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Digital spillovers and SMEs' performance in Sub-Saharan Africa

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According to the IMF (2020), 20 million jobs per year have to be provided in Sub-Saharan Africa (SSA) to absorb the growing workforce in the subcontinent. Yet, the potential of simple digital technologies such as email, websites, and mobile money in terms of wealth and job creation has not been fully exploited by African firms. While the uptake of mobile phone technology has facilitated a multiplication of Internet-based innovations throughout the region, this dynamic is hampered by a large Internet divide and low penetration of these technologies among firms and individuals. In 2015, African countries' Internet penetration rates did not exceeding 60 percent of the population, with some countries like Niger, Sierra Leone, or Guinea-Bissau displaying penetration rates lower than five percent of the population.

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... /... In 2015 again, small African businesses were employing around 80% of the subcontinent's workforce (World Economic Forum, 2015). Yet, according to World Bank Enterprise Surveys conducted between 2013 and 2018, less than 60% of SMEs were using email for their business operations, and less than 30% used a website for business-related purposes. By comparison, 90% of large firms surveyed over the same period declared using email and/or a website during their activities. The development potential of digital technologies is therefore strongly constrained by their low diffusion and use among SMEs, which are as of yet the greatest job providers and wealth creators in the region.

In this policy brief, we use survey data from the WBES to provide an empirical assessment of the contribution of digital technologies diffusion to African SMEs' performance. Compared to existing empirical evidence on the impacts of digital technologies on African firms, the quantitative analysis hereafter presented incorporates various novelties. First, it investigates relationships between different usages of digital technologies – that is, email, website and mobile money – and various indicators of firm performance: total revenue, labour productivity, exports, and employment. Second, it exploits repeated cross-section survey data, drawn from the WBES covering a large sample of some 15,000 firms from 40 African countries, surveyed between 2006 and 2018. Third and mostly, our empirical analysis is the first to separate the spillover effects of digital technologies diffusion from the consequences of their adoption by African firms.

In the next section, we review the expected gains from digitization for the private sector, with a particular emphasis on the potential spillovers of digital technology diffusion on firm performance. The third section presents main empirical patterns of digital adoption by African SMEs, and empirical evidence on industry and location spillovers on these firm's individual performance. The fourth section concludes.

Expected gains from digitization for the African private sector

The adoption and diffusion of digital technologies among firms has led to a range revolutions in the way firms, industries, socio-economic interactions are shaped (Marsh et al, 2017; Goldfarb & Tucker, 2019). By reducing transaction costs and informational asymmetries, digital technologies are expected to boost firms' organizational and production capacities, to improve goods and service markets functioning, and to correct government failures. They could also generate positive spillovers effects on their productivity, innovation, market outreach, and thereby, spur job creation. However, there is a risk that digitization could be a source of a creative-destruction process, provoking firm exit or industries' obsolescence. Therefore, the digital dividends in terms of wealth and job creation are likely but not granted.

Digital technologies adoption and business operations

The penetration of digital technologies within the firm such as computer and mobile technologies' applications – i.e. email, website, spreadsheet software, social networks, digital platforms, and so on – has changed its organizational structure, production processes, communication protocols, and contributed to the creation of the firm's own digital knowledge. This results in fluidized communication and coordination between firm's workers, improved input usage and innovation processes, and eased access to critical information for decision making and market expansion (Paunov & Rollo, 2015, 2016; Islam et al., 2018ab). This is particularly true for Internet-related technology which, in addition to improving the firm's efficiency in input use and

innovation, strongly facilitates the collection of information on administrative procedures (e.g. business licenses), on market and political risks, on the tax system structure, tariffs and non-tariff measures, customer and competitor profiles, and so on. However, due to their high costs, Internet technologies might be unaffordable for smaller-size African enterprises. By contrast, mobile phone-related technologies, especially mobile money, have experienced a large diffusion among the population in some African countries and helped promote financial inclusion and risk-sharing (Patnam & Yao, 2020; Aker, 2017; Aker & Blumenstock, 2014), due to their low cost and ease of use (Aker & Mbiti, 2010), and a proven impact on information search and other transaction costs reduction (Duncombe & Heeks, 2002; Islam et al., 2018ab).

Moreover, digital technologies may also be instrumental to firm performance and job creation by their action on the business environment. Basic Internet technologies can indeed be very conducive to business operations by fluidizing the coordination between market actors and reducing price dispersion (Aker, 2010; Aker & Fafchamps, 2014), easing access to formal financial services (Kpodar & Andrianaivo, 2011), and improving access to public services (Aker, 2017; Cariolle, 2020). In fact, basic Internet technologies like email improve communication between customers and suppliers, facilitate interactions with the government and bureaucracy, and thereby help reduce informational asymmetries and the monetary and non-monetary costs associated with the firm's bilateral transactions. More strategic technologies like website may be particularly instrumental to improving the market and global value chain positioning of firms without requiring pre-existing business relationships (Sadowski et al., 2002; Harrison & Waite, 2006), thereby reducing communication and information search costs to reach customers and suppliers. In the same way, more sophisticated technologies such as digital platforms, e.g. job platforms or digital marketplaces, are called upon to improve markets functioning by bringing together suppliers and customers at minimum cost. These expected systemic effects of digital technologies suggest that strong spillovers could arise from their diffusion among private firms.

Digital spillovers

Digital spillovers are the indirect positive or adverse consequences, also called externalities, of the diffusion of digital technologies and digital knowledge outside the firm. They are inherent to digital technologies being general purpose technologies (Bresnahan & Trajtenberg, 1995) and network goods (Katz & Shapiro, 1985; Crémer et al, 2000), whose applications spread across all branches of an economy and benefits increase with the size of user's network (Marsh et al, 2017).

