Policy Research Working Paper 9946

Infrastructure Quality and FDI Inflows

Evidence from the Arrival of High-Speed Internet in Africa

Justice Tei Mensah
Nouhoum Traore

WORLD BANK GROUP
International Finance Corporation
February 2022

Policy Research Working Paper 9946

Abstract

Does ambient infrastructural quality affect foreign direct investment (FDI) in developing countries? This paper investigates how the arrival of high-speed Internet in Africa triggered FDI to the region. It also explores the role of complementary infrastructure, such as access to electricity and road connectivity, in amplifying the impact of Internet connectivity on investment. The identification strategy exploits plausibly exogenous variations in access to high-speed Internet induced by the staggered arrival of submarine fiber-optic Internet cables and spatial variations in terrestrial fiber cable networks across locations on the continent. Findings from the paper show that access to high-speed Internet induces FDI, particularly in the service sector, with the finance, technology, retail and health services subsectors as the main beneficiaries. Access to (hard) infrastructure such as electricity and roads, amplifies the impact of Internet connectivity on FDI, thus highlighting the role of complementarities in the impact of infrastructure. Further, the results suggest that improvement in quality of governance, and increased performance of incumbent firms are plausible mechanisms.

This paper is a product of the Development Impact Department, International Finance Corporation. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at http://www.worldbank.org/prwp. The authors may be contacted at jmensah2@ifc.org and ntraore3@ifc.org.

Infrastructure Quality and FDI Inflows: Evidence from the Arrival of High-Speed Internet in Africa*

Justice Tei Mensah[†] Nouhoum Traore[‡]

Originally published in the Policy Research Working Paper Series on *February 2022*. This version is updated on *March 2023*.
To obtain the originally published version, please email prwp@worldbank.org.

JEL: O12, O16, F21, F23, G21, N77
Key words: High-speed Internet, FDI, Services, Banking, Technology, Africa

*We thank seminar participants at the IFC and World Bank for their helpful comments. Comments and support from Moussa Blimpo, Mark Dutz, Albert Zeufack, Valentina Saltane, Camilo Mondragon-Velez, and Issa Faye are deeply appreciated. This paper was supported by the research program at IFC's Sector Economics and Development Impact Department. The paper is also a background paper for the World Bank Flagship Report on "Digital Africa". All errors and views expressed in this paper are those of the authors. They do not necessarily represent the views of the International Finance Corporation/World Bank Group.

[†]Office of The Chief Economist, Africa Region, The World Bank. Email:jmensah2@worldbank.org
[‡]International Finance Corporation, The World Bank Group. Email:ntraore3@ifc.org

1 Introduction

Foreign direct investment (FDI) is an important driver of economic growth as it facilitates technology transfer and job creation in host economies (Smarzynska Javorcik, 2004; Toews and Vézina, 2021).[1] As a result, countries embark on massive investment promotion drives aimed at reducing the transaction costs of investors by providing them with easy access to information on investment opportunities in the country, including understanding and overcoming the legal and regulatory hurdles involved in setting up businesses in the country (Harding and Javorcik, 2011). In addition, some countries undertake structural reforms to liberalize their economies, offering, among other things, tax holidays for investors to make their economies attractive investment locations (Reinikka and Svensson, 1999; Harding and Javorcik, 2011) for investors who are attracted to countries with low costs of doing business (Amiti and Javorcik, 2008). In spite of these incentives, some countries still struggle to attract FDI due to low-quality infrastructure and its implications for the cost of doing business (Reinikka and Svensson, 1999).

In this paper, we show causal evidence of the impact of infrastructure quality on investment flows to developing countries by leveraging the arrival of high-speed Internet to Africa as a unique natural experiment. Between 2000 and 2012, Africa experienced a significant improvement in its Internet landscape with the arrival of several submarine fiber-optic Internet cables linking the continent to the global Internet network via Europe (Figure 1). Prior to this, Internet transmissions to the continent were mainly through satellite, which was characterized by low bandwidth speed and high cost of service. The submarine cables brought faster Internet speeds at relatively low cost, thereby increasing uptake of Internet for commercial and household uses. The arrival of fast Internet via submarine cables was particularly beneficial to the banking and finance sector, as it enabled the adoption of financial technologies (Fintech) such as Internet banking and real-time gross settlement system (RTGS), leading to an increase in economic activities in the sector (D'Andrea and Limodio, 2019). The technology sector also benefited, as the availability of high-speed Internet created supply and demand for technology services.[2] Similarly, shown by Hjort and Poulsen (2019), manufacturing and service sector firms experienced increased performance following the arrival of the submarine Internet cables and subsequent connection to inland towns and cities via the terrestrial fiber backbone networks. We interpret high-speed Internet connection as a positive technological shock that led to an expansion in the productive sectors with possible implications on demand for investments in these sectors.

Therefore, our goal is to show how the arrival of high-speed Internet triggered FDI in the var-

[1] There is also a large body of literature showing mixed evidence on the impact of FDI on destination markets. See for instance, Edwards and Jenkins (2015), Abebe et al. (2018) and Crescenzi and Limodio (2021)

[2] See for example: https://www.bbc.com/news/technology-46055595

ious sectors in Africa. In addition, we explore the role of complementary infrastructure, such as access to electricity and roads, in amplifying the impact of Internet connectivity. To this end, we assemble unique project-level data on sectoral FDI together with data on Internet infrastructure to estimate the spillover effects of fast Internet connectivity on FDI flows. The spatial and time granularity of our datasets allows us to undertake the analysis at the subnational level. Our identification strategy is a difference-in-difference (DiD) design that relies on the plausibly exogenous variation in access to high-speed Internet induced by the staggered arrival of submarine Internet cables across countries and the spatial variation in access to the terrestrial fiber backbone network within countries. Essentially, we compare districts connected to the terrestrial fiber network to those unconnected, and explore the changes in the FDI flows to these districts before and after the arrival of the submarine cables in the respective countries.

Three main findings emerge from the analysis. First, the arrival of high-speed Internet played a key role in stimulating FDI to Africa. However, the effects are largely concentrated in the service sector, with finance, technology, health and retail subsectors as the main beneficiaries. The effect on FDI in services is statistically and economically significant in both the intensive and extensive margins. On the extensive margin, the probability of a subnational district receiving FDI in services increases by 5.7 percentage points (pp) following the arrival of high-speed Internet connectivity. On the intensive margin, access to high-speed Internet connectivity is associated with a 9.6% and 23.6% increase the number and value of FDI in services. Within the service sector, we find positive and statistically significant effects of Internet connectivity on FDI into the various subsectors, viz, finance, technology, health and retail. The effects of the submarine Internet cables on FDI in other sectors such as manufacturing, energy and construction were not statistically significant.

Second, our findings show that the effects of high-speed Internet connectivity on FDI pertain largely to subnational districts with high access to complementary infrastructure such as electricity and roads. Electricity access, in particularly, plays a key role in amplifying the effect of Internet connectivity in attracting investment. This is largely due to the fact that access to electricity is essential in powering devices such as computers and mobile phones that use the Internet. Thus, the findings from this paper underscore the important role of complementary infrastructure, such as access to electricity and roads, in amplifying the economic impact of Internet services in developing countries.

Finally we provide suggestive evidence on two potential mechanisms: (i) access to high-speed Internet connectivity is associated with improvement in the quality of governance. Access to Internet reduces information friction and enhances reporting and scrutiny, thereby enabling citizens to demand greater accountability from their governments. The improvement in the quality of governance makes countries attractive for investment as it reduces uncertainties and cost of doing business. (ii) Access to internet is associated with an increase in performance of incumbent firms due to the expansion in market opportunities for both firms and consumers enabled by Internet connectivity. This increase in firm performance (proxied by sales) is a potential signal of the perceived high returns on investment to investors, thereby resulting in high FDI inflows.

This paper contributes to two strands of the literature. First, it offers a novel contribution to the literature on the drivers of FDI in developing countries. A growing number of studies have focused on the role of deliberate government policies, such as investment promotion initiatives (Harding and Javorcik, 2011, 2012), and business regulations (Arita et al., 2013), in attracting FDI. Harding and Javorcik (2011), for instance, show that investment promotions are effective in attracting FDI, particularly in countries with cumbersome business regulations and information asymmetries.[3] Toews and Vézina (2021) also present evidence that natural resource booms trigger FDI in non-extractive sectors. Evidence from other studies also shows that non-economic factors, such as cultural ties between countries, influence FDI flows across countries. For instance, using a quasi-random allocation of refugees in the United States induced by the 1980 Refugee Act, Mayda et al. (2019) show evidence of greater outward FDI flow to the origin countries of refugees from US states with higher concentration of refugees. In spite of these compelling evidence, little is known about the premium that foreign investors place on the quality of infrastructural services in destination markets when they are assessing investment opportunities. Findings from this study therefore provide an important contribution to the literature by demonstrating the infrastructure premium in attracting FDI.

Second, this paper contributes to the emerging strand of literature on the economic impacts of modern infrastructure, such as Internet and electricity, in developing and emerging economies (Hjort and Tian, 2021). The arrival of high-speed Internet in Africa has been a topic of growing interest to many researchers (Hjort and Poulsen, 2019; D'Andrea and Limodio, 2019; Ouedraogo et al., 2020; Goldbeck and Lindlacher, 2021). By leveraging the gradual arrival of submarine Internet cables in Africa, Hjort and Poulsen (2019) show that access to high-speed Internet increases employment for skilled and unskilled labor. Firms also benefited through productivity improvements. D'Andrea and Limodio (2019) show that access to high-speed Internet led to a boom in the financial sector as it enabled technology adoption among African banks. These positive impacts of Internet connectivity on job creation (Hjort and Poulsen, 2019) and technology adoption (D'Andrea and Limodio, 2019) translated into high economic growth in Africa (Goldbeck and Lindlacher, 2021). These induced impacts on jobs creation and

[3]That may be induced by language and cultural distance.

technology adoption also translated in economic growth as shown by Goldbeck and Lindlacher (2021). Thus, consistent with D'Andrea and Limodio (2019), our findings of a positive impact of high-speed Internet on FDI in the banking sector provide suggestive evidence on the channels through which access to high-speed Internet stimulates financial development. Findings on the complementary role of access to electricity are also consistent with Andersen and Dalgaard (2013) and Mensah (2018), who show that (unreliable) electricity provision is a challenge to economic development in Africa.

The rest of the paper proceeds as follows. In Section 2, we present the conceptual framework linking Internet to investment in service (finance and technology) sectors. Section 3 describes the data used in the analysis while the identification strategy is outlined in Section 4. We present and discuss the findings in Section 5. We discuss potential mechanisms and robustness checks in Sections 6 and 7 respectively. Section 8 concludes the paper with a summary of main findings.

2 Conceptual Framework

In this paper, we hypothesize that access to high-speed Internet is likely to trigger investments in low-income countries with the service sector as the most likely beneficiary, as Internet connectivity will enable faster adoption of Internet in the sector. Subsectors such as retail, finance and technology services are also potential beneficiaries. In this section, we describe how Internet connectivity increases technology adoption in the financial services and technology sectors, and consequently its effects on the development of these sectors to illustrate the spillover effects of access to high-speed Internet on investments.

2.1 High-Speed Internet and FDI in Financial Services

Financial technologies, popularly referred to as "Fintech" have changed the banking and finance landscape around the world by reducing costs and improving efficiencies of financial intermediation. The banking sector has historically been organized around manual processing, with customers going to banking halls to make deposits and withdrawals. Interbank payments were settled via a netting system: a system of deferred payments, usually until the end of a business day, before all payments were tallied and funds exchanged among participating institutions (Bech et al., 2007). This affected the pace and volume of interbank transactions. The advent of modern technologies such as the Internet enabled the adoption of Fintech, such as Internet banking and the real-time gross settlement system (RTGS).

