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Spatial internet spillovers in manufacturing

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Abstract

Does local internet diffusion spur manufacturing performance in developing countries? To answer this question, we conduct instrumental variable estimations, using repeated cross-section data on 44,073 manufacturing firms from 109 developing and transition economies, and find large positive spillover effects of local email incidence on manufacturing firms' sales and sales per worker. This evidence is driven by the local dissemination of email technology within industries rather than across industries. However, further analysis stresses that inter-industry spillovers are actually U-shaped, that is, negative at low email incidence rates but turning positive once incidence reaches approximately 50% of the local universe of firms. This suggests that local internet spillovers across industries are subject to network effects. Last, these threshold effects seem related to the presence of outward-oriented firms, which are known to exhibit higher digital absorptive capacity. Overall, this paper shows that local industrialisation paces may strongly diverge between poorly and highly digitalised environments.

Keywords: Connectivity, internet, spillovers, manufactures, industrialisation.
JEL classification: F61, L25, O33, O14, O18.

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1 Introduction

Digital technologies (DT)[1] have become essential to the conduct of business in both high- and lower-income countries, mainly through their effect on information diffusion, transaction costs reduction, innovation promotion, and overall markets' functioning (Paunov & Rollo, 2015, 2016; Aker, 2017; Goldfarb & Tucker, 2019). But beyond the direct benefits of DT adoption for firms, their dissemination in their proximate environment may also indirectly affect firms' activity. Being both general purpose technologies and network goods, benefits of digital technologies, such as the internet or mobile phones, spill over industries and increase with the user network (Bresnahan & Trajtenberg, 1995; Björkegren, 2019; Katz & Shapiro, 1985). Hence, a greater diffusion of DT in a delimited geographical area may generate positive spillover effects via network effects or knowledge spillovers (Marsh, Rincon-Aznar, Vecchi, & Venturini, 2017; Paunov & Rollo, 2015, 2016). . However, there is also a risk that digitalisation[2] primarily benefits first adopters or dominant firms, at the expense of those that are less performing and have a lower absorptive capacity (Görg & Greenaway, 2004; Marsh et al., 2017), pushing forward the most advanced sectors of the economy to the detriment of the more traditional ones (Choi, Dutz, & Usman, 2020; Hjort & Poulsen, 2019; Rodrik, 2018). The digitalisation process could hence accelerate the decline of certain industries, widen regional economic disparities, and even assist in the de-industrialisation process in poorly digitalised places (Rodrik, 2016a, 2016b, 2018; Wu, Wang, & Sun,. 2021). Therefore, the net economic benefits drawn from the diffusion of digital technologies are likely but not guaranteed.

The uncertainty upon digital dividends, especially those related to internet diffusion, is particularly salient for firms operating in the manufacturing sector in developing countries. First, while evidence of a positive effect of internet on the service sector is strong (Freund & Weinhold, 2002; Kneller & Timmis, 2016), it is less clear whether this process has benefited the manufacturing sector (Stiroh, 2002). Yet, some expect knowledge spillovers resulting from DT diffusion to be greater in manufacturing than in services because of higher technological progress in the former (Glaeser, Kallal, Scheinkman, & Shleifer, 1992).

Second, evidence on the consequences of the manufacturing sector's digitalisation is widely documented for industrialised countries, but rather scarce in the case of developing ones.[3] Yet, the manufacturing sector is at the core of the industrialisation process and identified as a critical source of income and job creation in developing countries (Rodrik, 2016a, 2018; Tybout, 2000). A better understanding of the contribution of DT to manufacturing firms' performance is therefore of utmost importance for developing countries, especially those caught in an under-industrialisation trap or suffering from premature de-industrialisation (Diao, McMillan, & Rodrik, 2019; Rodrik, 2016b).

Third, recent studies have addressed the direct impact of firms' internet adoption on their performance in low-income countries (Hjort & Poulsen, 2019), but less is known about spillovers stemming from the local diffusion of internet technologies in developing areas (Wu et al. 2021).[4] This paper contributes to fill this gap by investigating spatial internet spillovers resulting from the local diffusion of email technology on the performance of firms in the manufacturing sector, in a large sample of developing and transition economies.

Our empirical analysis is carried out on a repeated cross-section sample of 44,073 manufacturing firms, surveyed between 2006 and 2018 through 11 survey waves, located in 562 cities or regions from 109 developing and transition economies. To address endogeneity concerns, the local incidence of email use among firms is instrumented by a set of composite instrumental variables (IVs) (Borusyak & Hull, 2020). In this setting, identification follows from the quasi-random assignment of infrastructure-related aggregate connectivity shocks, weighted by firms' location distance to main connectivity infrastructures.

Our results support that local diffusion of email technology generates substantive positive spillovers in terms of revenue and labour productivity in the manufacturing sector: a 10-percentage point increase in the local share of firms using email results in a 40% increase in manufacturing firm's sales and sales per worker. This finding is robust to a variety of specifications and robustness checks. Moreover, distinguishing between intra-industry and inter-industry local spillovers, we stress that this evidence is driven by the local dissemination of the email technology within rather than outside the industry where the firm operates. However, we also show that local inter-industry spillovers are U-shaped, with negative inter-industry spillovers turning positive once a local email incidence threshold of approximately 50% is reached, suggesting that network effects are at play. Going further, we find that these positive (negative) inter-industry spillovers on the firm's output are actually linked with its outward (inward) orientation, which is a marker of a greater technological absorptive capacity. Overall, our analysis highlights the contribution of digitalisation to industrialisation, a key element of structural change, in developing economies.

The next section sets out our analytical framework and reviews the related literature. The third section exposes our empirical framework, while the fourth one presents our main findings. Robustness checks are performed in the fifth section and the sixth section concludes.

2 Local internet spillovers and industrialisation

As evidenced by studies on agglomeration economies (Jacobs, 1969; Marshall, 1890; see also Glaeser et al., 1992; Frenken, Van Oort, & Verburg, 2007), spillovers from ICTs often materialize locally. Internet diffusion makes it possible to overcome physical distances and to share knowledge and information with remote entities. But the transmission and absorption of tacit knowledge and non-codified information through communication technologies generally requires to be supplemented by physical encounters, and therefore be rooted in a delimited geographic area (Gaspar & Glaeser, 1998; Storper & Venables, 2004 Wu et al., 2021).

Spatial information spillovers are a critical "engine of growth"[5], generating *intra-industry* and *inter-industry* externalities (Glaeser et al., 1992; Jacobs, 1969; Marshall, 1890).[6] In a context of digitalisation, spatial internet spillovers within industries result from the transmission of knowledge, innovations, good practices, through internet-based technologies between firms operating in a same industry and located in the same place. By contrast, local internet spillovers across industries are linked to the diffusion of internet-based technologies across proximate industries, facilitating communication with upstream and downstream industries or the creation of new inter-industry linkages.[7]

Moreover, internet technologies are not only general-purpose information technologies whose dividends spread within and across industries, they are also network goods whose benefits depend on the user network (Katz & Shapiro, 1985): the greater the number of email users in a given location or industry, the greater the number and frequency of interactions through this technology. Such network effects of DT have been empirically evidenced in specific developing contexts as Rwanda (Björkegren, 2019) or China (Wu et al., 2021). We therefore expect spatial internet spillovers to be accentuated by the size of internet user network in a given area (Grace, Kenny, & Qiang, 2003; Stiroh, 2002; Wu et al., 2021).

Therefore, internet spillovers will strongly depend on firms' and industries' capacity to absorb internet technologies and related organizational changes (Hjort & Poulsen, 2019; Marsh et al., 2017). Digital absorptive capacity[8] can be explained by: a lack of digital skills within the firm, insufficient efforts towards innovations, a time lag between technology integration and its effects on firms'/ industries' development, a low exposure to international competition, or by insufficient research and development ($R\&D$) activities (Görg & Greenaway, 2004; Hjort & Poulsen, 2019; Marsh et al., 2017; Paunov & Rollo, 2016). As a result, the diffusion of internet technologies may translate into revenue losses for firms unable to absorb them. Moreover, in the longer run, it may also spur structural change, increasing disparities between cities with low and high internet penetration rates and causing the decline of traditional industries using obsolete technologies or made obsolete by technological shift (Choi et al., 2020; Diao et al., 2019; McMillan, Rodrik, & Sepulveda, 2016; Wu et al, 2021).

In this paper, we investigate spillover effects generated by the local diffusion of email technology, both within and across industries on the manufacturing sector. We also highlight certain characteristics of companies that allow them to take greater advantage of internet spillover effects.

3 Empirical framework

3.1 Baseline model

To estimate the causal effect of the local diffusion of internet technologies on manufacturing firms' performance, our IV approach consists in estimating the following second-stage (1a) and first-stage equations (1b):

$$Y_i = \alpha_0 + \alpha_1 \overline{Internet}_{l(i)t(i)} + \alpha_2 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \varepsilon_{1i} \quad (1a)$$

$$\overline{Internet}_{l(i)t(i)} = \beta_0 + \beta_1 Z_{l(i)t(i)} + \beta_3 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \varepsilon_{2l(i)t(i)} \quad (1b)$$

Where the subscripts i, j, s, l, and t respectively refer to the firm, country, stratification sector, location, and fiscal year. Y_i measures the performance of the firm, $\overline{Internet}_{l(i)t(i)}$ is the incidence of email use in location l at time t, which measures the spatial internet spillovers. $Z_{l(i)t(i)}$ represents the set of instruments and X_i is a vector of firm-level characteristics. These equations also include country-year ($d_{j(i)t(i)}$), sector ($d_{s(i)}$), location dummies ($d_{l(i)}$), and random error terms (ε_i). Standard errors are robust to heteroscedasticity and clustered at the country-year level.

