 2018: OECD Indicators." September 11, 2018. Paris: OECD Publishing. https://www.oecd.org/en/publications/education-at-a-glance-2018_eag-2018-en.html.

104 Banerjee, Pritam, Arti Grover, Sanjay Kathuria, Aaditya Mattoo, and Viviana Maria Eugenia Perego. "Unleashing E-Commerce for South Asian Integration." November 2019. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/149301574840045883.

105 Vergara Cobos, Estefania. "Cybersecurity Economics for Emerging Markets." September 17, 2024. Washington, DC: World Bank Group. https://openknowledge.worldbank.org/entities/publication/4ec1bf22-3658-4d69-b9d3-43122254bc66.

106 Crémer, Jacques, Yves-Alexandre de Montjoye, and Heike Schweitzer. "Competition policy for the digital era." 2019. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/21dc175c-7b76-11e9-9f05-01aa75ed71a1/language-en.

107 Crémer et al., "Competition policy for the digital era."

108 Gerli, Paolo, Marlies Van der Wee, Sofie Verbrugge, and Jason Whalley. "The involvement of utilities in the development of broadband infrastructure: A comparison of EU case studies." 2018. Telecommunications Policy, Volume 42, No. 9, pp. 726-743. https://ideas.repec.org/a/eee/telpol/v42y2018i9p726-743.html.