RTGS enables a one-to-one exchange of money and securities between banks (financial institutions) in real time without needing to bundle or net them with other trades (D'Andrea and Limodio, 2019). The real time nature of interbank settlement under the RTGS means that huge volumes of transactions can be made in an efficient manner. Thus, RTGS adoption is associated with a significant reduction in the cost of interbank settlements and improves efficient integration of the financial sector (Townsend, 1978; Guerrieri and Lorenzoni, 2009; D'Andrea and Limodio, 2019). This has positive implications for the performance of the banking sectors, as a reduction in the cost of interbank lending leads to an increase in interbank borrowing as well as an expansion in credit to the private sector (D'Andrea and Limodio, 2019). Thus, RTGS plays an important role in the development of the financial sector. The adoption of RTGS is relatively recent. As of 1986, only four countries (Denmark, Netherlands, Sweden, and the United States) had adopted the RTGS, increasing to 93 (including 11 in Africa) by 2006 (Bech et al., 2007). Today, almost all countries have adopted some form of RTGS.

What influenced the adoption of RTGS across countries? Aside from regulatory and policy reforms, access to high-speed Internet is a key determinant of RTGS uptake across the world. As a real-time exchange, RTGS requires fast and reliable interconnection among parties. D'Andrea and Limodio (2019), for instance, show that the arrival of high-speed Internet in Africa led to an increase in the adoption of RTGS. As a result, banks significantly reduced their liquidity hoarding, while interbank transactions and lending to customers increased. Essentially, the findings from D'Andrea and Limodio (2019) suggest that access to high-speed Internet in Africa led to a boom in the financial sector.

Automation of banking sector operations is another channel through which Internet access influences the banking sector. Internet banking and other seamless banking operations (e.g., ATMs, debit/credit cards) have enabled banks to overcome the constraints of traditional "brick-and-mortar" banking to provide fast and cost-effective services to clients. This reduces overhead costs, allowing banks to stay competitive.

In this paper, we hypothesize that the positive impacts of Fintech, such as RTGS and Internet banking uptake by banks, are channels through which access to high-speed Internet influences investment in the banking (financial) sector. For instance, a booming financial sector via the adoption of RTGS increases competition and creates new opportunities for investment in the sector.

2.2 High-speed Internet and FDI in Technology Services

Further, we argue that the demand and supply of digital services associated with Internet use are the key channels through which high-speed Internet connectivity influences investment in the technology services sector.

From a demand perspective, increasing uptake of broadband Internet, particularly among Africa's growing middle class, has fueled demand for digital services, such as online entertainment, social networking, online banking, e-payments, telemedicine, and e-commerce. Demand for these services is particularly high when they are made in Africa or have content tailored for the African market, creating opportunities for digital firms that provide these services. For instance, content aggregation companies like iROKOtv in Nigeria have been providing streaming services to viewers in Africa and the diaspora over the past decade focused solely on African movies. Netflix has recently entered the space by establishing its Africa office in Nigeria with the aim of tapping into Africa's movie industry. Social media companies like Twitter and Facebook have also set up offices in Africa, while ride-sharing companies like Uber and Bolt are present in many African countries. Thus, as Africa's young and booming population, rapid urbanization, and expansion in Internet connectivity contribute to increasing the continent's share of population with an online presence, there are huge economic prospects for the development of a digital economy on the continent. These trends are expected to catalyze investments into the technology services sector to meet the growing demand for digital services.

Secondly, from the supply-side, access to fast Internet has created a "launch pad" for digital entrepreneurship in Africa (Manyika et al., 2013). With the rising demand for digital services and the low concentration of tech companies on the continent, a new generation of tech entrepreneurs is rising in Africa. In many countries across the continent, young and vibrant entrepreneurs are establishing start-ups in such areas as mobile payments, online retail, e- transport and logistics, and e-learning. For instance, in Nigeria alone, Konga and Jumia have become major online retailers, while Kobo360—an e-logistics company—is expanding and providing freight transport services to clients in the country.[4] In Kenya, Twiga Foods operates a digital platform that connects manufacturing firms and consumers with informal market vendors, thereby reducing the inefficiencies in the agricultural value chain.

Further, access to fast Internet creates opportunities for business process outsourcing (BPO) firms. BPOs cover a range of activities, from data collection, entry, and processing to responding to calls from customers. With relatively low labor costs and a rising share of the educated labor force, access to quality infrastructure, such as high-speed Internet, provides a competitive advantage for African firms to attract outsourcing contracts from multinationals in developed economies (Mann and Friederici, 2015). Notable examples of successful BPOs include the Sama

[4] Jobberman is a leading digital marketplace for employers and prospective employees by providing employment-oriented services for job applicants in Nigeria.

(formerly Samasource) and Busara Lab,[5] both based in Nairobi, Kenya.[6] Sama, a San Francisco-based company, has established its presence in Kenya, where it employs people to generate and process data for cutting-edge AI projects for Silicon Valley tech firms.[7]

As these tech start-ups (including incumbent firms) grow, they require significant investments in order to survive and scale up. However, given the low levels of capital in many African countries, the importance of FDI in providing the needed capital to African technology firms cannot be overemphasized. In addition, big Silicon Valley firms like Google and Microsoft are investing directly in incubator hubs in Africa to train future tech entrepreneurs. Thus, aside from the direct impact of access to high-speed Internet on socioeconomic outcomes, the infrastructure is also a catalyst for investment in the technology services sector.

3 Data

Our main data is project-level data on FDI from fDiMarkets,[8] a subsidiary of the Financial Times. fDiMarkets monitors cross-border investments around the globe and is a major source of data used by the World Bank and UNCTAD[9] to measure cross-border financial flows. It provides detailed information relating to date of announcement, sector, subsector, whether the investment is greenfield (new) or brownfield (expansion),[10] name of investors, source country and city (state), destination country and city, capital investment, and anticipated direct jobs created, among other things. Data on FDI from 2003 to 2018 are used in this study.

We conduct our analysis at the subnational level, specifically at the second administrative level, hereafter referred to as district. For each district and year, we compute the total number of FDI projects and value of investment for each sector. In this paper, we focus on three main sectors: manufacturing,[11] services, energy and real estate (construction).[12] We exclude FDI in telecom and Internet construction, and extractives (mining and petroleum) given that: (i) investments in telecom and Internet construction could be associated with the Internet roll out thereby resulting in reverse causality; and (ii) investments in the extractives are largely influ-

[5]The Busara Lab is used by researchers around the world to conduct surveys, interactive games, and experiments.

[6]Morocco and South Africa now export significant services in the BPO area. The sector generates more than US$1.5 billion of revenues and accounts for 54,000 jobs in South Africa (Manyika et al., 2013).

[7]The company counts Google, Microsoft, Salesforce, and Yahoo among its clients. See: https://www.bbc.com/news/technology-46055595

[8]https://www.fdimarkets.com/

[9]The United Nations Conference on Trade and Development

[10]About 95% of projects in the database are greenfield.

[11]garments and apparel, machinery, agro-processing, etc.

[12]electricity generation, transmission & generation, real estate construction.

enced by discoveries of deposits and less of ambient infrastructure quality. Within the service sector, we leverage the detailed nature of the data to classify the data into three categories (subsectors), FDI in: financial services, technology services, and other services.[13] Our final dataset is a district-year panel between 2003 and 2018.

In addition, we compile data on the staggered arrival of submarine Internet cables to the coasts of various African countries, as well as the connections to landlocked countries, using data from www.africabandwidthmaps.com,[14] www.submarinecablemap.com, and other country-specific sources. We complement this with data on terrestrial fiber backbone network from www.africabandwidthmaps.com. Figure 1 shows trends in the number of countries connected to at least one submarine cable between 2003 and 2018.

We complement the Internet data with additional data on infrastructure such as electricity grid network from https://gridfinder.org/, and road density from the Global Roads Inventory Project.[15] Also, we use data on the quality of governance from the World Bank's World Governance Indicator database[16] and finally firm-level data in nine countries[17] from the World Bank Enterprise Survey (WBES).

Further, to avoid zero-inflated data, we restrict our analysis to subnational districts that received at least one FDI during the sample period. Our final data is a balanced panel of 401 subnational districts in 32 countries over a 16-year period.[18] Summary statistics of the full data are presented in Table 1.

4 Empirical Strategy

In the 1990s, satellite transmission was the main source of Africa's Internet connection. It was characterized by high connection costs and slow speeds, which affected the utilization of Internet services for productive uses. To address these issues, several countries partnered with telecom companies to undertake massive infrastructural investments by laying fiber-optic sub-

[13]Financial services include activities such as retail banking, investment banking, and insurance; Technology services classification include FDI in business services (computer systems design, software publishers, motion picture & sound recording industries, custom computer programming services, travel and ticketing, rental and leasing services), software and IT services, biotechnology, paper printing & packaging, communications, consumer electronics, Semiconductors, Aerospace; Other services include, retail, health care, hospitality, and real estate services.

[14]A digital consulting firm focused on publishing maps on Internet infrastructure in Africa

[15]https://www.globio.info/download-grip-dataset

[16]https://info.worldbank.org/governance/wgi/

[17]These include, Ethiopia, Ghana, Kenya, Mauritania, Nigeria, Senegal, Tanzania, Uganda, and Zambia

[18]These include: Angola, Benin, Botswana, Burundi, Cameroon, Central African Republic, Democratic Republic of Congo, Eritrea, Ethiopia, Gabon, Ghana, Kenya, Lesotho, Madagascar, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Republic of the Congo, Rwanda, Senegal, Somalia, South Africa, Sudan, Eswatini, Tanzania, Togo, Uganda, Zambia, and Zimbabwe

marine cables (SMC) from Europe to Africa. The cables began arriving on the African coastline between 1997 and 2002, but only a few countries had access to them. We refer to these early cables as the "first-generation" SMCs to Africa. Also, the bandwidth capacity of these early submarine cables was still relatively low, limiting high-speed Internet access to a few locations. The construction of the undersea cables slowed between 2002 and 2008, partly due to the global financial crisis and dotcom bubble (D'Andrea and Limodio, 2019). However, between 2009 and 2012, Africa witnessed a boom in the arrival of ("second-generation") fiber-optic submarine cables, with the number of African countries with at least one submarine cable connection increasing from about 20 in 2008 to 52 in 2012 (see Figure 1).[19] Figure 2 shows the gradual arrival of the submarine cables between 2000 and 2018. Further, the landing points of the submarine cables were mostly cities along the coast.

However, to get this Internet available to end-users, it has to travel through the "middle-mile" and "last-mile" networks.[20] The "middle mile" consist of the national (fiber) "backbone" infrastructure which transmits high-capacity internet from the landing points of the submarine cables throughout the domestic network. Along these fiber backbone networks, there are several connection points, referred to as "Internet nodes", that connect the backbone to the "last-mile" infrastructure–which is essentially the form of infrastructure that households and firms connect directly to for Internet. In Africa, the last mile network usually consists of fiber broadband cables, and mobile internet (via mobile phone towers) (Hjort and Poulsen, 2019). The national backbone infrastructure also played an important role in connecting (neighboring) landlocked countries to the submarine cables.

As highlighted by Hjort and Poulsen (2019), in almost all African countries, the backbone network were built by national telecom companies, albeit, in some instances, private telcos extended the network. Also, many of these backbone networks were built many years before to the arrival of the submarine cables, as Internet was hitherto transmitted via telephone cables.

We treat the arrival of the SMCs as a positive shock in Internet connectivity. This is because, Internet via these cables is: (i) faster, and (ii) cheaper than satellite-based Internet. In Togo and Mauritania, for instance, connections to the submarine cables reduced the cost of international bandwidth for 1 Mb/s from $1,174 to $73 and $3,500 to $29 respectively.[21] This obviously

[19]As of the end of 2018, only three African countries (Central African Republic, Eritrea, and South Sudan) were unconnected to at least one submarine cable. Also, every seaboard country in Africa, except Guinea-Bissau and Eritrea, has at least one submarine cable landing. See https://www.broadbandcommission.org/Documents/working-groups/DigitalMoonshotforAfrica_Report.pdf

[20]The "middle-mile" can be likened to the network of electricity transmission lines that carries high voltage energy from generation plants to substations. The "last-mile" on the other hand can be likened to the network of distribution lines which carries low voltage electricity from substations to customers.