3.2 Data and descriptive statistics

The variables used in our baseline model are drawn from the standardised World Bank Enterprise Surveys (WBES). They provide repeated cross-sectional data, covering an original representative sample of stratified randomly sampled firms (based on firm size, location and sector), operating in formal, non-agricultural sectors and urban areas of developing and transition countries. Our baseline sample covers 44,073 manufacturing firms from 562 locations (cities or regions) in 109 developing and transition economies, surveyed over the period 2006-2018.[9] In each country, data were gathered using an extensive and internationally comparable questionnaire administered via face-to-face interviews with business owners and senior managers. Variables' sources and definition as well as some descriptive statistics are presented in Appendices A, B, C and D.

3.2.1 *Firms' performance (Y_i)*

To measure firm's performance we use two output variables: the logarithm of the firm's total annual sales (in USD) and the logarithm of the firm's total annual sales per full-time permanent worker adjusted for temporary workers (in USD) to measure labour productivity, as commonly used in the literature (Chemin, 2020; Léon, 2020).

3.2.2 *Spatial diffusion of email technology ($\overline{\boldsymbol{Internet}}_{\boldsymbol{l(i)t(i)}}$)*

Internet diffusion is proxied by email use among manufacturing and service firms in the location where the firm operates. We focus on email use rather than website ownership, the other internet-related variable included in the WBES. Indeed, while a company may have a website without using internet on a daily basis or even having an internet connection (Fabiani, Schivardi, & Trento, 2005), email use reflects a cheaper, multipurpose (internal or external communications), less strategic and less skill-intensive use of internet (Sadowski, Maitland, & van Dongen, 2002). Moreover, emails can be accessed via a slow internet connection (fixed or mobile). For these reasons, we consider that email incidence among firms is an indicator of internet diffusion better fit for international comparisons than website incidence.

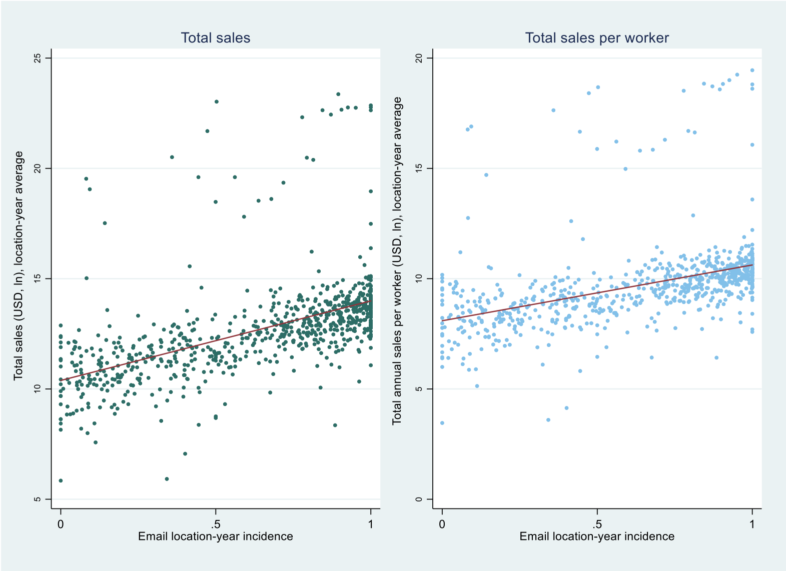
Therefore, we follow Acs, Audretsch, and Feldman (1994), Haskel, Pereira, and Slaughter (2007), and Paunov and Rollo (2016), and compute the incidence rate of email use at the location level:

$$\overline{Internet}_{l(i)t(i)} = \frac{1}{N_l - 1}\left(\sum_{f \in l} Email_{f,l} - Email_{i,l}\right), \forall l \in L, i \neq f \qquad (2)$$

Where *Email* is a dichotomous variable indicating whether firms i and f in location l use email to conduct business, or not. L refers to the set of locations l where firms operate, and N_l refers to the respective number of firms in each location l. To compute this incidence variable, we impose a minimum of 10 observations by location and exclude manufacturing firm i's own adoption of email technology to address eventual reverse causality bias. This approach is also necessary to separate the direct effect of a firm's individual adoption of email technology (included as a control variable), from spillover effects coming from its diffusion at the location level.

Figure 1 graphically represents the simple correlation between email incidence and firms' average performances. It highlights a strong and positive relationship between email incidence and firms' sales and productivity.

Figure 1: Email incidence in locations and manufacturing firms' performance.



Source: WBES data and authors' calculation based on 739 locations from 109 countries.

3.2.3 *Control variables*

We control for a set of firm-level characteristics whose impact on performance has been evidenced in the literature (Dollar, Hallward-Driemeier, & Mengistae, 2005; Paunov & Rollo, 2015, 2016). To separate the effect of the individual adoption of email technology from spillover effects caused by its local diffusion, we control for email and website adoption at the firm level. To consider the firm's absorptive capacity, we control for its size, measured by the number of full-time permanent employees when the firm started operations, and its maturity, proxied by firm's age (in years) and its top manager's experience (in years).[10] We control for other determinants of the firm's performance such as its public and foreign ownership structure, its degree of export orientation, and its financial liabilities (measured by a dummy equal to one if the firm has a credit line or a loan from a financial institution). Moreover, since access to internet relies on access to energy, we also consider the firm's electricity constraint, as reported by the firm.[7] Last, our set of control variables also comprises the geographical distance to the closest international connectivity infrastructure – i.e. the closest submarine cable (SMC) landing stations or Internet eXchange Point (IXP) in the country where the firm operates – which also serves as weight in our instrumental variable setup, hereafter described. Summary statistics of standard WBES variables used in our empirical analysis are reported in Table 1.

Table 1: Summary statistics of WBES variables.

	Mean	Std. Dev.	Min	Max
Firm outcomes (Y_i)				
Real annual sales (USD, ln)	13.25	2.59	0	27.28
Real annual sales / worker(USD, ln)	9.84	1.97	0	21.89
Internet spillovers ($\overline{Internet}_{l(i)t(i)}$)				
Email location incidence [0;1]	0.717	0.25	0	1
Control variables (X_i)				
Email adoption (0 or 1)	0.72	0.45	0	1
Website adoption (0 or 1)	0.45	0.50	0	1
% of state ownership	0.54	5.85	0	100
% of foreign ownership	6.97	23.58	0	100
% dir. indir. Exports in sales	12.64	27.70	0	100
Firm's age (years, ln)	2.73	0.71	0	4.76
Initial # perm. FT employees(ln)	2.678	1.26	0	13.81
Manager experience (years, ln)	2.66	0.75	0	4.32
Bank loan (0 or 1)	0.38	0.49	0	1
Distance to connectivity infra (km, ln)	4.67	2.00	0.693	8.351
Electricity obstacle (ordered, 0 to 4)	1.79	1.49	0	4

Sample: 40,154 manufactures from 521 locations (cities/regions) in 109 developing and transition countries.

3.3 Instrumental variable setting

Our identification strategy is meant to address two empirical challenges. First, an individual firm's performance may affect overall local economic activity, and hence, neighbouring firms' inclination to adopt emails, through for instance imitation behaviours. Such a mechanism could be a source of reverse causality bias. Second, omitted variables, especially unobserved local conditions, may influence both firm's performance and the local incidence of internet technologies. To estimate the causal effect of email incidence on manufacturing firms' performance, we adopt a composite instrumental variable approach, formalized by Borusyak and Hull (2020), consisting in weighting random aggregate connectivity shocks by a plausibly endogenous factor reflecting firms' exposure to them. Additional information on the IV's rationale and calibrations is provided in Supplementary materials (Section A.1) and Appendix E.2.

Our instrument set combines two complementary sources of random variation in aggregate connectivity, related to the deployment of telecommunications submarine cables (SMCs): i) the variation in the number of SMCs laid in a country, and ii) the country's experience of SMC outages, more specifically, the duration of their associated repairs. Because the risk of cable outages naturally arises from the laying of SMCs and increases with their number, using together these two nested IVs improves first-stage statistics[11], while enabling to estimate causal inter- and intra-spillover effects or identify thresholds in spillover effects with a consistent instrument set (see Appendix E).

SMCs are the cornerstone of the worldwide telecommunications network, whereby more than 95% of world telecommunications, including internet traffic, are carried. As a result, threats upon SMC infrastructure integrity are a key concern for governments, companies, and international agencies. In this regard, SMCs' outages are a critical and random source of telecommunication shut- or slowdowns, inducing expensive repairs, higher insurance and rerouting costs. Importantly, these costs are amplified by the time needed to repair cables (Carter et al., 2010; OECD, 2014; Palmer-Felgate, Irvine, Ratcliffe, & Bah, 2013; Pope, Talling, &

Carter, 2017).[12] In our estimation sample, 29 out of 109 countries have experienced internet disruptions caused by SMCs' faults – induced by ship anchoring, fishing nets, sabotage, maintenance, or unidentified causes[13] – during the current and four years preceding the reference fiscal year (Table 2).