[21]See the World Bank's World Development Report 2021. https://openknowledge.worldbank.org/bitstream/handle/10986/35218/9781464816000.pdf

implies a high user cost for customers who rely on satellite transmission for Internet services. Hence, coupled with the relatively slow speed of satellite connections, submarine connectivity brought faster and cheaper Internet to many African countries, thereby enabling greater uptake and utilization of the Internet for commercial and household uses.

In this paper, we follow the approach of Hjort and Poulsen (2019) and exploit the plausibly exogenous variations in the arrival of the SMCs in Africa in a difference-in-difference design. The timing of the arrival of the SMCs is arguably exogenous given the fact that: (i) the construction of the cables was undertaken through a consortium of countries and hence delays in coordination among the project partners could induce significant delays; (ii) even in the absence of delays, a country's relative location along the coastal line influenced the timing of SMC connection; and (iii) access to the SMCs by landlocked countries depend to a large extent on the speed of construction (expansion) of national backbone networks of neighboring countries (Goldbeck and Lindlacher, 2021).

Essentially, we estimate the effect of Internet connectivity on FDI using a double difference design that leverages two main sources of variations. First, the staggered arrival of SMCs along the African coastlines, and second comparing subnational districts connected to the terrestrial backbone network with those unconnected to the network, focusing exclusively on backbone networks constructed prior to the arrival of the SMCs. Consequently, we specify our baseline equation as follows:

$$Y_{ict} = \phi \cdot \mathbb{1}(Submarine_{ct} \times Connected_i) + \beta \cdot X_i \times T + \Gamma_i + \eta_{ct} + \mu_{ict} \tag{1}$$

where Y_{ct} is a placeholder for the sector-specific FDI receipts in subnational district i, country c, and year t. Three main measures of FDI are used: (i) a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; (ii) the number of FDI projects in the relevant year; and (iii) the total size (monetary value) of FDI projects in the relevant year. It is important to emphasize that FDI in Internet infrastructure is excluded due to the potential of reverse causality. Likewise, FDIs in extractives are also excluded. $\mathbb{1}(Submarine_{ct})$ is an indicator variable equal to 1 if a country is connected to at least one submarine Internet cable at time t and 0 if otherwise. $\mathbb{1}(Connected_i)$ is an indicator variable that is equal to 1 if a district is connected to the fiber backbone network in the country and 0 if otherwise. Specifically, we consider a district to be connected if the terrestrial backbone line is within the boundaries of the district and 0 otherwise.[22] We also include district level controls (distance to the coast, road density and intensity of electricity grid network), interacted with time trends. Γ_i and η_{ct}

[22] i.e. either at least one fiber line passes through the district boundary or the boundary contains at least one endpoint of the network.

represent fixed effects for district and country×year, respectively. The inclusion of district fixed effects absorbs time-invariant district effects that may influence FDI flows. Country-year fixed effects, on the other hand, enable us to absorb country-specific temporal shocks that may influence the outcome variable. The main parameter of interest is ϕ which represents the causal impact of access to high-speed Internet connectivity on FDI flows. Standard errors are clustered at the district level to allow within-district correlation among the residuals (Abadie et al., 2022). The inverse hyperbolic sine (IHS) transformation was applied to continuous variables, such as investment size, and the number of FDI projects.

In this setup, causal identification of impact relies on the assumption that the timing of the arrival of (connection to) submarine cables is plausibly exogenous (D'Andrea and Limodio, 2019; Hjort and Poulsen, 2019). In other words, absent the arrival of submarine cables, trends in FDI receipts between connected and unconnected districts would have evolved along a similar pattern (i.e., the so-called "parallel trends" assumption). To assess the validity of the identifying assumption, we estimate an event study to trace the trends in FDI receipts before and after connection to the submarine fiber-optic network between connected and unconnected districts. Meanwhile, recent advances in the literature suggest that the two-way fixed effects (TWFE) estimator is likely to be biased due to the possibility of heterogeneity in the treatment effects across groups (De Chaisemartin and D'Haultfoeuille, 2018, 2020a,b; Goodman-Bacon, 2021; Callaway and Sant'Anna, 2021; Borusyak et al., 2021). This implies that the regular event studies estimates based on the TWFE estimator are plausibly biased. Therefore, we present event study estimates using the "imputation" estimator by Borusyak et al. (2021) which ensures consistency in the presence of the TWFE and also deals with issues of spurious identification and negative weighting (Acemoglu et al., 2022; De Chaisemartin and D'Haultfoeuille, 2020b).

Finally, in the main analysis, we focus exclusively on the "second-generation" SMCs to Africa. This is motivated by the fact that: (i) the "first-generation" SMCs had relatively low bandwidth capacity and hence low internet speeds. Bandwidth cost also remained relatively expensive. On the other hand, the "second-generation" SMCs brought faster Internet speeds at low cost to the continent, and marked the beginning of rapid expansion in Internet connectivity in Africa (Hjort and Poulsen, 2019); (ii) the arrival of the "first-generation" SMCs (1997-2002) predates the start of our FDI data (2004), hence limiting the application of our before-and-after design, and (iii) the staggered arrival of the "second-generation" SMCs also enables causal identification of impact as used in Hjort and Poulsen (2019). Therefore, in our quest to examine the effects of high-speed Internet connectivity on FDI, focusing on "second-generation" SMCs offers the best option. However, including countries that already received the "first-generation" SMCs in the analysis while assigning treatment status to the arrival of the "second-generation"

SMCs may pose challenges to causal identification.[23] Therefore, our baseline analysis focuses solely on countries without prior connection to the "first-generation" SMCs. Nonetheless, we show in Section 7.2 that our results are robust to the inclusion of these countries.

5 Results

We begin by presenting descriptive evidence on the trends in FDI receipts between connected (treated) and unconnected (control) districts before and after the arrival of the first SMC cable in their respective countries. This allows us to check the gap in FDI receipts between treated and control districts before and after the arrival of high-speed Internet connection, thus providing a validity check of our identifying assumption that requires that FDI receipts in the two groups would have evolved along a similar pattern in the absence of treatment. As shown in Figure 3, we observe a similar upward trend in the number of FDI projects between treated and control districts within five years prior to the SMC arrival. However, the gap in FDI receipts between treated and control districts begins to increase after the arrival of the SMC, suggesting a potentially positive impact of high-speed Internet connectivity on FDI receipts.

5.1 Main Results

We now turn our attention to the main results. We present our DiD estimates of the effects of high-speed Internet connectivity on sectoral FDI using the baseline specification in equation (1). Table 2 presents the results showing how high-speed Internet connection affects FDI receipts in: All sectors, Services, Manufacturing, and Other Sectors (Energy and Real Estate). Across these sectors, we evaluate the effects of Internet connectivity on three outcomes: "FDI (0/1)" a dummy variable set equal to 1 if a district in year t received FDI in the respective sector and 0 if otherwise; "# FDIs (IHS)" the IHS transformation of the number of FDI projects received in year t; and "FDI Size ($,IHS)" the IHS transformation of the size (monetary value) of FDIs received. Also for each of these outcomes, we estimate two variant specifications, with and without baseline district controls interacted with time trends. Our preferred specifications are those with the baseline district controls interacted with time trends (even numbered columns).

Starting with the aggregate FDI receipts across all sectors,[24] our results suggest that high-speed Internet connectivity increases the probability of receiving FDI by about 6.3 pp (column 2). Also, the arrival of high-speed Internet is associated with an increase in the number and

[23] For example, countries already connected to the "first-generation" SMCs may have a high (low) probability of receiving the "second-generation" SMCs.

[24] Excluding investments in extractives, telecom and Internet construction

size of FDI receipts by 10.5% (column 4) and 33.4% (column 6) respectively.[25] Which sectors are the impact of Internet connectivity on FDI concentrated? The results in columns 7-12 show a positive impact of Internet connectivity on FDI into services. The probability of receiving FDI in the services sector increases by 5.7 pp, while the number and size of FDI receipts in services increase by 9.6% (column 10) and 23.6% (column 12) respectively following the arrival of high-speed Internet. In terms of FDI in manufacturing, we do not find any statistically significant effect of high-speed Internet connectivity, albeit the estimates are positive and relatively sizeable. Similarly, we do not find any consistent evidence of an impact of Internet connectivity on FDI in the energy and real estate (sub)sectors. Overall, the results herein suggest that while access to fast Internet is associated with an increase in FDI receipts, the effect is mainly concentrated in FDI in service-related activities. This falls in line with our a priori expectations that Internet-dependent sectors, like services, are plausibly the most likely direct beneficiaries of investments induced by high-speed Internet connectivity.

To further understand the Internet-FDI nexus, we drill deeper into the service(s) sector to explore the effects of Internet connectivity on FDI in the various subsectors, namely, financial services, technology services, and others (health and retail). In Table 3 (column 7-12), we find that access to high-speed Internet leads to an increase in FDI in financial services: the probability of receiving FDI into the subsector increases by 5.7 pp, while the number and size of the investments into the subsector increases by 6.2% (column 10) and 20.4% (column 12) respectively. FDI into technology services also improves with connectivity to high-speed Internet. The probability of receiving FDI in technology services increases by 2.7 pp (column 14), while the number of FDI projects in technology services increases by 3.4% (column 16). The effect on the size of FDI into technology services is also positive and significant (column 17) albeit it loses significance once we control for district level characteristics interacted with time trends (column 18). We also find positive effects on FDI in other service subsectors (including health and retail). These effects are statistically and economically meaningful. The probability of receiving FDI increases by 2 pp (column 20), while the number and size of FDI in the subsector increase by 4.1% (column 22) and 11.5% (column 24) respectively. Taken together, the main finding from the results is that high-speed Internet connectivity increases FDI, although the effect is mainly concentrated in the services sector (e.g., finance, technology, retail, and health).

Aside the overall positive average effect of Internet connectivity on FDI, how does the effect vary over time? This is important for at least two reasons: (i) dynamic estimates from an event-study analysis allow us to provide an assessment of the "parallel trends" assumption– a

[25] In a IHS-linear model, this effect is given as $\approx \exp(\hat{\beta} - 0.5\widehat{Var}(\hat{\beta})) - 1$, where $\widehat{Var}(\hat{\beta})$ is the estimated variance of $\hat{\beta}$ (Bellemare and Wichman, 2020). Hence, in column 4, the estimate corresponds to $\exp(0.1005 - 0.5(0.0334)^2) - 1 = 0.105$

fundamental assumption behind the DiD design; and (ii) to assess whether the impact of Internet connectivity on FDI is instantaneous or accumulate over time. Also, motivated by the recent advances in the literature in relation to the limitations of the regular TWFE estimator in producing consistent estimates in the presence of differential weighting and heterogeneous treatment effects, we use the Borusyak et al. (2021) estimator and conduct event study analysis.

Figure 4 presents event study estimates from Borusyak et al. (2021) estimator showing trends in the number of FDI projects (all sectors) before and after the arrival of high-speed Internet at the district level. Before the arrival of fast Internet enabled by SMC connectivity, point estimates are close to zero and statistically insignificant, suggesting that connected and unconnected districts were not on differential trends in FDI receipts prior to the arrival of SMCs at the country level, conditional on our fixed effects. This provides support to our parallel trends assumption. However, once connected to the backbone network, and the subsequent availability of high-speed Internet to treated districts, FDI receipts into connected districts began to rise at a faster rate relative to unconnected districts. The effect persists throughout the five years after the SMC's arrival. We conduct similar analyses focusing on the service sector (and subsectors) as shown in Figure 5. Again we find consistent evidence of an increase in FDI in the service (sub)sector(s) after the arrival of SMCs and the absence of pretrends. The results from these event study analyses provide further support to the robustness of our results in Tables 1 and 3.

5.2 Role of Complementary Enablers

In this section, we explore the role of complementary infrastructure, such as access to road and electricity, in amplifying or reducing the effects of access to high-speed Internet in attracting FDI. In other words, is access to high-speed Internet enough to drive FDI, or the effect conditional on having complementary (hard) infrastructure (road and electricity)?