Our IV design assumes that firms' exposure to SMC connectivity shocks depends on their distance to the closest international connectivity infrastructure (SMC landing stations or IXPs). In a core-periphery setting, populations remote from (close to) connectivity infrastructures are more (less) exposed to telecommunication network disruptions and suffer (benefit) from worse (better) connectivity than close (remote) ones. This spatial hierarchy in internet connectivity is explained by the necessity to maintain internet access in most important economic and population centres if the whole network capacity is undermined (Grubesic & Murray, 2006; Grubesic, O'Kelly, & Murray, 2003; Gorman & Malecki, 2000; Gorman, Schintler, Kulkarni, & Stough, R, 2004; Malecki, 2002).

Table 2: Internet disruptions and repair duration caused by SMCs' faults over (t; $t-4$), estimation sample.

iso	Σ repair days	Σ disruptions	iso	Σ repair days	Σ disruptions
ARM	1	1	KEN	26	3
BDI	16	2	LBN	13	2
BEN	15	1	LBR	2	1
BGD	9	3	LKA	56	2
CHN	5	3	MMR	20	1
CMR	7	1	MYS	1	1
CMR	3	2	NGA	37	3
COL	2	1	PAK	29	3
DJI	22	2	PHL	49	1
ECU	1	1	PHL	4	2
ETH	7	1	SLE	8	2
GEO	1	1	TZA	10	1
IDN	49	1	YEM	12	1
IND	33	4	ZMB	12	1
JOR	1	1	**Total**	**451**	**49**

Source: Authors' calculation. Data drawn from the Subtel forum http://subtelforum.com/category/cable-faults-maintenance/, Akamai's reports on the "State of Internet Connectivity", and completed by manual internet searches.

Our IV strategy therefore consists in weighting two main sources of exogenous aggregate connectivity shocks – the number of SMCs laid in a given country and the cumulative duration of outage repairs – by the distance from the location to the closest internet connectivity infrastructure. The number of SMCs is divided by the distance to connectivity infrastructure (the closer, the greater the connectivity) while SMCs' outage repairs are multiplied by this distance (the closer, the lower the exposure to slowdowns). As a result, we obtain two IVs, exhibiting location-year variability after the inclusion of country-year and location fixed-effects. Figure 2 below represents graphically the correlation of IV1 and IV2 with the incidence of email use at the location level.

The first instrument ($IV1$) is calculated as follows:

$$IV1_{j(i)l(i)t(i)} = SMC_{j(i)} \times \frac{1}{1+\ln(1+Distance_{l(i)t(i)})} \qquad (3)$$

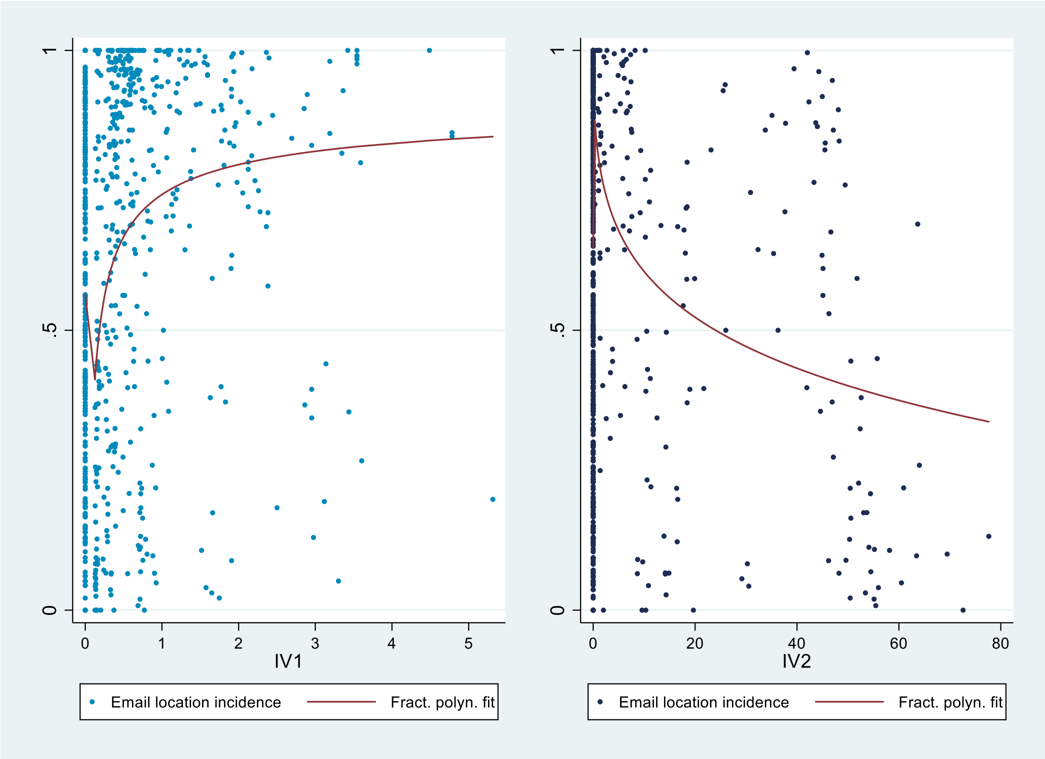
Where $SMC_{j(i)}$ is the number of SMCs laid in country j and $Distance_{l(i)t(i)}$is the distance from the firm's location l to the closest connectivity infrastructure at time t.

The second ($IV2$) reflects firms' exposure to SMC-induced internet disruptions and associated cable repair duration. Because shocks can have a lagging effect on the penetration of internet through a decrease in internet service quality and an increase in internet tariffs, this IV is calculated over various time-windows going up to four years before the fiscal year, as expressed in Equation (4):

$$IV2_{j(i)l(i)t(i)} = \frac{1}{1+\tau_2-\tau_1}\sum_{\tau=t-\tau_2}^{t-\tau_1} Repair\_days_{j(i)\tau(i)} \times [1 + \ln(1 + Distance_{l(i)\tau(i)})] \qquad (4)$$

Where τ_1 = [0; 3] ≤ τ_2 = [1; 4], $Repair\_days_{j(i)\tau(i)}$ is the cumulative number of days necessary to repair damaged cables in country j in year $(t - \tau)$, and $Distance$ is the same weighting distance variable as in Equation (3). In baseline estimations, $IV2$'s time window is set to $[t; t - 4]$ in order to optimise first-stage statistics.[14]

Figure 2. Correlation between instruments and email incidence in locations.



Source: WBES data and authors' calculation based on 739 locations from 109 countries.

4 Empirical results

4.1 Baseline estimations

Table 3 reports the results of IV-2SLS pooled estimations of the baseline econometric model (Eq. (1)) on a baseline sample of some 44,073 firms located in 109 developing and transition economies. We start by estimating our model without including control variables (column (1)). Then we include the distance to infrastructures, as well as email and website adoption variables (column (2)), and finally, all control variables. To check whether estimated spillover effects are directly related to firm's internet adoption and not to indirect channels, we interact $\overline{Internet}_{l(i)t(i)}$ with email and website adoption variables, alternatively (columns (5)-(8)). First-stage estimates of baseline estimations are reported in Appendix E.1.

First-stage and overidentification statistics support the validity of the IV set-up in baseline estimations, while first stage estimates reported in Appendix E.1 show that IVs have the expected sign.[15] KP F-test and LM statistics however suggest that estimates associated to interaction variables in columns (5) to (8) might be subject to weak instrument bias, and should therefore be taken with caution. Second-stage estimations first show some intuitive results regarding control variables: firm's size and age - more than manager's experience- have a positive and significant impact on sales and productivity. Access to a bank loan and being a foreign firm have also a positive and robust effect on firms' performance. More importantly, our findings indicate a positive and significant effect of email location incidence on manufacturing firms' total sales and sales per worker, independent of the firms' use of email or website.

According to baseline estimates in columns (3) and (4), total sales and sales per worker are found to increase by approximately 4 percent following a 1 percentage point increase in the local incidence of email. Moreover, estimates in columns (5) to (8) also suggest that local internet spillovers are mediated by the firm's own use of the internet, captured by the email and website adoption dummy variables. They support that if firms do not adopt internet technologies such as email or website, their revenue would suffer from the local diffusion of emails in their proximate environment, probably due to an increased competition from neighbouring firms adopting emails and/or local economic transformations.

Therefore, unlike studies that do not find evidence of positive ICT spillovers in industrialized countries (Acharya, 2016; Marsh et al., 2017; Stiroh, 2002), we highlight substantial positive spatial internet spillovers on manufacturing firms' performance in a large sample of developing and transition economies. However, we cannot yet determine the nature of these spatial spillovers, that is, whether they are driven by intra-industry or inter-industry diffusion of emails. The next sub-section addresses this question.