To address this question, we revisit the baseline analysis and leverage spatial data on access to road and electricity grid network: two critical infrastructure that supports the productive sectors of the economy by aiding transport and providing needed energy for the production of goods and services. Specifically, we compute the density of electricity grid and road networks at the district level and classify districts into high and low (grid/road) density based on the sample median. Thus "high electrification (high road density)" is a dummy equal to 1 if the electricity grid (road) density is above the sample median and 0 otherwise. The density of the electricity grid is used as a measure (proxy) of the availability of electricity and hence the cost of electricity connection (supply). Places with high grid intensity plausibly have low connection costs, all else equal. Similarly, high road density is used as a proxy for transport cost, i.e., high road density implies low transport cost and vice versa.

We combine these infrastructure data with our baseline data and estimate the following specification:

$$Y_{ict} = \phi \cdot \mathbb{1}(Submarine_{ct} \times Connected_i) + \gamma \cdot \mathbb{1}(Submarine_{ct} \times Connected_i \times Infra) + \beta \cdot Z_i \times T + \Gamma_i + \eta_{ct} + \mu_{ict} \tag{2}$$

where $Infra$ is a placeholder for the (high) electrification (road) dummy. Z_i is a placeholder for baseline measures such as distance to the coast interacted with time trends. All else remains as previously defined. The coefficient of interest, γ, measures the effect of having a high-speed Internet connection via the submarine cables in districts with high electrification (road) density. Based on the results in Tables 1 and 3, we do this analysis for total FDI and FDI in services.

Results are presented in Tables 4 and 5. Starting with Table 4, columns 1-9 show the interaction effects on FDI in all sectors. Across the various specifications, we find positive and statistically significant effects on the interaction between high-speed internet connectivity and the high electrification dummy.[26] Interestingly, the effect of Internet connectivity in places with low electrification is not statistically significant. This provides suggestive evidence of the complementary role that access to electricity plays in amplifying the effects of Internet connectivity. The interaction between road density and internet connectivity is largely (statistically) insignificant, albeit positive.

Next, we focus on FDI in the services sector. Once again the interaction with electrification is highly significant across all specifications. In column 10 for instance, the results show that high-speed Internet connectivity in districts with high electrification footprints increases the probability of attracting FDI into services by 8.1 pp relative to Internet connectivity in districts with low electrification. The interaction with road density is also positive and statistically significant in all cases except columns 12, 15, and 18 where we estimate the joint interaction effects together in the same specification. Nonetheless, the results here suggest that access to road networks also amplifies the effects of Internet connectivity in attracting FDI into the services sector.

Further, in Table 5, we examine the role of access to electricity and roads in amplifying the effects of Internet connectivity on FDI into finance and technology services as well as the other (retail and health) services categories. Again, access to electricity plays a crucial role in enhancing the effects of Internet connectivity on FDI in these service subsectors. For instance, Internet connectivity increases the probability of attracting FDI to finance, technology, and health and retail services by 5.3 pp (column 1), 6.9 pp (column 10), and 4.3 pp (column 19) respectively

[26] The effects are insignificant in 2 out of 6 cases.

in districts with high electrification rate relative to district low electrification rate. Interestingly the interactive effect of road networks on the Internet-FDI nexus is largely evident with respect to FDI in technology services.

Overall, the main takeaway from the analysis in this section is that while access to high-speed Internet is associated with increased investment in the services sector, the effect is largely concentrated in districts with better access to (complementary) infrastructure, particularly electricity. This is plausibly due to the key role electricity plays in powering digital equipment and the general effect of electricity on technology adoption. Therefore, the findings herein provide suggestive evidence that electricity services amply the role of high-speed Internet in attracting investment.

6 Potential Mechanisms

The preceding analysis shows a positive effect of high-speed Internet connectivity on FDI, particularly in the service sector. In this section, we provide evidence on [some] potential pathways via which high-speed Internet connectivity influences FDI arrivals. In this paper, we hypothesize at least three channels: (i) a reduction in the cost of doing business, including but not limited to, transport cost and other trade barriers; (ii) improvement in the quality of governance; and (iii) market expansion (Hjort and Tian, 2021). Empirical evidence on these channels particularly, changes in cost of doing business following the arrival of fast internet, is constrained by the lack of data. However, we show some (suggestive) evidence of the governance and market expansion channels.

6.1 Quality of Governance

Recent evidence from the literature shows that access to digital technologies such as Internet and mobile phones affect political economy outcomes such as confidence in government (Guriev et al., 2020), political mobilization (Manacorda and Tesei, 2020), and corruption (Gonzalez, 2021). For instance, Gonzalez (2021) shows that expansion in mobile phone connectivity reduced electoral fraud in Afghanistan, while Guriev et al. (2020) also shows that expansion in mobile internet connectivity is associated with a reduction in government approval by citizens. In all these, a principal mechanism is that access to these digital technologies reduces information friction, thus enabling citizens to demand greater accountability from governments. In other words, Internet access enhances reporting and scrutiny, for example via social media, and thus will induce governments to be more transparent and accountable to the populace thereby improving the quality of governance (Khazaeli and Stockemer, 2013).

For investors, quality of governance is an important driver of investment decisions, as it largely influences the cost of doing business and also reduces uncertainty in the business environment. To this end, we test the association between high-speed connectivity via the SMC arrivals and quality of governance using metrics such as regulatory quality, government effectiveness, control of corruption, political stability, and rule of law from the World Bank's World Governance Indicator database.[27]

Specifically, we run the following specification at the country-level regression

$$Y_{ct} = \phi \cdot \mathbb{1}(Submarine_{ct}) + \beta \cdot X_c \times T + \psi_c + \eta_t + \epsilon_{ct} \tag{3}$$

where Y_{ct} is a placeholder for the measure of the quality of governance in country c at year t; $\mathbb{1}(Submarine_{ct})$ an indicator variable set equal to 1 if the country is connected to at least one submarine Internet cable and 0 if otherwise. We also control for represent baseline controls such as whether the country is anglophone or otherwise interacted with time trends ($X_c \times T$).[28] Standard errors are clustered at the country level.

The results in Table 6 show a positive relationship between the arrival of the SMCs and governance measures albeit, the relationship is statistically significant only with respect to regulatory quality, and government effectiveness. In column 2, for instance, high-speed Internet connectivity is associated with a 0.072 standard deviation (sd) increase in the regulatory quality index. This result is particularly important to the findings of the paper since the regulatory quality index captures "perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development". Hence, access to the Internet is associated with policies that support private sector development. Similarly, high-speed Internet connectivity is associated with a 0.12 sd increase in the government effectiveness index. Overall, the results herein provide suggestive evidence that Internet connectivity is associated with an improvement in the quality of governance, which could plausibly incentivize foreign investments.

[27] https://info.worldbank.org/governance/wgi/

[28] The anglophone/francophone/Lusophone classification is used as a proxy for the legal origins of the country, i.e., common law vs civil law, as the current legal framework in many African countries was inherited from their colonial rulers (Anderson, 2018).

6.2 Market Expansion

Another channel underlying the economic impact of Internet connectivity is the expansion in market access for both firms and consumers (Hjort and Tian, 2021). In addition to traditional "brick-and-mortar" markets, Internet access offers an additional market channel via "online markets", thus allowing firms to sell products outside the boundaries of traditional markets, at relatively low cost. The expansion in market access via online platforms (in addition to offline/traditional platforms) will result in increased revenue for firms with positive implications on profitability. The potential for high revenue is particularly important for investors as it increases the expected return on investment.

To test this channel, we use firm-level data from the WBES to explore the relationship between high-speed Internet connectivity and firm sales by estimating the following equation:

$$Y_{mict} = \phi \cdot \mathbb{1}(Submarine_{ct} \times Connected_i) + \beta X_{mt} + \Gamma_i + \eta_{ct} + \mu_{mict} \tag{4}$$

where Y_{mict} is the outcome of firm m in city i, country c at time t; X_{mt} is a vector of firm controls (ownership type, firm size, and whether it is foreign or domestic), while Γ_i represent city fixed effects. All else remains as previously defined. Standard errors are clustered at city level.

In Table 7, we find a positive effect of Internet connectivity and the two measures of firm sales: log of total sales and sales per worker. These results provide suggestive evidence of the economic benefits of Internet connectivity on revenue, potentially signaling a high return on investment.

7 Robustness Checks

Before concluding the paper, we address two potential challenges to our baseline analysis, namely: standard error clustering and extending the sample to include countries with prior connection to the first-generation SMCs.

7.1 Standard Errors

We begin by showing the robustness of our analysis to alternative clustering. Given that one dimension of our treatment indicator–SMC arrival–varies at the country level, we conduct additional analysis by clustering our standard errors at the country level to account for serial correlation within countries. The results are shown in Tables A1 and A2 in the Appendix. The statistical significance remain robust as in the baseline results (Tables 1 and 3) where we cluster the standard errors at the subnational level.

We also show that our results are robust to spatial correlation in the residuals by replicating the baseline results (Tables 1 and 3) using the Conley (1999) estimator. Results are shown in Tables A3 and A4 in the Appendix.

7.2 Sample Extension

As highlighted in Section 4, our baseline analysis focuses exclusively on the set of countries that got connected to the "second-generation" SMCs to Africa without prior connection to the first-generation SMCs. In this section, we relax this criterion to include countries with a prior connection to an SMC before 2007, while still focusing on the effect of high-speed Internet connectivity via the second-generation SMCs on FDI.[29] Essentially, we classify these countries as though there were not "treated" prior to 2007. While in principle, these countries were already connected to the early SMCs that arrived on the continent, Internet speed in these countries was relatively low due to the low bandwidth capacity of these early cables. Hence, given our focus on "high-speed" Internet connectivity, our focus on the second-generation SMCs should suffice.

To this end, we replicate the baseline analysis in Tables 1 and 3 using the extended sample and show the results in Tables A5 and A6 respectively in the Appendix. Compared to the baseline results (Tables 1 and 3), our new results based on the extended sample are qualitatively and quantitatively similar (Tables A5 and A6) albeit the latter are slightly smaller in magnitude. We also perform our event study analysis using the Borusyak et al. (2021) estimator. Results in Figure A1 also confirm our earlier findings of an increase in FDI after connection to the SMCs. Thus, overall, we find consistent evidence that high-speed Internet connectivity is associated with high FDI inflow, particularly, in the service sector.

8 Conclusion

This paper provides causal evidence of the role of infrastructure quality in driving FDI in developing economies. It explores how the arrival of high-speed Internet in Africa via submarine Internet cables stimulated FDI into the continent. It also examines the influence of complementary infrastructure, such as electricity and road connectivity, in amplifying the impact of Internet access, and also explores potential mechanisms underlying the impact are also explored.

[29] The additional countries included are Senegal, Ghana, Nigeria, Benin, South Africa, Angola, Gabon, Cameroon, and Sudan

We use granular data on FDI projects in several African countries matched with spatial data on Internet infrastructure roll out to estimate the effects of Internet connectivity on sectoral FDI in Africa. Our identification strategy leverages the plausibly exogenous variations in the staggered arrival of submarine fiber Internet cables that brought high-speed Internet to the continent and the spatial variations in access to the terrestrial cable network.

First, we show that the arrival of high-speed Internet played a crucial role in stimulating FDI to Africa. The effects are, however, largely concentrated in the service(s) sector, with finance, technology, health and retail subsectors as main beneficiaries. The probability of receiving FDI, as well as the number and value of FDI in these services (sub)sectors, increased with access to fast Internet. Second, we show that the effects of high-speed Internet connectivity on FDI pertain largely to subnational districts with better access to complementary infrastructure such as roads and electricity. In particular, we find consistent evidence on the complementary role of electricity access on the impact of Internet connectivity on investment. This is plausibly due to the key role electricity plays in powering digital equipment and the general effect of electricity on technology adoption. Hence, access to electricity services amply the role of high-speed Internet in attracting investment. Third, we provide suggestive evidence that an increase in the quality of governance and market expansion–resulting in high sales (return on investments)–as potential mechanisms through which high-speed Internet connectivity induces FDI.

Overall, the findings of the paper underscore the importance of quality infrastructure provision in attracting investments to developing and emerging economies. In addition, the results highlight the complementarities in the economic impact of infrastructural services. Thus, future research on the impact of infrastructural services should pay particular attention to these complementarities.

References

Abadie, A., Athey, S., Imbens, G. W., and Wooldridge, J. M. (2022). When Should You Adjust Standard Errors for Clustering?*. *The Quarterly Journal of Economics*. qjac038.

Abebe, G., McMillan, M. S., and Serafinelli, M. (2018). Foreign direct investment and knowledge diffusion in poor locations: Evidence from Ethiopia. Technical report, National Bureau of Economic Research.

Acemoglu, D., He, A., and le Maire, D. (2022). Eclipse of rent-sharing: The effects of managers' business education on wages and the labor share in the us and denmark. Technical report, National Bureau of Economic Research.

Amiti, M. and Javorcik, B. S. (2008). Trade costs and location of foreign firms in China. *Journal of Development Economics*, 85(1-2):129–149.

Andersen, T. B. and Dalgaard, C.-J. (2013). Power outages and economic growth in Africa. *Energy Economics*, 38:19–23.

Anderson, S. (2018). Legal origins and female hiv. *American Economic Review*, 108(6):1407–1439.

Arita, S., Tanaka, K., et al. (2013). FDI and investment barriers in developing economies. Technical report, Institute of Developing Economies, Japan External Trade Organization (JETRO).

Bech, M. L., Hobijn, B., et al. (2007). Technology diffusion within central banking: The case of real-time gross settlement. *International Journal of Central Banking*, 3(3):147–181.

Bellemare, M. F. and Wichman, C. J. (2020). Elasticities and the inverse hyperbolic sine transformation. *Oxford Bulletin of Economics and Statistics*, 82(1):50–61.

Borusyak, K., Jaravel, X., and Spiess, J. (2021). Revisiting event study designs: Robust and efficient estimation. *arXiv preprint arXiv:2108.12419*.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of Econometrics*, 225(2):200–230.

Conley, T. G. (1999). Gmm estimation with cross sectional dependence. *Journal of econometrics*, 92(1):1–45.

Crescenzi, R. and Limodio, N. (2021). The impact of Chinese FDI in Africa: Evidence from Ethiopia. Technical report.

D'Andrea, A. and Limodio, N. (2019). High-speed Internet, financial technology and banking in Africa. Technical report, Centre for Applied Research on International Markets Banking.

De Chaisemartin, C. and D'Haultfoeuille, X. (2018). Fuzzy differences-in-differences. *The Review of Economic Studies*, 85(2):999–1028.

De Chaisemartin, C. and D'Haultfoeuille, X. (2020a). Difference-in-differences estimators of intertemporal treatment effects. Technical report.

De Chaisemartin, C. and D'Haultfoeuille, X. (2020b). Two-way fixed effects estimators with heterogeneous treatment effects. *American Economic Review*, 110(9):2964–96.

Edwards, L. and Jenkins, R. (2015). The impact of Chinese import penetration on the South African manufacturing sector. *The Journal of Development Studies*, 51(4):447–463.

Goldbeck, M. and Lindlacher, V. (2021). Digital infrastructure and local economic growth: Early internet in sub-saharan africa. Technical report, Working Paper.

Gonzalez, R. M. (2021). Cell phone access and election fraud: Evidence from a spatial regression discontinuity design in afghanistan. *American Economic Journal: Applied Economics*, 13(2):1–51.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of Econometrics*.

Guerrieri, V. and Lorenzoni, G. (2009). Liquidity and trading dynamics. *Econometrica*, 77(6):1751–1790.

Guriev, S., Melnikov, N., and Zhuravskaya, E. (2020). 3G Internet and confidence in government. *Forthcoming: Quarterly Journal of Economics*.

Harding, T. and Javorcik, B. S. (2011). Roll out the red carpet and they will come: Investment promotion and FDI inflows. *The Economic Journal*, 121(557):1445–1476.

Harding, T. and Javorcik, B. S. (2012). Investment Promotion and FDI Inflows: Quality Matters. *CESifo Economic Studies*, 59(2):337–359.

Hjort, J. and Poulsen, J. (2019). The arrival of fast Internet and employment in Africa. *American Economic Review*, 109(3):1032–79.

Hjort, J. and Tian, L. (2021). The economic impact of internet connectivity in developing countries.

Khazaeli, S. and Stockemer, D. (2013). The internet: A new route to good governance. *International Political Science Review*, 34:463–482.

Manacorda, M. and Tesei, A. (2020). Liberation technology: mobile phones and political mobilization in Africa. *Econometrica*, 88(2):533–567.

Mann, L., G. M. and Friederici, N. (2015). The Internet and business process outsourcing in East Africa.

Manyika, J., Armando, C., Moodley, L., Moraje, S., Yeboah-Amankwah, S., Chui, M., and Anthonyrajah, J. (2013). Lions go digital: The Internet's transformative potential in Africa.

Mayda, A. M., Parsons, C. R., Pham, H., and Vézina, P.-L. (2019). Refugees and foreign direct investment: Quasi-experimental evidence from US resettlements. Technical report.

Mensah, J. T. (2018). Jobs! Electricity shortages and unemployment in Africa. Technical Report 8415, World Bank Policy Research Working Paper.

Ouedraogo, R., Sy, M. A. N., et al. (2020). Can digitalization help deter corruption in Africa? Technical report, International Monetary Fund.

Reinikka, R. and Svensson, J. (1999). *How inadequate provision of public infrastructure and services affects private investment.* The World Bank.

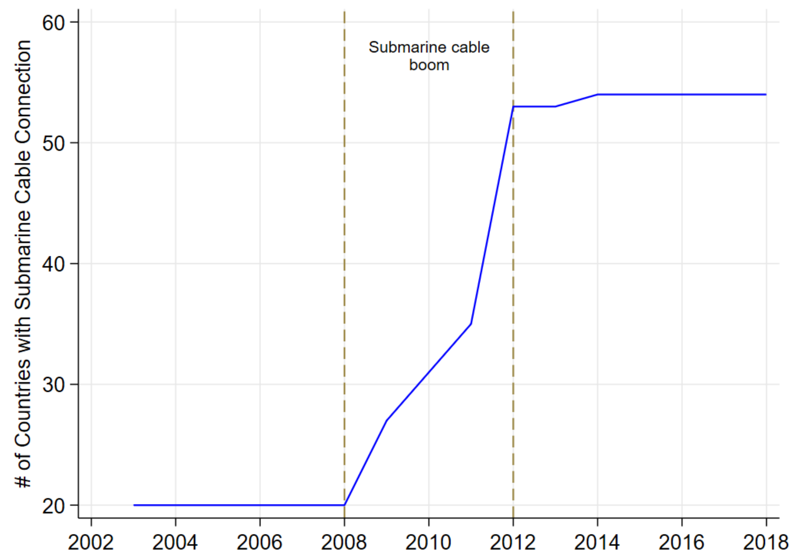
Smarzynska Javorcik, B. (2004). Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review*, 94(3):605–627.

Toews, G. and Vézina, P.-L. (2021). Resource discoveries, FDI bonanzas, and local multipliers: Evidence from Mozambique. *Review of Economics and Statistics*, pages 1–36.

Townsend, R. M. (1978). Intermediation with costly bilateral exchange. *The Review of Economic Studies*, 45(3):417–425.

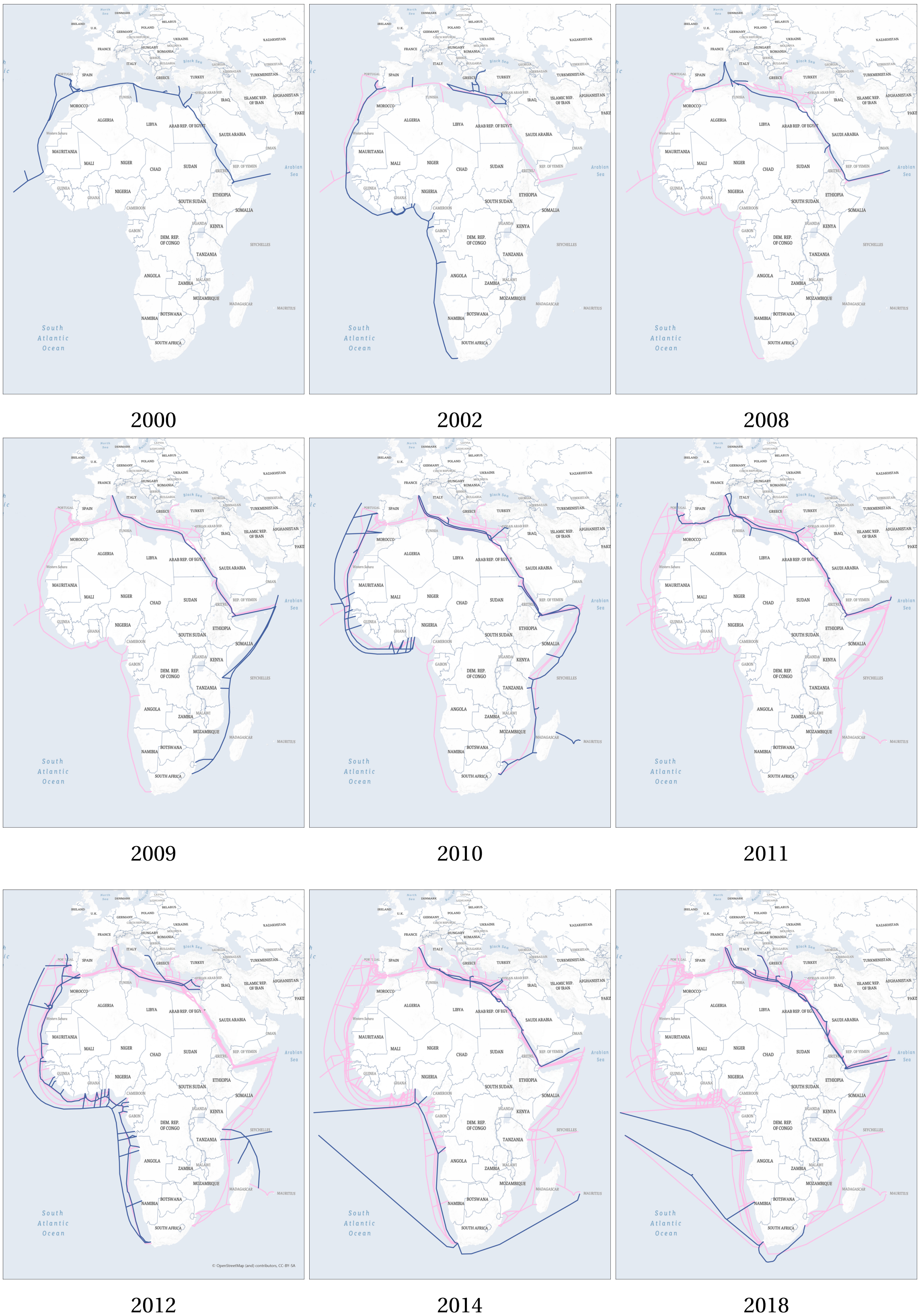
Figures

Figure 1: Trends in Submarine Internet Cable Connectivity in Africa



The figure shows the cumulative number of African countries with a connection to at least one submarine fiber-optic Internet cable between 2000 and 2018.