Table 3: Baseline estimates

Dep. Var:	(1) Sales	(2) Sales	(3) Sales	(4) Sales / work.	(5) Sales	(6) Sales / work.	(7) Sales	(8) Sales / work.
(A) $\overline{Internet}_{l(i)t(i)}$	4.738**	6.614***	4.341***	4.137***	-9.685*	-8.915*	-5.155**	-4.663***
	(2.113)	(2.217)	(0.726)	(0.763)	(5.591)	(5.172)	(2.018)	(1.632)
(B) $\overline{Internet}_{l(i)t(i)}$x email					37.133***	34.534***		
					(12.244)	(10.500)		
(C) $\overline{Internet}_{l(i)t(i)}$x website							36.116***	33.520***
							(3.346)	(3.240)
Email adopt		1.123***	0.689***	0.410***	-26.124**	-24.531***	2.458***	2.050***
		(0.165)	(0.112)	(0.066)	(10.158)	(8.771)	(0.433)	(0.412)
Website adopt		1.017***	0.627***	0.275***	0.626**	0.273	-29.398***	-27.595***
		(0.072)	(0.051)	(0.045)	(0.254)	(0.248)	(2.773)	(2.606)
Dist. to connect. infra (km, ln)		-0.003	-0.019	-0.002	-0.011	0.006	-0.062	-0.043
		(0.028)	(0.041)	(0.025)	(0.081)	(0.064)	(0.060)	(0.045)
Exports (% sales)			0.006***	0.001	0.011***	0.005***	0.010***	0.005***
			(0.001)	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)
Initial # perm. FT employees (ln)			0.641***	0.026	0.808***	0.182*	0.823***	0.195**
			(0.040)	(0.037)	(0.091)	(0.099)	(0.086)	(0.091)
Manager exp (years, ln)			0.002	-0.023	-0.044	-0.064	-0.123	-0.139**
			(0.061)	(0.041)	(0.091)	(0.070)	(0.077)	(0.068)
Firm's age (years, ln)			0.200***	0.031	0.347***	0.166*	0.302***	0.125**
			(0.048)	(0.024)	(0.079)	(0.088)	(0.080)	(0.055)
% of foreign ownership			0.008***	0.005***	0.009***	0.005***	0.007***	0.004*
			(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)
% of state ownership			0.004***	0.000	0.001	-0.003	-0.003	-0.006**
			(0.001)	(0.000)	(0.006)	(0.005)	(0.003)	(0.003)
Bank loan (0 or 1)			0.577***	0.289***	0.512***	0.227**	0.551***	0.265**
			(0.049)	(0.057)	(0.094)	(0.112)	(0.114)	(0.104)
Electricity obstacle			0.023	-0.005	0.146	0.109	0.023	-0.005
			(0.031)	(0.030)	(0.096)	(0.090)	(0.070)	(0.067)
(A) F-Stat	27.13	383.91	125.62	125.62	107.22	107.20	107.22	107.20
(B)-(C) F-Stat					14.91	14.93	118.97	117.23
Country-year, location, sector FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KP Wald F	27.13	384	107.2	107.2	2.206	2.181	12.40	12.30
LM stat	2.041	5.118	7.868	7.859	0.917	0.912	1.611	1.607
Hansen J test (P-val.)	0.196	0.135	0.201	0.208	-	-	-	-
N	56,839	54,873	44,073	44,073	44,073	44,073	44,073	44,073

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates of the first-stage equation not reported. Standard errors are presented in parentheses, are robust to heteroscedasticity and clustered by country-fiscal year. First-stage estimates of baseline estimations (cols (3) and (4)) reported in Appendix E.1.

4.2 Intra-industry *versus* inter-industry spillovers

To study local internet spillover effects within and across industries, we decompose the location-level email incidence variable into i) a variable measuring the spatial diffusion of email use among firms operating in the same industry as the firm considered, and ii) a variable measuring the spatial diffusion of email use among the universe of firms operating in the same location but in the remaining set of industries. The set of considered industries is the result of stratification sectors' grouping, detailed in Section C.2 in Supplementary Materials.[16]

We therefore conduct 2SLS estimations of the following system of equations:

$$Y_i = \gamma_0 + \gamma_1 \overline{Internet\_intra}_{l(i)k(i)} + \gamma_2 \overline{Internet\_inter}_{l(i)k(i)} + \gamma_3 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \epsilon_i \quad (5a)$$

$$\overline{Internet\_intra}_{l(i)k(i)t(i)} = \delta_0 + \delta_1 Z_{l(i)t(i)} + \delta_2 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \epsilon_{2l(i)k(i)t(i)} \quad (5b)$$

$$\overline{Internet\_inter}_{l(i)k(i)t(i)} = \zeta_0 + \zeta_1 Z_{l(i)t(i)} + \zeta_2 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \epsilon_{3l(i)k(i)t(i)} \quad (5c)$$

Where (ϵ_{1i}, $\epsilon_{2l(i)k(i)t(i)}$, $\epsilon_{3l(i)k(i)t(i)}$) is the error terms structure.

Results, reported in Table 4, show opposite intra and inter-industry local spillover effects, depending on whether digital technology diffusion takes place within or outside the industry where the firm operates.[17] On the one hand, we find that the incidence of email use in the same industry has a positive and significant effect on the firm's sales and sales per worker. On the other hand, a larger local diffusion of email across other industries significantly deteriorates manufacturing firms' performance. To ensure that our findings are not biased by small sample size in specific location-industry pairs, we re-run estimations excluding those with less than 20 observations. The results, reported in columns (3) and (4), highlight robust, 1% significant, but softer spillover effects. Therefore, in light of previous estimations, our analysis so far supports that positive intra-industry spillovers supersede negative inter-industry ones, but also indicates that the overall or net spillover effects could be much larger if the negative inter-industry spillovers were lower. In the next sub-sections, we provide additional insights into the mechanisms underlying such spillover effects.

Table 4: Inter- and intra-industry spillovers.

Dep. Var:	(1) Total sales	(2) Sales / worker	(3) Total sales	(4) Sales / worker
	Baseline sample		Location-industry with $N_{k,l} \geq 20$	
(A) $\overline{Internet\_inter}$	-13.852***	-12.990***	-6.192***	-5.923***
	(2.372)	(1.961)	(2.065)	(2.143)
(B) $\overline{Internet\_intra}$	22.353***	20.852***	7.681***	6.932***
	(2.221)	(1.523)	(1.070)	(1.067)
	1st-stage estimates			
Endog. var (A):				
IV1	0.164**	0.164**	0.218**	0.218**
	(0.067)	(0.067)	(0.093)	(0.093)
IV2 – Calibration: (t; t-4)	-0.012**	-0.012**	-0.018**	-0.018**
	(0.006)	(0.006)	(0.008)	(0.008)
Weak-id SW F stat	28.01	25.87	78.82	75.16
Under-id SW Chi-2 stat.	73.74	72.21	80.46	76.73
Endog. var (B):				
IV1	0.113***	0.112***	0.204***	0.204***
	(0.032)	(0.033)	(0.070)	(0.070)
IV2 – Calibration: (t; t-4)	-0.006**	-0.006**	-0.010*	-0.010*
	(0.003)	(0.003)	(0.006)	(0.006)
Weak-id SW F stat	77.15	55.64	754.36	818.76
Under-id SW Chi-2 stat.	78.78	56.88	770.08	835.83
Control variables (X_i)	Yes	Yes	Yes	Yes
Fixed effects (d_{jt}, d_l, d_s)	Yes	Yes	Yes	Yes
KP F-stat	8.014	7.932	20.91	20.30
N	43,490	43,426	26,919	26,889

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors are presented in parentheses, and are robust to heteroscedasticity and clustered by country-fiscal year.

4.3 Threshold spillover effects and firm's outward orientation

A first and obvious explanation for the existence of negative digital spillovers lies in the size of the internet user network. A critical mass of internet users might be necessary for network effects to become palpable (Grace et al., 2003; Wu et al., 2021). By contrast, below a certain rate of technology diffusion within industries, first movers on the new technology may capture the market share of less productive competitors or use their market power to impose barriers to new entrants. Within locations, the spread of technology may increase the profitability of ICT-intensive industries at the expense of less ICT-intensive industries, with possible adverse consequences for local productive capacity (Choi et al., 2020). Moreover, Marsh et al. (2017) argue that it may take time for a technology to become widespread and fully exploited, which points to the possibility of threshold spillover effects induced by the delayed diffusion of digital technologies within locations, both within and across industries.

To investigate these non-linear spillover effects on manufacturing firm's performance, we introduce into the baseline equation (1) the squared term of the internet spillover variable, yielding the following system of equations:

$$Y_i = \eta_0 + \eta_1 \overline{Internet}_{l(i)t(i)} + \eta_2 \overline{Internet}^2_{l(i)t(i)} + \eta_3 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \upsilon_i \quad (6a)$$

$$\overline{Internet}_{l(i)t(i)} = \beta_0 + \beta_1 Z_{l(i)t(i)} + \beta_2 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \upsilon_{2l(i)t(i)} \quad (6b)$$

$$\overline{Internet}^2_{l(i)t(i)} = \theta_0 + \theta_1 Z_{l(i)t(i)} + \theta_2 X_i + d_{j(i)t(i)} + d_{l(i)} + d_{s(i)} + \upsilon_{3l(i)t(i)} \quad (6c)$$

With (υ_{1i}, $\upsilon_{2l(i)t(i)}$, $\upsilon_{3l(i)t(i)}$) the error terms structure. 2SLS estimates of equation (8), reported in Table 5, reveal non-linear internet spillover effects on manufacturing firms' sales and sales per worker. After testing for the presence of U-shaped spillover effects on sales, we reject, within a 1% confidence-level, the hypothesis of a monotone or inverse U-shaped relationship, and identify an email incidence cut-off equal to 0.53.

Second, we take the analysis in columns (3) to (6) further by replacing $\overline{Internet}$ and $\overline{Internet}^2$ with their corresponding inter-(intra-)industry email incidence variables in the set of endogenous variables, controlling in parallel for the intra-(inter-)industry incidence. These additional estimations support a similar U-shaped inter-industry spillover effect on manufacturing firms' sales and sales per worker, with a close incidence cut-off value (0.45). Hence, an insufficient email user network size seems to lie behind negative (inter-industry) spillovers, suggesting that the internet penetration gap may widen the industrialisation gap between highly and poorly digitalised cities.[18] By contrast, intra-industry spillovers do not follow such a U-shaped curve, suggesting that knowledge and information spillovers, rather than network effects, could lie behind within-industry externalities.

However, an insufficient network size does not preclude the capacity of a minority of high-performing firms displaying a higher capacity to absorb technological change to take advantage of the diffusion of ICTs across industries in a poorly digitalised environment (Marsh et al., 2017; Paunov & Rollo, 2015, 2016). This absorptive capacity is expected to be markedly higher in outward-oriented firms, defined as exporting, foreign or multi-plant firms (Glaeser et al., 1992; ; Farole & Winkler, 2012; Paunov & Rollo, 2016). Therefore, we interact $\overline{Internet\_inter}$ with a dummy reflecting the firm's inward-orientation: it is equal to one if, at the same time, the firm is single-plant, does not export, and has no foreign ownership.[19] Estimates presented in column (4) suggest that threshold negative (positive) inter-industry spillovers were probably driven by inward-(outward-)oriented firms. In fact, the diffusion of internet across industries is higher in locations where firms are more outward-oriented – the internet being indispensable to communicate with distant clients, suppliers, and other business partners –, with potentially a better chance of reaching the incidence threshold above which spillovers become positive. This interpretation is supported by the correlation plot and additional estimations using the dimensions of outward orientation – namely share of direct and indirect exports, foreign ownership and multi-plant status – as interaction variables separately provided in Section C.3 of Supplementary Materials.

Table 5: Threshold spillover effects.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. Var::	**Total sales**	**Sales / worker**	**Total sales**	**Sales / worker**	**Total sales**	**Sales / worker**	**Total sales**	**Sales / worker**
Endogenous variables:								
(A) $\overline{Internet}$	-29.212***	-26.966***						
	(5.961)	(5.415)						
(B) $\overline{Internet}^2$	27.883***	25.851***						
	(3.632)	(3.040)						
(A) $\overline{Internet\_inter}$			-24.349***	-22.971***			29.59***	26.75***
			(3.311)	(2.932)			(2.508)	(2.701)
(B) $\overline{Internet\_inter}^2$			28.073***	26.365***				
			(2.407)	(1.838)				
(A) $\overline{Internet\_intra}$					254.180	253.225		
					(441.883)	(458.538)		
(B) $\overline{Internet\_intra}^2$					-230.739	-231.118		
					(427.001)	(443.497)		
$\overline{Internet}$ x inward .							-34.975***	-31.26***
							(5.185)	(4.790)
Additional controls:								
$\overline{Internet\_intra}$			0.827***	0.624**				
			(0.282)	(0.260)				
$\overline{Internet\_inter}$					-10.257	-10.028		
					(17.955)	(18.869)		
Inward orientation							23.087***	20.915***
							(3.706)	(3.337)
				1st-stage statistics				
Endog. var (A):								
Weak-id SW F stat	53.93	53.83	75.30	73.69	1.10	1.06	64.28	69.08
Under-id SW Chi-2 stat.	55.06	54.96	76.89	75.25	1.12	1.09	65.64	70.55
Endog. var (B):								
Weak-id SW F stat	89.93	89.77	130.39	127.44	1.05	1.02	47.68	51.09
Under-id SW Chi-2 stat.	91.81	91.65	133.15	130.14	1.07	1.04	48.69	52.17
KP Wald F-stat	2.346	2.346	83.85	84.10	0.116	0.107	6.292	6.512
Lind & Melhum U shape T-test	4.90***	4.98***	7.35***	7.83***	0.50	0.49	-	-
Threshold	0.52	0.52	0.43	0.43	0.55	0.55	-	-
Control variables (X_i)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects (d_{jt}, d_l, d_s)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	44,073	44,009	43,490	43,426	43,490	43,426	43,400	43,336

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates not reported. Standard errors are presented in parentheses, are robust to heteroscedasticity and clustered by country-fiscal year. U-shape t-test tests the null that the relationship is monotone or inverse U-shaped.

5 Robustness checks

In this section, we conduct a series of robustness checks which consist in ensuring that our findings are not undermined by omitted variable bias or location selection bias. All robustness check estimates are reported in Section B in Supplementary Materials.[20]

First, one possible caveat in our identification strategy is that unobserved characteristics of the firm's proximate environment could be directly conducive to firm's performance. Although the inclusion of country-year and location fixed-effects, as well as the (time-varying) location's distance to connectivity infrastructures mitigates this concern, other time-varying local factors correlated with both local internet access and firm's performance, such as the business environment, could bias our result. To address this issue, we first proceed to reduced-form estimations of the direct effect IVs on performance proxies and find that instruments behave in the same way as in first-stage estimations, suggesting that our IVs have an impact on firms' performance through the use of email. We also include in the set of control variables a proxy of local economic activity, orthogonal to local internet diffusion and the firm's own activity. Results are detailed in Sections A.2 and B.1 of Supplementary Materials.

Second, we perform pre-trend tests by regressing the three-year lagged total sales (per worker) over $\overline{Internet}_{l(i)t(i)}$, instrumented by our baseline instrument set (Borusyak et al., 2021). We also proceed to a reduced-form OLS estimation of the lagged dependent variable on instrumental variables IV1 and IV2. Results are reported in columns (3) and (4) of the table in Section B.1 of Supplementary Materials and do not provide evidence of an effect of internet spillovers on the lagged dependent variable. Moreover, to address the omitted variable bias that could arise from the non-random exposure to connectivity shocks (Borusyak & Hull, 2020), we perform falsification tests by regressing IV1 and IV2 on their "expected" values[21] (including location and country- year FEs), and using the resulting residuals as "recentered" instruments. Estimates, reported in columns (5) to (7) of the table in Section B.1 (Supplementary Materials), are also robust and consistent with baseline estimations.

Third, we augment our baseline econometric specification by controlling for additional sources of omitted variable bias. In fact, there could be linkages between specific industries, channelling or mediating spillover effects, which our model does not control for. We therefore include in our specification industry-pair dummy variables, equal to one if the firm operates in a given pair of industries, zero otherwise. Moreover, we also replace stratification sector FEs by dummies indicating the four-digit ISIC code of the firm's main product, to make sure that unobserved characteristics of the firm's output do not alter estimated relationships. Estimates, reported in Section B.2 of Supplementary Materials support the robustness of our results.

Fourth, we exclude landlocked countries from the sample because they cannot host SMCs, and can only be indirectly connected to them via the terrestrial cable network. The apparent absence of cable could therefore be associated with heterogeneous outcomes for these countries, because of missing information on terrestrial infrastructure deployment, cross-border connectivity, and cable-related internet disruptions. Results are robust to these additional checks, reported in Section B.3 of Supplementary Materials.

Fifth, even though location FEs reduce the concern for location selection bias (Duranton & Puga, 2020; Gaubert, 2018), we rerun estimations excluding from the sample large, multi-plant, foreign and exporting firms, which are more likely to be mobile and to choose locations close to connectivity infrastructures. In addition, we make sure that the estimated relationships are not affected by a low number of firms in some locations, by imposing a minimum of 50 firms in locations. In fact, locations that are far from infrastructures may host a smaller number of firms, among which less-performing firms may be over-represented. Results, reported in Sections B.4 and B.5 (Supplementary Materials), show that our findings remain robust to these ultimate sample restrictions.

6 Conclusion

Internet technologies play a critical role in environments where firms are strongly constrained in their daily interactions by large transactions costs, missing infrastructures and high levels of uncertainty. The adoption and diffusion of new technologies are likely to deliver net benefits, but these may not always be guaranteed due to limited digital absorptive capacity of some firms and industries, and to thresholds in network effects.

Focusing on manufacturing firms in a large sample of developing and transition economies, this paper shows that beyond the direct benefits of internet adoption by manufacturers, local diffusion of the email technology has yielded strong and positive spatial spillover effects on manufacturing firms' performance. In fact, IV estimations document a positive effect of an increased incidence of email use within locations on manufactures' revenues and labour productivity. However, these spillovers are subject to important threshold effects arising from the cross-industrial dimension: while the diffusion of the internet within an industry generates positive spillovers on firm performance whatever the incidence rate, the network of email users has to reach a critical size to produce positive externalities across industries. We indeed find evidence of negative spatial spillover effects from the diffusion of the internet across industries on manufacture sales and productivity below an email incidence threshold of approximately 40-50% of the local universe of firms. Last, these threshold effects seem related to the presence of outward-oriented firms, which tend to operate in places where internet is more diffused and demonstrate a greater absorptive capacity.

Overall, our empirical analysis, in line with recent findings on digitalisation in developing countries (Hjort & Poulsen, 2019; Wu et al, 2021), supports the idea that net spatial internet spillovers on developing countries' manufacturing sector are strong and positive. But evidence of U-shaped local spillover effects suggest that industrialisation paces may diverge between poorly and highly digitalised environments. To go further, the characteristics of firms that benefit the most from Internet use could be explored more extensively (in terms of sector of activity, workforce composition, etc.).

Additionally, while the literature has long documented agglomeration economies driving industrialization dynamics in developed countries, evidence on these dynamics in low-income countries remain scarce, especially in sub-Saharan African countries. In the context of the rapid urbanization pace prevailing in SSA (Vernon Henderson et al, 2017; Jedwab & Vollrath, 2019), patterns of agglomeration economies and the concomitant role of digitalization will probably shape the future of the continent, and so, probably deserve to be further investigated.