Figure 2: Arrival of Submarine Internet Cables in Africa



The figure shows the gradual arrival of submarine Internet cables in Africa. black lines show additional cables that are in-service at the respective years. Pink lines are existing cables. Maps are constructed using spatial data from https://cablemap.info/_default.aspx

Figure 3: Trends in FDI receipts in connected and unconnected districts before and after the arrival of high-speed internet

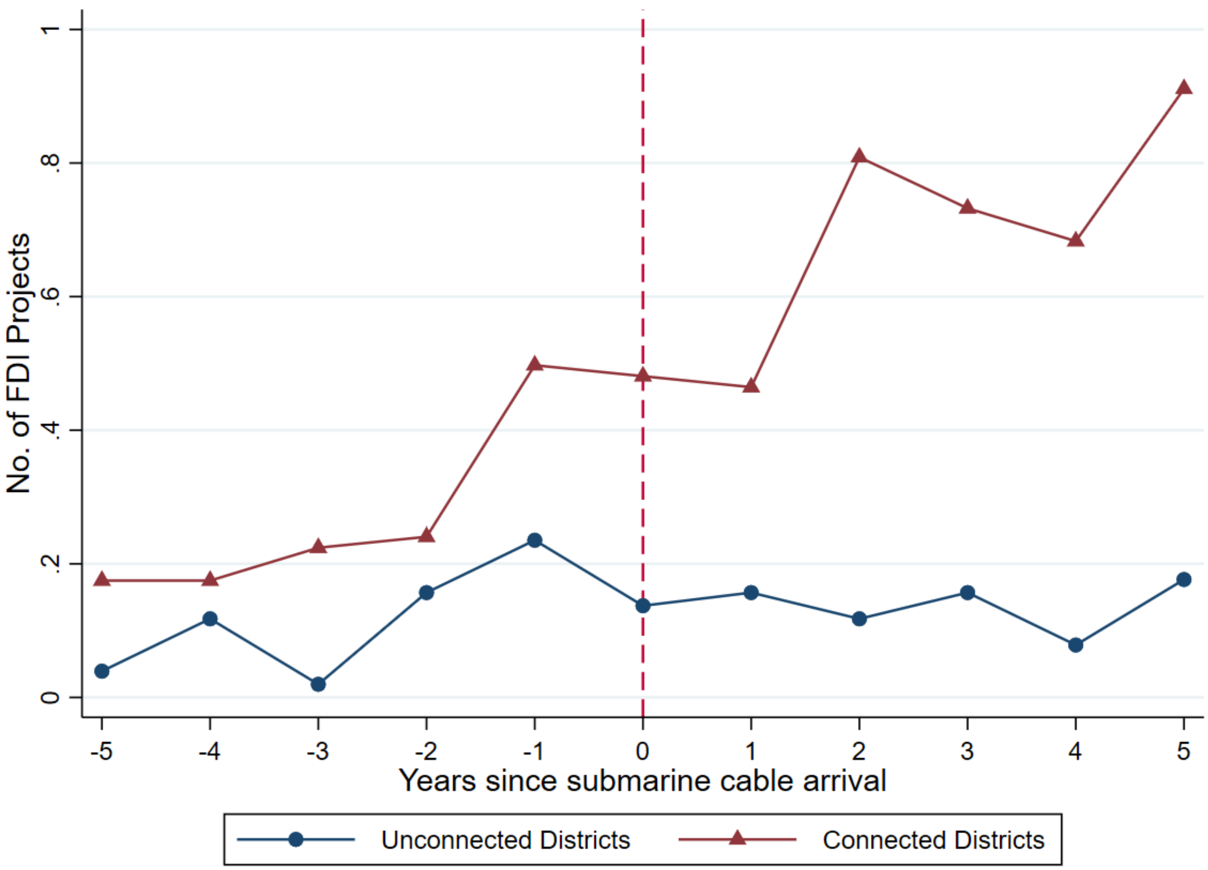
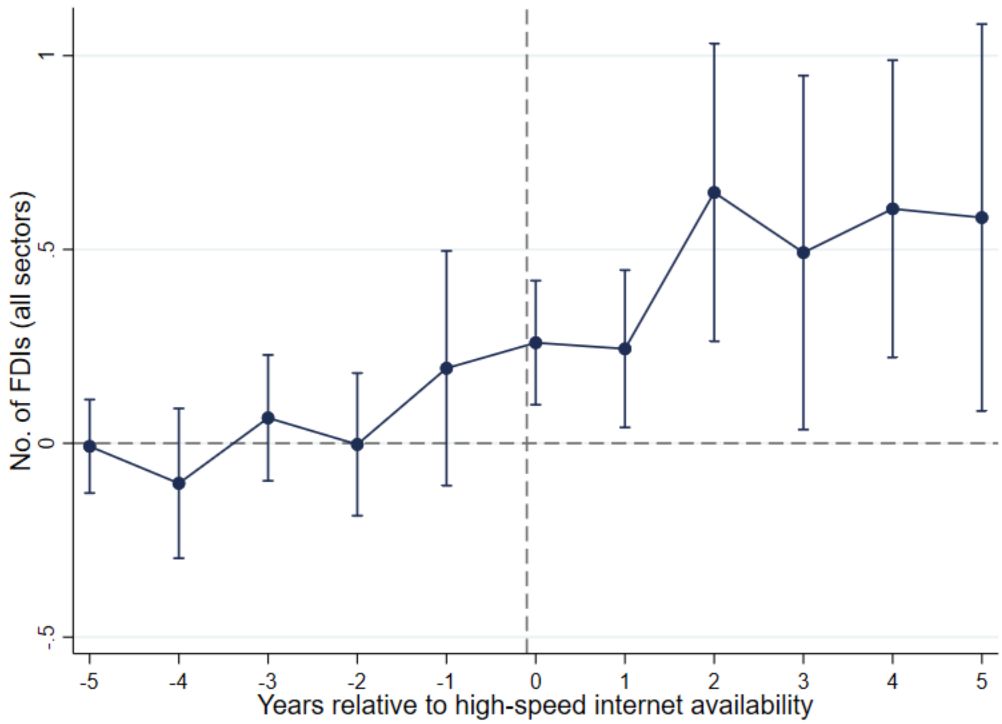


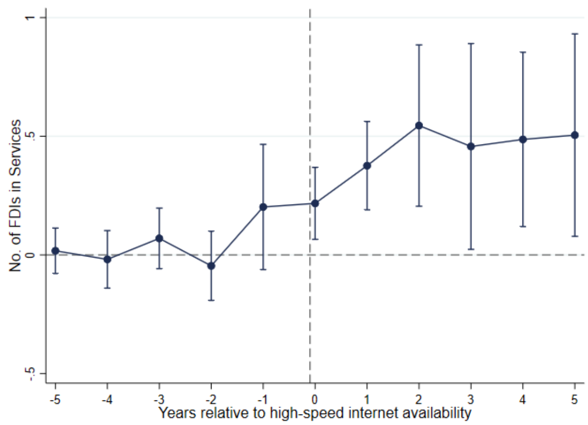
Figure 4: Event Study: High-speed Internet and FDI



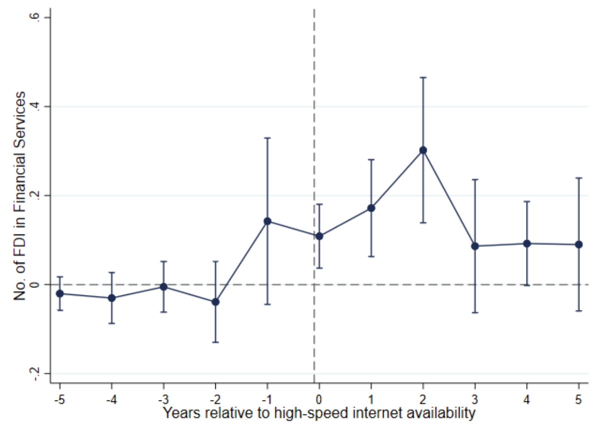
The figure shows event study estimates from theBorusyak et al. (2021) estimator. The outcome variable is the number of FDI projects in the district at year t. Standard errors are clustered at subnational district level.

Figure 5: Event Study Analysis: High-speed Internet and FDI at the Subnational level

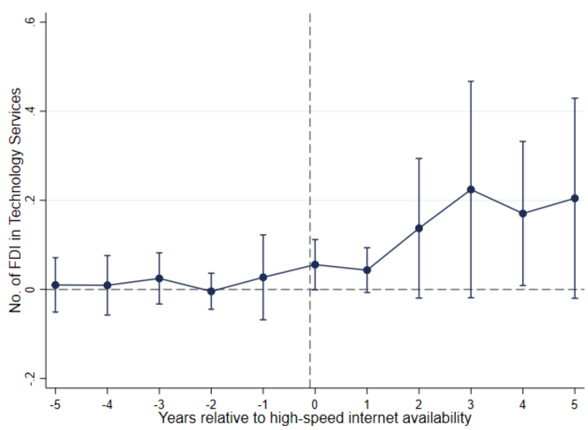
(a) Services (all)



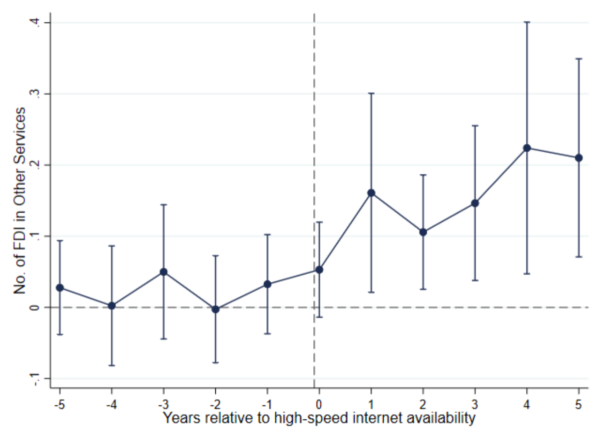
(b) Financial Services



(c) Technology Services



(d) Other Services (health + retail)



The figure shows event study estimates from theBorusyak et al. (2021) estimator. The outcome variable is the number of FDI projects in the respective sectors in the district at year t. Standard errors are clustered at subnational district level.

Tables

8.1 Baseline Results

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min.	Max.
FDI in All Sectors (0/1)	0.192	0.394	0	1
# of FDI in All Sectors	0.628	3.165	0	73
FDI in All Sectors ($ million)	39.9	241.5	0	7457.1
FDI in Manufacturing (0/1)	0.076	0.265	0	1
# of FDI in Manufacturing	0.104	0.427	0	6
FDI in Manufacturing ($ million)	14.296	142.608	0	7058.8
FDI in Services (0/1)	0.14	0.347	0	1
# of FDI in Services	0.492	2.871	0	69
FDI in Manufacturing ($ million)	10.705	84.169	0	4237.326
FDI in Other Sectors (Energy & Real Estate) (0/1)	0.027	0.161	0	1
# of FDI in Other Sectors (Energy & Real Estate)	0.033	0.217	0	4
FDI in Other Sectors (Energy & Real Estate) ($ million)	12.881	155.925	0	6811.5
FDI in Financial Services (0/1)	0.072	0.259	0	1
# of FDI in Financial Services	0.117	0.548	0	11
FDI in Financial Services ($ million)	1.518	9.106	0	319.7
FDI in Tech Services (0/1)	0.06	0.238	0	1
# of FDI in Tech Services	0.203	1.492	0	38
FDI in Tech Services ($ million)	3.942	63.584	0	4127.7
FDI in Other Services (health & retail) (0/1)	0.07	0.255	0	1
# of FDI in Other Services (health & retail)	0.173	1.15	0	33
FDI in Other Services (health & retail)	5.244	40.826	0	1595.7
Submarine	0.544	0.498	0	1
Connected	0.741	0.438	0	1
Submarine × Connected	0.409	0.492	0	1
Electricity grid network (km)	4.434	7.747	0.011	56.9
Distance to the coast (km)	4.272	3.788	0	16.9
Road length (km)	1149.439	2374.847	0.001	22051.2