Last, while our results are informative about the impact of the spread of the Internet technology on the private sector development, our analysis is limited to the study of formal manufacturing firms, located in urban areas. The examination of digital spillover effects in rural areas or in the informal sector, where market failures supposedly addressed by these technologies (information asymmetries, travel costs, etc.)are salient, could be further relevant areas of research and help in policy-decision making in economies still predominantly rural and/or informal.

Notes

[1] Goldfarb and Tucker (2019) define digital technologies, of which internet technologies are part, as "the representation of information in bits [. . .] rather than atoms", which "reduces the cost of storage, computation and transmission of data" (p.3).
[2] In this paper, digitalisation refers to the growing use of digital technologies in socio-economic interactions.
[3] Paunov and Rollo (2015) address this issue, but in a succinct way. They identify larger returns to email diffusion within industries for service firms than for those operating in the manufacturing sector.
[4] The issue of spatial spillovers in the manufacturing sector of industrialised economies has been, however, extensively covered (Cingano & Schivardi, 2004; Martin, Mayer, & Mayneris, 2011; Wixe, 2015).
[5] Romer (1986), cited in Glaeser et al. (1992).
[6] For the sake of our analysis clarity, we keep this dichotomy between intra and inter-industry spillovers in its original expression (Glaeser et al., 1992), having in mind the recent advances in the literature that put forward a diversification effect (induced by related local production variety) underlying intra-industry spillovers, and a portfolio effect (induced by unrelated local production variety) underlying inter-industry spillovers (Frenken et al., 2007).
[7] To our knowledge, empirical research on inter-industry spillovers from ICTs' diffusion is rather scarce and mostly focused on industrialized economies (Harrisson et al., 1996; Marsh et al, 2017).
[8] Defined as a firm's "capacity to assimilate the technological knowledge created outside the firm and to apply it within its production process" (Marsh et al., 2017, p.1068).
[9] In the WBES, the fiscal year corresponding to reported sales and firms' characteristics diverges from the year of the survey round.
[10] We also control for workforce composition variables in a working paper version of this article that can be found here, assuming that they can affect firms' absorptive capacity. However, controlling for these variables leads to a significant sample attrition without modifying the results, that is why these variables are not included in this paper.
[11] The nested nature of SMC deployment and exposure to shocks finds support in Appendix D, which shows a positive correlation between SMC number (V3 and V6) and outage days experience (V4 and V5) on the one hand, and a negative correlation between outage days experience (V4 and V5) and email adoption (V1), website adoption (V7), and email spillovers (V2) on the other hand. Moreover, as instruments are nested, they should respect the monotonicity condition necessary for 2SLS estimators with multiple IVs to be valid (Imbens & Angrist, 1994).
[12] Note that regardless of whether firms have access to the internet via a computer or a mobile device, their connectivity will be similarly affected by SMCs-related internet disruptions.
[13] Excluding disruptions caused by government interventions or natural disasters, which could make exclusion restrictions violated. Estimations conducted without these two exclusion restrictions, reported in Appendix E.2 (column (7)), are consistent with baseline estimations.
[14] IV estimations using different time-windows are reported in Appendix E.2, and are further detailed in Section A.2 of Supplementary Materials. Following Borusyak et al.(2021), we also carried out IV estimates by fixing separately IVs' components - i.e. aggregate connectivity shocks or distance to infrastructures –at their value at the fiscal year of the first survey round (see results in Section A.3 of Supplementary Materials).
[15] As expected, the instrument based on the SMC network size ($IV1$) has a significant positive effect on email location incidence, while the instrument based on adverse connectivity shocks ($IV2$) has a significant negative effect. Alternative calibration of the IV setup, explored in Appendix E.2 and further detailed in Section A.2 of Supplementary Materials, gives additional information on the nested nature of our instruments.
[16] This grouping of sectors into industries has been made to avoid location-level sample attrition that would have occurred if incidence variable had been computed using stratification sectors. Estimations based on an alternative sectors' grouping procedure, explained in Section C.2 (Supplementary Materials), are provided in Section C.1 (Supplementary Materials). Results obtained are consistent with those presented in this section.
[17] Due to the small number of observations in some location-industry pairs associated with no within-location variation in incidence variables, the collinearity with location fixed-effects has led to a slightly reduced sample size compared to baseline estimations in Table 3.
[18] As recently evidenced in a sample of Chinese cities by Wu et al. (2021).
[19] Estimations using separately these characteristics of firms as interaction variables are reported in Section C.3 (Supplementary Materials). They show that inter-industry spillovers are positive when firms export, are foreign owned, or multi-plants.
[20] Additional estimations using alternative dependent variables, such as the workforce composition or innovation are provided in Section C.4 in the same Supplementary Materials.
[21] See preamble of Section B.1 in Supplementary Materials for an explanation of how these expected values are generated.

References

Acharya, R. C. (2016). ICT use and total factor productivity growth: intangible capital or productive externalities? *Oxford Economic Papers*, 68(1), 16–39.

Acs, Z. J., Audretsch, D. B., & Feldman, M. P. (1994). R & D spillovers and recipient firm size. *The Review of Economics and Statistics*, 336–340.

Aker, J. (2017). Using digital technology for public service provision in developing countries potential and pitfalls. Digital Revolutions in Public Finance.

Björkegren, D. (2019). The adoption of network goods: Evidence from the spread of mobile phones in rwanda. *The Review of Economic Studies*, 86(3), 1033–1060.

Borusyak, K., & Hull, P. (2020). Non-random exposure to exogenous shocks: Theory and applications (Tech. Rep.). National Bureau of Economic Research.

Borusyak, K., Hull, P., & Jaravel, X. (2021). Quasi-experimental shift-share research designs. *The Review of Economic Studies*, Forthcoming.

Bresnahan, T., & Trajtenberg, M. (1995). General purpose technologies 'engines of growth'? *Journal of Econometrics*, 65(1), 83–108.

Carter, L., Burnett, D., Drew, S., Marle, G., Hagadorn, L., Bartlett-McNeil, D., & Irvine, N. (2010). Submarine cables and the oceans: connecting the world (No. 31). UNEP/Earthprint.

Chemin, M. (2020). Judicial efficiency and firm productivity: Evidence from a world database of judicial reforms. *The Review of Economics and Statistics*, 102(1), 49–64.

Choi, J., Dutz, M. A., & Usman, Z. (2020). The future of work in africa: Harnessing the potential of digital technologies for all. World Bank Publications.

Cingano, F., & Schivardi, F. (2004). Identifying the sources of local productivity growth. *Journal of the European Economic association*, 2(4), 720–742.

Diao, X., McMillan, M., & Rodrik, D. (2019). The recent growth boom in developing economies: A structural-change perspective. In *The Palgrave handbook of development economics* (pp. 281–334), Springer.

Dollar, D., Hallward-Driemeier, M., & Mengistae, T. (2005). Investment climate and firm performance in developing economies. *Economic Development and Cultural Change*, 54(1), 1–31.

Duranton, G., & Puga, D. (2020). The economics of urban density. *Journal of Economic Perspectives*, 34(3), 3–26.

Fabiani, S., Schivardi, F., & Trento, S. (2005). ICT adoption in italian manufacturing: firm-level evidence.

Industrial and Corporate Change, 14(2), 225–249.

Farole, T., & Winkler, D. E. (2012). Foreign firm characteristics, absorptive capacity and the institutional framework: the role of mediating factors for FDI spillovers in low-and middle-income countries. World Bank policy research working paper (6265).

Frenken, K., Van Oort, F., & Verburg, T. (2007). Related variety, unrelated variety and regional economic growth. *Regional Studies*, 41(5), 685–697.

Freund, C., & Weinhold, D. (2002). The internet and international trade in services. *American Economic*

Review, 92(2), 236–240.

Gaspar, J., & Glaeser, E. L. (1998). Information technology and the future of cities. *Journal of Urban Economics*, 43(1), 136–156.

Gaubert, C. (2018). Firm sorting and agglomeration. American Economic Review, 108(11), 3117–53.

Glaeser, E. L., Kallal, H. D., Scheinkman, J. A., & Shleifer, A. (1992). Growth in cities. *Journal of Political Economy*, 100(6), 1126–1152.

Goldfarb, A., & Tucker, C. (2019). Digital economics. Journal of Economic Literature, 57(1), 3–43.

Görg, H., & Greenaway, D. (2004). Much ado about nothing? do domestic firms really benefit from foreign direct investment? The World Bank Research Observer, 19(2), 171–197.

Gorman, S. P., & Malecki, E. J. (2000). The networks of the internet: an analysis of provider networks in the USA. *Telecommunications Policy*, 24(2), 113–134.

Gorman, S. P., Schintler, L., Kulkarni, R., & Stough, R. (2004). The revenge of distance: Vulnerability analysis of critical information infrastructure. *Journal of Contingencies and Crisis Management*, 12(2), 48–63.

Grace, J., Kenny, C., & Qiang, C. Z.-W. (2003). Information and communication technologies and broad-based development: A partial review of the evidence. The World Bank.

Grubesic, T. H., & Murray, A. T. (2006). Vital nodes, interconnected infrastructures, and the geographies of network survivability. *Annals of the Association of American Geographers*, 96(1), 64–83.

Grubesic, T. H., O'Kelly, M. E., & Murray, A. T. (2003). A geographic perspective on commercial internet survivability. *Telematics & Informatics*, 20(1), 51–69.

Haskel, J. E., Pereira, S. C., & Slaughter, M. J. (2007). Does inward foreign direct investment boost the productivity of domestic firms? *The Review of Economics and Statistics*, 89(3), 482–496.

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

Imbens, G. W., & Angrist, J. D. (1994). Identification and estimation of local average treatment effects. *Econometrica*, 62(2), 467–475.

Jacobs, J. (1969). *The economy of cities*. Vintage.

Jedwab, R., & Vollrath, D. (2019). The urban mortality transition and poor-country urbanization. *American Economic Journal: Macroeconomics*, 11(1), 223-75.

Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *American Economic Review*, 75(3), 424–440.

Kneller, R., & Timmis, J. (2016). ICT and exporting: The effects of broadband on the extensive margin of business service exports. *Review of International Economics*, 24(4), 757–796.

Léon, F. (2020). The elusive quest for high-growth firms in Africa: when other metrics of performance say nothing. *Small Business Economics*, 1–22.

Lind, J. T., & Mehlum, H. (2010). With or without u? the appropriate test for a u-shaped relationship. *Oxford Bulletin of Economics and Statistics*, 72(1), 109–118.

Malecki, E. J. (2002). The economic geography of the internet's infrastructure. *Economic Geography*, 78(4), 399–424.

Marsh, I. W., Rincon-Aznar, A., Vecchi, M., & Venturini, F. (2017). We see ICT spillovers everywhere but in the econometric evidence: a reassessment. *Industrial and Corporate Change*, 26(6), 1067–1088.

Marshall, A. (1890). *Principles of economics*. London: Macmillan.

Martin, P., Mayer, T., & Mayneris, F. (2011). Spatial concentration and plant-level productivity in France. *Journal of Urban Economics*, 69(2), 182–195.

McMillan, M., Rodrik, D., & Sepulveda, C. P. (2016). The recent growth boom in developing economies: A structural-change perspective. In *Structural change, fundamentals, and growth: a framework and case studies* (pp. 281–334). Washington, DC: International Food Policy Research Institute.

OECD. (2014). International cables, gateways, backhaul and international exchange points. (Tech. Rep.). Organisation for Economic Cooperation and Development.

Palmer-Felgate, A., Irvine, N., Ratcliffe, S., & Bah, S. S. (2013). Marine maintenance in the zones: A global comparison of repair commencement times. In *Suboptic conference from ocean to cloud* (pp. 22–25).

Paunov, C., & Rollo, V. (2015). Overcoming obstacles: the internet's contribution to firm development. *The World Bank Economic Review*, 29(suppl 1), S192–S204.

Paunov, C., & Rollo, V. (2016). Has the internet fostered inclusive innovation in the developing world? *World Development*, 78, 587–609.

Pope, E. L., Talling, P. J., & Carter, L. (2017). Which earthquakes trigger damaging submarine mass movements: Insights from a global record of submarine cable breaks? *Marine Geology*, 384, 131– 146.

Rodrik, D. (2016a). An African growth miracle? *Journal of African Economies*, 27(1), 10–27.

Rodrik, D. (2016b). Premature deindustrialization. *Journal of Economic Growth*, 21(1), 1–33.

Rodrik, D. (2018). New technologies, global value chains, and developing economies (Tech. Rep.). National Bureau of Economic Research.

Romer, P. M. (1986). Increasing returns and long-run growth. *Journal of Political Economy*, 94(5), 1002–1037.

Sadowski, B. M., Maitland, C., & van Dongen, J. (2002). Strategic use of the internet by small-and medium-sized companies: an exploratory study. *Information Economics and Policy*, 14(1), 75–93.

Stiroh, K. J. (2002). Are ICT spillovers driving the new economy? *Review of Income and Wealth*, 48(1), 33–57.

Storper, M., & Venables, A. J. (2004). Buzz: face-to-face contact and the urban economy. *Journal of Economic Geography*, 4(4), 351–370.

Tybout, J. R. (2000). Manufacturing firms in developing countries: How well do they do, and why? *Journal of Economic Literature*, 38(1), 11–44.

Henderson, J. V., Storeygard, A., & Deichmann, U. (2017). Has climate change driven urbanization in Africa?. *Journal of Development Economics*, 124, 60-82.

Wixe, S. (2015). The impact of spatial externalities: Skills, education and plant productivity. *Regional*

Studies, 49(12), 2053–2069.

Wu, S., Wang, P., & Sun, B. (2021). Can the internet narrow regional economic disparities? *Regional Studies*, 1–14.

Appendix

A. Variables' sources and definition.

	Description	Sources
Dependent variables:		
Total sales (USD, ln)	Total annual sales made during the last fiscal year in real USD	WBES
Real sales per worker (USD, ln)	Total sales weighted by the # of FT perm. workers adjusted for temp. workers	WBES
Interest variable:		
Email incidence	The share of firms declaring using internet in the location where the firm operates.	Authors' calculation, data from the WBES
Email intra-industry incidence	The share of firms declaring using internet in the location and industry where the firm operates.	Authors' calculation, data from the WBES
Email inter-industry incidence	The share of firms declaring using internet in the location but outside industry where the firm operates.	Authors' calculation, data from the WBES
IV components:		
SMC number	The number of SMCs laid in a given country	Telegeography
SMC outages' repair duration	The cumulative number of days necessary to repair cables after outages occur. This number is computed over a 5-year timeframe in baseline estimations, and shorter timeframes in additional estimations provided in Supplementary materials (Section A.2).	Authors calculation. Raw data drawn from the Subtel forum http://subtelforum.com/category/cable-faults-maintenance/, Akamai's reports on the "State of Internet Connectivity", and completed by manual internet searches.
Distance to connectivity infra (km, ln)	Distance to the closest submarine cable's landing stations or Internet Exchange Point	Telegeography, Packet Clearing House and Peer ing DB
Control variables:		
Email adoption (0,1)	Does the firm use emails to communicate with clients or customers (1=yes,0=no)	WBES
Website adoption (0,1)	Does the firm have its own website? (1=yes, 0=no)	WBES
% of state ownership	Percent of the firm owned by the government/State	WBES
Distance to connectivity infra (km, ln)	Distance to the closest submarine cable's landing stations or Internet Exchange Point	Telegeography, Packet Clearing House and Peer ing DB
% of foreign ownership	Share of the firm owned by private foreign entities	WBES
% dir. indir. exports in sales	Share of sales that are exported directly or indirectly	WBES
Firm's age (years, ln)	Number of years since the creation of the firm	WBES
Initial # perm. FT employees (ln)	Number of full-time permanent employees when the firm started its operations	WBES
Manager experience (years, ln)	Number of years of experience the top manager has in the firm's sector	WBES
Bank loan (0,1)	Equal 1 when the firm has subscribed a credit or a loan from a financial institution, 0 otherwise	WBES
Electricity obstacle (ordered, 0 to 4)	To what extend is electricity an obstacle for the activity of the firm? 0: not an obstacle, 1: a minor obstacle, 2: a moderate obstacle, 3: a major obstacle, or 4: a very severe obstacle to their operations	WBES

B. Sample statistics, by fiscal year.

Fiscal year	Freq.	Percent	Fiscal year	Freq.	Percent
2005	5,764	13.08	2012	10,298	23.37
2006	3,026	6.87	2013	3,662	8.31
2007	3,812	8.65	2014	523	1.19
2008	2,350	5.33	2015	1,028	2.33
2009	5,130	11.64	2016	2,012	4.57
2010	1,810	4.11	2017	61	0.14
2011	4,597	10.43	**Total**	44,073	100

C. Sample statistics, by country.

iso	Obs	Std. Dev.	Freq.	iso	Obs	Std. Dev.	Freq.	iso	Obs	Std. Dev.	Freq.
AFG	155	0.35	0.35	GEO	163	0.37	27.97	MWI	34	0.08	67.05
AGO	311	0.71	1.06	GHA	545	1.24	29.21	MYS	457	1.04	68.08
ALB	159	0.36	1.42	GIN	142	0.32	29.53	NAM	167	0.38	68.46
ARG	1,615	3.66	5.08	GMB	33	0.07	29.6	NER	62	0.14	68.6
ARM	111	0.25	5.33	GNB	46	0.1	29.71	NGA	869	1.97	70.58
ATG	26	0.06	5.39	GRD	16	0.04	29.74	NIC	529	1.2	71.78
AZE	126	0.29	5.68	GTM	646	1.47	31.21	NPL	357	0.81	72.59
BDI	154	0.35	6.03	GUY	56	0.13	31.34	PAK	470	1.07	73.65
BEN	109	0.25	6.28	HND	429	0.97	32.31	PER	1,350	3.06	76.72
BFA	71	0.16	6.44	HRV	431	0.98	33.29	PHL	1,274	2.89	79.61
BGD	1,068	2.42	8.86	IDN	1,839	4.17	37.46	PNG	27	0.06	79.67
BGR	787	1.79	10.65	IND	6,243	14.17	51.63	PRY	541	1.23	80.9
BIH	181	0.41	11.06	IRQ	466	1.06	52.68	RUS	1,400	3.18	84.07
BLR	158	0.36	11.42	JAM	60	0.14	52.82	RWA	111	0.25	84.32
BLZ	69	0.16	11.57	JOR	255	0.58	53.4	SEN	420	0.95	85.28
BOL	485	1.1	12.67	KAZ	276	0.63	54.02	SLE	144	0.33	85.6
BRA	886	2.01	14.68	KEN	273	0.62	54.64	SRB	167	0.38	85.98
BRB	57	0.13	14.81	KGZ	155	0.35	55	SSD	83	0.19	86.17
BTN	82	0.19	15	KHM	106	0.24	55.24	SWZ	114	0.26	86.43
BWA	33	0.07	15.07	KNA	23	0.05	55.29	TCD	114	0.26	86.69
CAF	33	0.07	15.15	LAO	173	0.39	55.68	TGO	29	0.07	86.75
CHN	1,464	3.32	18.47	LBN	179	0.41	56.09	THA	496	1.13	87.88
CIV	253	0.57	19.04	LBR	138	0.31	56.4	TJK	161	0.37	88.24
CMR	162	0.37	19.41	LCA	53	0.12	56.52	TTO	108	0.25	88.49
COD	449	1.02	20.43	LKA	298	0.68	57.2	TUN	297	0.67	89.16
COG	21	0.05	20.48	LSO	119	0.27	57.47	TUR	1,154	2.62	91.78
COL	1,641	3.72	24.2	MAR	129	0.29	57.76	TZA	286	0.65	92.43
CPV	23	0.05	24.25	MDA	120	0.27	58.03	UGA	509	1.15	93.59
CRI	230	0.52	24.77	MDG	198	0.45	58.48	UKR	834	1.89	95.48
DJI	46	0.1	24.88	MEX	1,847	4.19	62.67	URY	533	1.21	96.69
DMA	20	0.05	24.92	MKD	209	0.47	63.15	VCT	41	0.09	96.78