Table 2: High-speed Internet and FDI

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	All Sectors						**Services**					
Submarine X Connected	0.0791***	0.0632**	0.1394***	0.1005***	0.4226***	0.2957**	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164**
	(0.0264)	(0.0283)	(0.0333)	(0.0334)	(0.1090)	(0.1244)	(0.0244)	(0.0255)	(0.0315)	(0.0305)	(0.0890)	(0.0920)
R-squared	0.4173	0.4306	0.6149	0.6320	0.4377	0.4515	0.4564	0.4751	0.6449	0.6638	0.5272	0.5517
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Manufacturing						**Other Sectors (Energy & Real Estate)**					
Submarine X Connected	0.0111	0.0009	0.0194	0.0116	0.0752	0.0306	0.0224*	0.0164	0.0199*	0.0129	0.1162	0.0886
	(0.0170)	(0.0193)	(0.0163)	(0.0183)	(0.0873)	(0.0976)	(0.0122)	(0.0143)	(0.0118)	(0.0139)	(0.0723)	(0.0862)
R-squared	0.2914	0.2959	0.3384	0.3453	0.2819	0.2866	0.2441	0.2491	0.2490	0.2538	0.2311	0.2348
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year *t* and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year *t* and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year *t*; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table 3: High-Speed Internet and FDI in Services Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	Services (all)						**Financial Services**					
Submarine X Connected	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164**	0.0512**	0.0566**	0.0582**	0.0609**	0.1692**	0.1887**
	(0.0244)	(0.0255)	(0.0315)	(0.0305)	(0.0890)	(0.0920)	(0.0216)	(0.0233)	(0.0230)	(0.0249)	(0.0704)	(0.0770)
R-squared	0.4564	0.4751	0.6449	0.6638	0.5272	0.5517	0.3774	0.3951	0.4372	0.4519	0.4096	0.4268
	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
	Technology Services						**Other Services (health+ retail)**					
Submarine X Connected	0.0340**	0.0273**	0.0464***	0.0335**	0.0754*	0.0542	0.0480***	0.0201*	0.0712***	0.0408**	0.2466***	0.1103**
	(0.0148)	(0.0131)	(0.0179)	(0.0161)	(0.0384)	(0.0390)	(0.0158)	(0.0120)	(0.0225)	(0.0203)	(0.0838)	(0.0519)
R-squared	0.4312	0.4443	0.6096	0.6200	0.4844	0.4966	0.4194	0.4368	0.5321	0.5462	0.4494	0.4733
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year *t* and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year *t* and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year *t*; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table 4: High-speed Internet and FDI: Role of Complementary Infrastructure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	FDI (0/1)			# FDIs (IHS)			FDI Size ($,IHS)		
					All Sectors				
Submarine × Connected	0.0281	0.0312	0.0221	0.0104	0.0120	-0.0201	0.1435	0.1489	0.0790
	(0.0311)	(0.0351)	(0.0354)	(0.0405)	(0.0465)	(0.0491)	(0.1444)	(0.1616)	(0.1626)
× High Electrification	0.0541*		0.0415	0.1712***		0.1387**	0.2999*		0.2762
	(0.0309)		(0.0405)	(0.0567)		(0.0632)	(0.1656)		(0.2142)
× High Road density		0.0437	0.0171		0.1347***	0.0496		0.2001	0.0319
		(0.0278)	(0.0385)		(0.0505)	(0.0554)		(0.1464)	(0.1976)
Internet + Internet× Electrification	0.0822		0.0636	0.1816		0.1186	0.4433		0.3552
p-value	0.0116		0.2109	0.0001		0.0833	0.0039		0.1603
Internet + Internet× Road		0.0749	0.0392		0.1468	0.0295		0.3490	0.1109
p-value		0.0262	0.3767		0.0007	0.5966		0.0192	0.5890
Internet + Int×Elec + Int× Road			0.0807			0.1682			0.3871
p-value			0.0239			0.0005			0.0167
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
					Services				
Submarine X Connected	0.0114	0.0179	0.0041	0.0064	0.0102	-0.0205	0.0746	0.0530	-0.0103
	(0.0276)	(0.0325)	(0.0323)	(0.0359)	(0.0442)	(0.0466)	(0.1068)	(0.1144)	(0.1165)
× High Electrification	0.0809***		0.0694*	0.1667***		0.1437**	0.3207***		0.2678**
	(0.0291)		(0.0369)	(0.0524)		(0.0561)	(0.1140)		(0.1304)
× High Road density		0.0617**	0.0160		0.1269**	0.0348		0.2547**	0.0825
		(0.0286)	(0.0378)		(0.0492)	(0.0524)		(0.1125)	(0.1333)
Internet + Internet× Electrification	0.0923		0.0735	0.1731		0.1231	0.3953		0.2575
p-value	0.0017		0.1129	0.0001		0.0454	0.0006		0.0994
Internet + Internet× Road		0.0796	0.0201		0.1371	0.0143		0.3077	0.0722
p-value		0.0089	0.6182		0.0004	0.7758		0.0042	0.6018
Internet + Int×Elec + Int× Road			0.0895			0.1580			0.3400
p-value			0.0049			0.0002			0.0025
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CountryXYear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3568	3664	3488	3568	3664	3488	3568	3664	3488

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. High Electrification is a dummy equal 1 if the density of the electricity grid network in the subnational district is above the median and 0 if otherwise. High Road density is a dummy equal 1 if the road density in the subnational district is above the median and 0 if otherwise. All regressions include the distance from the district centroid to the nearest coastline interacted with a time trend. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table 5: High-Speed Internet and FDI in Services: Role of Complementary Infrastructure

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	FDI (0/1)			# FDIs (IHS)			FDI Size ($,IHS)		
	Financial Services								
Submarine × Connected	0.0194	0.0283	0.0191	0.0198	0.0242	0.0134	0.0730	0.0942	0.0647
	(0.0237)	(0.0263)	(0.0271)	(0.0252)	(0.0285)	(0.0300)	(0.0786)	(0.0871)	(0.0908)
× High Electrification	0.0526**		0.0455*	0.0639**		0.0527*	0.1679**		0.1470
	(0.0240)		(0.0266)	(0.0305)		(0.0312)	(0.0820)		(0.0925)
× High Road density		0.0379	0.0090		0.0492*	0.0160		0.1215	0.0279
		(0.0252)	(0.0298)		(0.0297)	(0.0314)		(0.0833)	(0.0981)
Internet + Internet× Electrification	0.0720		0.0646	0.0837		0.0661	0.2409		0.2117
p-value	0.0047		0.0477	0.0037		0.0610	0.0036		0.0471
Internet + Internet× Road		0.0662	0.0281		0.0734	0.0294		0.2157	0.0926
p-value		0.0170	0.4220		0.0140	0.4119		0.0166	0.4336
Internet + Int×Elec + Int× Road			0.0736			0.0821			0.2396
p-value			0.0087			0.0080			0.0082
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	Tech Services								
Submarine X Connected	-0.0116	-0.0209	-0.0247	-0.0249	-0.0311	-0.0434	-0.0621	-0.0948*	-0.1109*
	(0.0179)	(0.0198)	(0.0218)	(0.0207)	(0.0266)	(0.0300)	(0.0427)	(0.0566)	(0.0625)
× High Electrification	0.0685***		0.0375	0.1054***		0.0724**	0.2086***		0.1149*
	(0.0242)		(0.0253)	(0.0352)		(0.0335)	(0.0750)		(0.0632)
× High Road density		0.0748***	0.0487**		0.0996***	0.0523*		0.2255***	0.1495***
		(0.0231)	(0.0229)		(0.0321)	(0.0274)		(0.0696)	(0.0523)
Internet + Internet× Electrification	0.0569		0.0128	0.0806		0.0290	0.1465		0.0040
p-value	0.0021		0.5887	0.0021		0.3661	0.0107		0.9481
Internet + Internet× Road		0.0539	0.0239		0.0686	0.0089		0.1307	0.0387
p-value		0.0036	0.3669		0.0025	0.7544		0.0178	0.4763
Internet + Int×Elec + Int× Road			0.0615			0.0813			0.1535
p-value			0.0015			0.0017			0.0111
	(19)	(20)	(21)	(22)	(23)	(24)	(25)	(26)	(27)
	Other Services (retail + health)								
Submarine X Connected	0.0104	0.0164	0.0006	0.0091	0.0198	-0.0042	0.0956	0.0766	0.0179
	(0.0198)	(0.0182)	(0.0182)	(0.0225)	(0.0242)	(0.0234)	(0.0983)	(0.0708)	(0.0738)
× High Electrification	0.0426**		0.0551*	0.0824***		0.0929**	0.1680**		0.1849*
	(0.0211)		(0.0281)	(0.0314)		(0.0385)	(0.0821)		(0.0987)
× High Road density		0.0142	-0.0196		0.0413	-0.0162		0.0870	-0.0240
		(0.0188)	(0.0258)		(0.0256)	(0.0309)		(0.0771)	(0.0942)
Internet + Internet× Electrification	0.0530		0.0557	0.0916		0.0887	0.2636		0.2028
p-value	0.0106		0.0710	0.0047		0.0446	0.0095		0.0577
Internet + Internet× Road		0.0306	-0.0190		0.0612	-0.0204		0.1636	-0.0061
p-value		0.0334	0.4402		0.0149	0.4818		0.0173	0.9510
Internet + Int×Elec + Int× Road			0.0361			0.0725			0.1788
p-value			0.0238			0.0128			0.0158
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CountryXYear FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3568	3664	3488	3568	3664	3488	3568	3664	3488

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. High Electrification is a dummy equal 1 if the density of the electricity grid network in the subnational district is above the median and 0 if otherwise. High Road density is a dummy equal 1 if the road density in the subnational district is above the median and 0 if otherwise. All regressions include the distance from the district centroid to the nearest coastline interacted with a time trend. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"

* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table 6: Internet Connectivity and Governance

	Regulatory Quality		Government Effectiveness		Control of Corruption		Political Stability		Rule of Law	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Submarine Internet Connectivity	0.0711*	0.0724*	0.1232**	0.1229**	0.1429	0.1433	0.0197	0.0318	0.0409	0.0449
	(0.0381)	(0.0393)	(0.0577)	(0.0566)	(0.0967)	(0.0969)	(0.1115)	(0.0979)	(0.0728)	(0.0750)
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mean dep. var	-0.8157	-0.8157	-0.8931	-0.8931	-0.6927	-0.6927	-0.6136	-0.6136	-0.7835	-0.7835
R-squared	0.9472	0.9475	0.9465	0.9465	0.9365	0.9366	0.8457	0.8582	0.9462	0.9491
Observations	448	448	448	448	448	448	448	448	448	448

Notes: Dependent variables are indices on governance from the World Bank World Governance Indicators database. Submarine Internet Connectivity is a dummy variable equal to 1 if the country is connected to at least one submarine fiber internet cable and 0 otherwise. Baseline Ctrls X Trend represents the interaction between a linear time trend and a dummy variable equal to 1 if the country is anglophone and 0 if otherwise. Robust standard errors clustered at the country level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table 7: High-Speed Internet Connectivity and Firm Performance

	Sales (log)		Sales per Worker (log)	
	(1)	(2)	(3)	(4)
Submarine X Connected	0.6709*	0.5796*	0.7357**	0.7437**
	(0.3520)	(0.3253)	(0.3457)	(0.3379)
Firm Ctrls	No	Yes	No	Yes
City FE	Yes	Yes	Yes	Yes
IndustryXYear FE	Yes	Yes	Yes	Yes
Yr of Est. FE	Yes	Yes	Yes	Yes

Notes: Dependent variables are the natural logs of total firm sales (constant 2009) and sales per worker (constant 2009). Firm Ctrls include: a dummy equal to 1 if firm is sole proprietorship and 0 otherwise; firm size; and whether the firm has foreign ownership. Robust standard errors clustered at the city level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

A Appendix

A.1 Robustness-clustering at country level

Table A1: High-speed Internet and FDI

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	All Sectors						Services					
Submarine X Connected	0.0791**	0.0632*	0.1394***	0.1005***	0.4226***	0.2957**	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164**
	(0.0278)	(0.0337)	(0.0284)	(0.0307)	(0.0943)	(0.1363)	(0.0240)	(0.0256)	(0.0251)	(0.0262)	(0.0764)	(0.0894)
Mean dep. var	0.1645	0.1697	0.2104	0.2187	0.7148	0.7396	0.1202	0.1239	0.1534	0.1595	0.4171	0.4299
R-squared	0.4173	0.4306	0.6149	0.6320	0.4377	0.4515	0.4564	0.4751	0.6449	0.6638	0.5272	0.5517
	Manufacturing						Other Sectors (Energy & Real Estate)					
Submarine X Connected	0.0111	0.0009	0.0194	0.0116	0.0752	0.0306	0.0224	0.0164	0.0199	0.0129	0.1162	0.0886
	(0.0121)	(0.0150)	(0.0115)	(0.0136)	(0.0684)	(0.0796)	(0.0131)	(0.0149)	(0.0119)	(0.0126)	(0.0839)	(0.0965)
Mean dep. var	0.0588	0.0608	0.0615	0.0638	0.2861	0.2962	0.0212	0.0226	0.0208	0.0222	0.1242	0.1326
R-squared	0.2914	0.2959	0.3384	0.3453	0.2819	0.2866	0.2441	0.2491	0.2490	0.2538	0.2311	0.2348
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the country level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table A2: High-speed Internet and FDI in Services Sector

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	Services (all)						Financial Services					
Submarine X Connected	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164**	0.0512*	0.0566**	0.0582**	0.0609**	0.1692**	0.1887**
	(0.0240)	(0.0256)	(0.0251)	(0.0262)	(0.0764)	(0.0894)	(0.0247)	(0.0265)	(0.0239)	(0.0262)	(0.0753)	(0.0821)
Mean dep. var	0.1202	0.1239	0.1534	0.1595	0.4171	0.4299	0.0659	0.0676	0.0706	0.0729	0.2156	0.2223
R-squared	0.4564	0.4751	0.6449	0.6638	0.5272	0.5517	0.3774	0.3951	0.4372	0.4519	0.4096	0.4268
	Technology Services						Other Services (health+retail)					
Submarine X Connected	0.0585***	0.0573***	0.0799***	0.0758***	0.1772***	0.1685***	0.0480***	0.0201	0.0712***	0.0408**	0.2466***	0.1103***
	(0.0133)	(0.0122)	(0.0226)	(0.0233)	(0.0392)	(0.0412)	(0.0131)	(0.0119)	(0.0171)	(0.0153)	(0.0711)	(0.0327)
Mean dep. var	0.0400	0.0421	0.0512	0.0541	0.1095	0.1155	0.0567	0.0591	0.0670	0.0702	0.2098	0.2171
R-squared	0.0940	0.1292	0.0681	0.0931	0.0640	0.0977	0.4194	0.4368	0.5321	0.5462	0.4494	0.4733
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the country level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

A.2 Conley Standard Errors

Table A3: High-speed Internet and FDI: Accounting for Spatial Clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	All Sectors						Services					
Submarine X Connected	0.0791***	0.0632**	0.1394***	0.1005***	0.4226***	0.2957***	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164***
	(0.0238)	(0.0254)	(0.0267)	(0.0265)	(0.1007)	(0.1085)	(0.0211)	(0.0224)	(0.0254)	(0.0252)	(0.0778)	(0.0808)
Mean dep. var	0.1202	0.1239	0.1534	0.1595	0.4171	0.4299	0.0659	0.0676	0.0706	0.0729	0.2156	0.2223
R-squared	0.0023	0.0101	0.0049	0.0276	0.0030	0.0122	0.0025	0.0148	0.0054	0.0338	0.0038	0.0216
	Manufacturing						Other Sectors (Energy & Real Estate)					
Submarine X Connected	0.0111	0.0009	0.0194	0.0116	0.0752	0.0306	0.0224**	0.0164	0.0199**	0.0129	0.1162*	0.0886
	(0.0131)	(0.0147)	(0.0123)	(0.0135)	(0.0654)	(0.0713)	(0.0107)	(0.0125)	(0.0099)	(0.0116)	(0.0632)	(0.0749)
Mean dep. var	0.0588	0.0608	0.0615	0.0638	0.2861	0.2962	0.0212	0.0226	0.0208	0.0222	0.1242	0.1326
R-squared	0.0001	0.0046	0.0002	0.0062	0.0002	0.0056	0.0009	0.0020	0.0007	0.0029	0.0007	0.0015
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year *t* and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year *t* and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year *t*; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Conley (1999) standard errors in parentheses, allowing for spatial correlation within a 200 km radius.
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

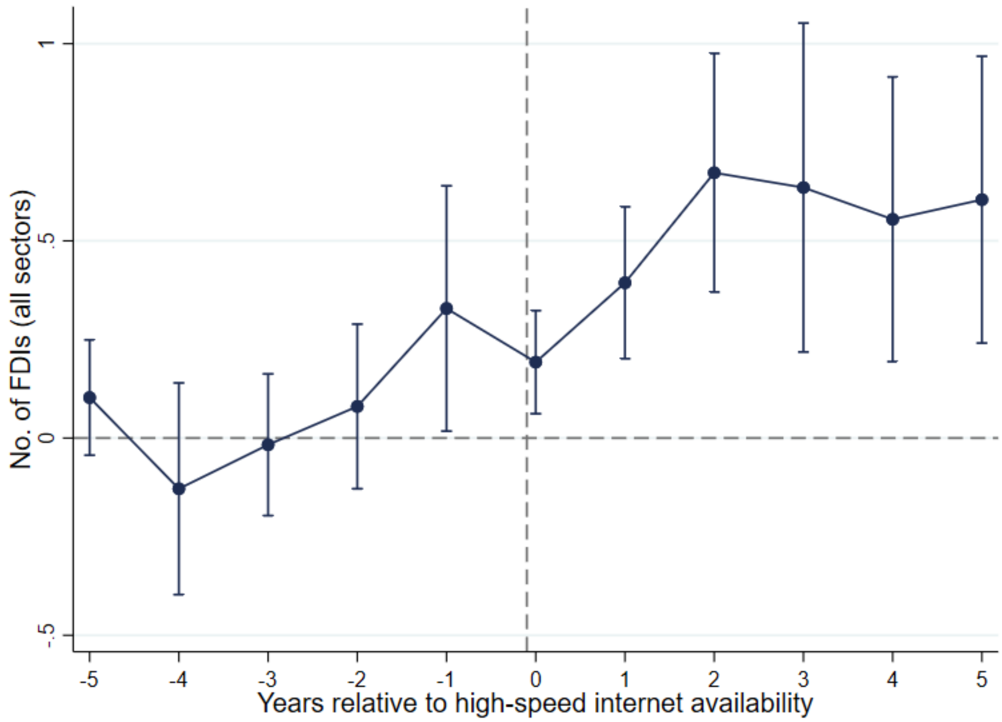
Table A4: High-Speed Internet and FDI in Services Sector: Accounting for Spatial Clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	Services (all)						Financial Services					
Submarine X Connected	0.0703***	0.0574**	0.1229***	0.0918***	0.3099***	0.2164***	0.0512**	0.0566***	0.0582***	0.0609***	0.1692**	0.1887***
	(0.0211)	(0.0224)	(0.0254)	(0.0252)	(0.0778)	(0.0808)	(0.0200)	(0.0220)	(0.0206)	(0.0223)	(0.0658)	(0.0723)
Mean dep. var	0.1202	0.1239	0.1534	0.1595	0.4171	0.4299	0.0659	0.0676	0.0706	0.0729	0.2156	0.2223
R-squared	0.0025	0.0148	0.0054	0.0338	0.0038	0.0216	0.0020	0.0119	0.0022	0.0117	0.0020	0.0118
	Technology Services						Other Services (health+ retail)					
Submarine X Connected	0.0340***	0.0273***	0.0464***	0.0335***	0.0754***	0.0542**	0.0480***	0.0201*	0.0712***	0.0408***	0.2466***	0.1103**
	(0.0104)	(0.0100)	(0.0121)	(0.0114)	(0.0194)	(0.0243)	(0.0128)	(0.0105)	(0.0166)	(0.0151)	(0.0651)	(0.0443)
R-squared	0.0015	0.0135	0.0020	0.0208	0.0007	0.0152	0.0021	0.0103	0.0034	0.0144	0.0038	0.0132
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536	3776	3536

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year *t* and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year *t* and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year *t*; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Conley (1999) standard errors in parentheses, allowing for spatial correlation within a 200 km radius."
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

A.3 Extending sample to include early (1st gen) SMCs

Figure A1: Event Study: High-speed Internet and FDI



The figure shows event study estimates from theBorusyak et al. (2021) estimator. The outcome variable is the number of FDI projects in the respective sectors in the district at year t. Standard errors are clustered at subnational district level.

Table A5: High-speed Internet and FDI: Extending the Sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	All Sectors						Services					
Submarine X Connected	0.0397*	0.0338	0.1024***	0.0856***	0.2088**	0.1533	0.0574***	0.0493**	0.1124***	0.0952***	0.2429***	0.1856***
	(0.0224)	(0.0237)	(0.0319)	(0.0326)	(0.1045)	(0.1127)	(0.0189)	(0.0197)	(0.0272)	(0.0264)	(0.0683)	(0.0673)
Mean dep. var	0.1919	0.1960	0.2683	0.2753	0.8805	0.9013	0.1400	0.1429	0.1999	0.2052	0.5079	0.5188
R-squared	0.4387	0.4435	0.7031	0.7088	0.4882	0.4928	0.4983	0.5055	0.7459	0.7515	0.5984	0.6072
	Manufacturing						Other Sectors (Energy & Real Estate)					
Submarine X Connected	-0.0087	-0.0126	0.0024	-0.0003	0.0081	-0.0110	0.0058	0.0055	0.0051	0.0053	0.0106	0.0158
	(0.0158)	(0.0173)	(0.0166)	(0.0180)	(0.0795)	(0.0861)	(0.0105)	(0.0112)	(0.0098)	(0.0108)	(0.0626)	(0.0687)
Mean dep. var	0.0764	0.0783	0.0805	0.0825	0.3685	0.3775	0.0268	0.0278	0.0268	0.0278	0.1566	0.1627
R-squared	0.3219	0.3244	0.3794	0.3827	0.3016	0.3035	0.2206	0.2226	0.2391	0.2410	0.2106	0.2121
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6384	6144	6384	6144	6384	6144	6384	6144	6384	6144	6384	6144

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level

Table A6: High-Speed Internet and FDI in Services Sector: Extending the sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)		FDI (0/1)		# FDIs (IHS)		FDI Size ($,IHS)	
	Services (all)						Financial Services					
Submarine X Connected	0.0574***	0.0493**	0.1124***	0.0952***	0.2429***	0.1856***	0.0367**	0.0399**	0.0496***	0.0519***	0.1266**	0.1356**
	(0.0189)	(0.0197)	(0.0272)	(0.0264)	(0.0683)	(0.0673)	(0.0153)	(0.0158)	(0.0185)	(0.0185)	(0.0520)	(0.0531)
Mean dep. var	0.1400	0.1429	0.1999	0.2052	0.5079	0.5188	0.0728	0.0741	0.0825	0.0843	0.2462	0.2512
R-squared	0.4983	0.5055	0.7459	0.7515	0.5984	0.6072	0.4198	0.4271	0.5291	0.5351	0.4771	0.4840
	Technology Services						Other Services (health+ retail)					
Submarine X Connected	0.0347***	0.0298**	0.0576***	0.0490***	0.1036**	0.0822**	0.0418***	0.0259**	0.0674***	0.0505***	0.1934***	0.1192**
	(0.0125)	(0.0121)	(0.0185)	(0.0173)	(0.0426)	(0.0403)	(0.0130)	(0.0122)	(0.0195)	(0.0179)	(0.0589)	(0.0479)
Mean dep. var	0.0602	0.0622	0.0890	0.0922	0.1762	0.1823	0.0700	0.0719	0.0918	0.0945	0.2781	0.2849
R-squared	0.5532	0.5571	0.7551	0.7581	0.6267	0.6302	0.4694	0.4769	0.6407	0.6474	0.5243	0.5337
Baseline Ctrls X Trend	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
District FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country X Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6384	6144	6384	6144	6384	6144	6384	6144	6384	6144	6384	6144

Notes: Submarine X Connected is a dummy variable equal to 1 if a subnational district is connected to a fiber-optic backbone network that is connected to the submarine cable in year t and 0 if otherwise. Baseline Ctrls X Trend represents the interaction between time trend and: distance from the district centroid to the nearest coastline, total length of roads, and electricity grid network. FDI (0/1) is a dummy variable equal to 1 if there was any FDI project in the district in year t and 0 if otherwise; # FDIs (IHS) is the inverse-sine hyperbolic transformation (IHS) of the number of FDI projects in the district in year t; and FDI Size ($,IHS) is the IHS transformation of the amount (constant USD) of FDI in the district. Robust standard errors clustered at the district level in parenthesis"
* Significant at 10 percent level ** Significant at 5 percent level *** Significant at 1 percent level