D. Dependent, independent, and instrumental variables correlation matrix.

		V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	V12	V13	V14	V15	V16	V17	V18
V1	Total sales (USD, ln)	1.00																	
V2	Total sales / wk (USD, ln)	0.85	1.00																
V3	email	0.43	0.29	1.00															
V4	Email spillovers	0.34	0.29	0.58	1.00														
V5	SMC x Distance infra	0.09	0.03	0.14	0.24	1.00													
V6	E(Outage days x Distance) [T; t-4]	-0.07	-0.10	-0.04	-0.08	0.31	1.00												
V7	Sum outage days [t; t-4]	-0.08	-0.12	-0.05	-0.08	0.38	0.94	1.00											
V8	SMC number	0.06	-0.01	0.14	0.23	0.77	0.61	0.57	1.00										
V9	website	0.41	0.23	0.51	0.39	0.12	-0.06	-0.06	0.10	1.00									
V10	Exports (% sales)	0.21	0.05	0.17	0.06	-0.01	-0.04	-0.01	-0.05	0.18	1.00								
V11	Initial # perm. FT employees (ln)	0.42	0.08	0.21	0.04	0.11	0.07	0.08	0.13	0.23	0.26	1.00							
V12	Manager exp (years, ln)	0.10	0.07	0.12	0.17	0.02	-0.15	-0.13	-0.06	0.12	0.04	-0.01	1.00						
V13	Firm's age (years, ln)	0.18	0.08	0.15	0.15	0.16	0.05	0.06	0.12	0.17	0.03	0.09	0.43	1.00					
V14	% of foreign ownership	0.18	0.10	0.09	-0.01	-0.05	-0.08	-0.06	-0.11	0.08	0.23	0.19	-0.03	-0.03	1.00				
V15	% of state ownership	0.06	0.03	0.02	-0.01	-0.01	-0.01	-0.01	-0.01	0.04	0.02	0.09	-0.02	0.03	0.00	1.00			
V16	Bank loan (0 or 1)	0.24	0.15	0.24	0.22	0.03	-0.11	-0.10	-0.02	0.21	0.10	0.06	0.13	0.12	0.00	-0.02	1.00		
V17	Electricity obstacle	-0.07	-0.05	-0.10	-0.19	-0.14	-0.02	-0.04	-0.14	-0.09	-0.04	-0.06	-0.02	-0.04	0.02	-0.01	-0.01	1.00	
V18	Distance to connectivity infra (km, ln)	-0.04	-0.02	-0.05	-0.09	-0.42	0.18	0.04	0.03	-0.05	-0.06	-0.01	-0.08	-0.09	-0.06	0.02	-0.07	0.01	1.00

E. Instrument set calibrations.

E.1. First stage estimates of baseline estimations, Table 3, columns (3) to (8).

Corresponding columns in Table 3	(3)	(4)	(5)		(6)		(7)		(8)	
Instrumented variables	(A)	(A)	(A)	(B)	(A)	(B)	(A)	(C)	(A)	(C)
IV1	0.175***	0.175***	0.175***	0.049***	0.175***	0.049***	0.175***	0.028**	0.175***	0.028**
	(0.058)	(0.058)	(0.058)	(0.014)	(0.058)	(0.014)	(0.058)	(0.012)	(0.058)	(0.012)
IV2	-0.012**	-0.012**	-0.012**	-0.002**	-0.012**	-0.002**	-0.012**	-0.001	-0.012**	-0.001
	(0.005)	(0.005)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)
Email adopt	-0.006***	-0.006***	-0.006***	0.720***	-0.006***	0.720***	-0.006***	-0.051***	-0.006***	-0.051***
	(0.002)	(0.002)	(0.002)	(0.044)	(0.002)	(0.044)	(0.002)	(0.011)	(0.002)	(0.011)
Website adopt	0.001**	0.001**	0.001**	0.000	0.001**	0.000	0.001**	0.832***	0.001**	0.832***
	(0.000)	(0.000)	(0.000)	(0.007)	(0.000)	(0.007)	(0.000)	(0.017)	(0.000)	(0.017)
Dist. to connect. infra (km, ln)	0.046***	0.046***	0.046***	0.013***	0.046***	0.013***	0.046***	0.009**	0.046***	0.009**
	(0.015)	(0.015)	(0.015)	(0.004)	(0.015)	(0.004)	(0.015)	(0.003)	(0.015)	(0.003)
Exports (% sales)	0.000	0.000	0.000	-0.000**	0.000	-0.000**	0.000	-0.000***	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Initial # perm. FT employees (ln)	-0.000	-0.000	-0.000	-0.005	-0.000	-0.005	-0.000	-0.005***	-0.000	-0.005***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.003)	(0.000)	(0.002)	(0.000)	(0.002)
Manager exp (years, ln)	-0.002	-0.002	-0.002	0.001	-0.002	0.001	-0.002	0.003**	-0.002	0.003**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)
Firm's age (years, ln)	0.001	0.001	0.001	-0.003*	0.001	-0.003*	0.001	-0.003*	0.001	-0.003*
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
% of foreign ownership	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	-0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
% of state ownership	-0.000	-0.000	-0.000	0.000	-0.000	0.000	-0.000	0.000***	-0.000	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bank loan (0 or 1)	0.002*	0.002*	0.002*	0.002	0.002*	0.002	0.002*	0.001	0.002*	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)
Electricity obstacle	0.001	0.001	0.001	-0.003	0.001	-0.003	0.001	0.000	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)
Observations	44,073	44,009	44,073	44,073	44,009	44,009	44,073	44,073	44,009	44,009

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Standard errors are presented in parentheses, are robust to heteroscedasticity and clustered by country-fiscal year.

E.2. Baseline and alternative instrument set calibrations.

First stage-and second-stage estimated of control variables are reported in Section A.2 in Supplementary Materials.

Dep. Var: Total sales (ln, USD)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	First stage estimates							**Reduced form estimations**			
	Baseline sample					Excl. East-Asia & Pac	Unrestricted IVs	Baseline sample		Excl. East-Asia & Pac	Baseline sample
IV1	0.036*** (0.002)	0.170*** (0.057)	0.171*** (0.057)	0.175*** (0.058)			0.179*** (0.062)	0.515*** (0.035)			0.121 (0.192)
IV2 -- calibrations											
(τ1 = 0; τ2 = 2)		-0.007** (0.003)									
(τ1 = 0; τ2 = 3)			-0.010** (0.004)								
(τ1 = 0; τ2 = 4)				-0.012** (0.005)	0.002*** (0.000)	-0.064** (0.028)	-0.013** (0.005)		0.045*** (0.004)	-0.496*** (0.167)	0.035** (0.018)
	Second-stage estimates										
$\overline{Internet}$	14.470*** (1.367)	4.585*** (0.746)	4.523*** (0.741)	4.341*** (0.726)	24.198*** (1.599)	8.008*** (1.671)	3.715*** (0.737)	- -	- -	- -	
X_{it} + FEs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
KP Wald F stat	304.7	97.06	98.84	107.2	107.6	5.248	107.5	-	-	-	-
LM stat	1.993	7.646***	7.688***	7.868***	1.648	1.575	8.298***	-	-	-	-
Hansen J (P-val.)	-	0.200	0.200	0.201	-	-	0.205	-	-	-	-
N	44,073	44,073	44,073	44,073	44,073	37,493	46,443	44,095	44,095	39,916	44,095
R-squared	0.312	0.342	0.342	0.342	0.249	0.319	0.346	0.346	0.347	0.329	0.347

Note: * significant at 10%, ** significant at 5%, *** significant at 1%. Control estimates of 1st-stage equation not reported. Standard errors are presented in parentheses, and are robust to heteroscedasticity and clustered by country-year of survey. In column (7), we do not exclude observations associated with internet outages caused by natural hazards and government interventions in the sample and in IV2 computation.

"Sur quoi la fondera-t-il l'économie du monde qu'il veut gouverner? Sera-ce sur le caprice de chaque particulier? Quelle confusion! Sera-ce sur la justice? Il l'ignore."

Pascal

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