First, positive digital spillovers may result from ***network effects***, induced by a higher penetration of digital technologies among firms, contributing to multiply and accelerate interactions between adopters of these technologies (Stiroh, 2002; Grace et al, 2004). ICTs are indeed network goods whose derived benefits depends on the technology adopter's network size (Crémer et al, 2000; Grace et al, 2004; Goldfarb & Tucker, 2019). The greater the number of a digital technology users in a given location or a given industry, the greater the socio-economic benefits derived from its adoption by users.

Second, positive ***digital knowledge spillovers*** result from the sharing of information, good practices, processes, and innovations related to digital technologies (Harrison et al, 1996; Paunov & Rollo, 2015, 2016). Digital knowledge spillovers fall within two categories (Marsh et al, 2017): on the one hand, the knowledge originating from competitors, also called (within-) industry spillovers, and on the other hand, the knowledge created from outside the industry, also called

cross- or inter-industry spillovers. While the first type of information spillovers has received a large attention from theoretical and empirical research (Stiroh, 2002; Paunov & Rollo, 2015, 2016), the second type of information spillovers is less documented and suggests that the creation and circulation of knowledge also spread across industries, when for instance upstream and downstream industries communicate and exchange ideas, processes, practices and so on (Marsh et al, 2017).

Third, ***negative digital spillovers*** may prevail if an increased used of related digital technologies by other firms translate into greater competition, which in turn may translate into revenue loss for firms with limited technology absorptive capacity (Görg & Greenaway, 2004; Marsh et al., 2017). This limited absorptive capacity can be explained by a lack of digital skills within the firm, by the delayed diffusion of positive digital technologies within industries, by a low exposure to international competition, or by limited research and development (R&D) activities (Görg & Greenaway, 2004; Marsh et al., 2017). The diffusion of digital technologies and knowledge may also induce structural change, i.e. "persistent change in the relative size of different sectors and occupations" (Hjort & Poulsen, 2019, p.1036), causing the decline of industries using obsolete technologies or made obsolete by technological shift (Choi et al, 2020).

Last, network effects and digital knowledge spillovers may be confined to a delimited geographical perimeter through ***agglomeration economies*** (Duranton & Puga, 2004; Van der Panne, 2004; Malmberg et al, 2006; Frenken et al, 2007)[1]. These agglomeration economies, which play within or across industries, embrace three main and distinct spatial dynamics: i) *Marshall externalities*[2], related to the digital spillovers between firms operating in the same industry or in similar activities at the same place, ii) *Jacobs externalities*, related to the digital spillovers between firms operating in diverse but complementary industries in a given location, and iii) *urbanization economies*, related to the digital spillovers induced by urban size and density, but independent from industries' structure, diversity or complementarity.

Empirical evidence

Patterns of digital technologies adoption by SMEs

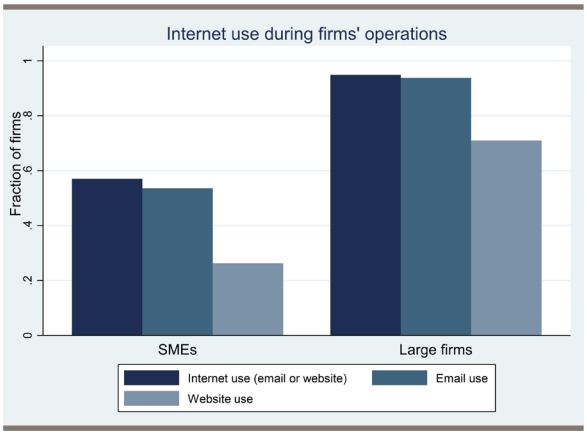
We use data from the WBES conducted between 2006 and 2018 over a sample of some 27,436 small and medium enterprises[3] (with less than 99 equivalent permanent full-time workers) to draw a general picture of digital practices by SMEs located in some 42 sub-Saharan African countries. These surveys are representative of the formal, non-agricultural, and urban African private sector. Therefore, the analysis of digital technologies' potential and SMEs performance does not reflect their effect on informal firms, nor those on the African agricultural sector or in rural areas.[4] Three main technologies are addressed: email and website, which are Internet-based ICTs, and mobile money, which is a digital financial service. Information on mobile money technology is only available in recent waves of standard enterprise surveys for a restricted sample of SMEs covering 14 countries.

Regarding Internet technologies adoption (Figure 1), there exists striking differences in Internet technology diffusion according to firm size, as 92% of large African firms declare using Internet during their operations, against 57%

1. According to Frenken et al (2007, p.687), agglomeration economies are "economies from which a firm can benefit by being located at the same place as one or more other firms".
2. Also called "localization economies".
3. This survey sample includes 846 micro-enterprises, i.e with less than 5 workers.
4. Which are important contributors to job creation in the region on which data on digital adoption is lacking. The contribution of digital technologies to market failure reduction in African rural areas is addressed in Cariolle (2020).

of the sample of SMEs and 44% in the sample of MEs. These numbers are driven by email technology adoption. The website technology is indeed less prevalent among large firms (72%), but particularly among SMEs (29%) and MEs (13%). In regards to mobile money adoption (Figure 2), 44.5% of SMEs use mobile money (MM) during their operations, against 32.3% of large firms. Three among four greatest obstacles to MM adoption identified by firms are related to the size of the MM users' network: the low penetration of the technology among their customers, among their suppliers, and the firm's unawareness of this technology.

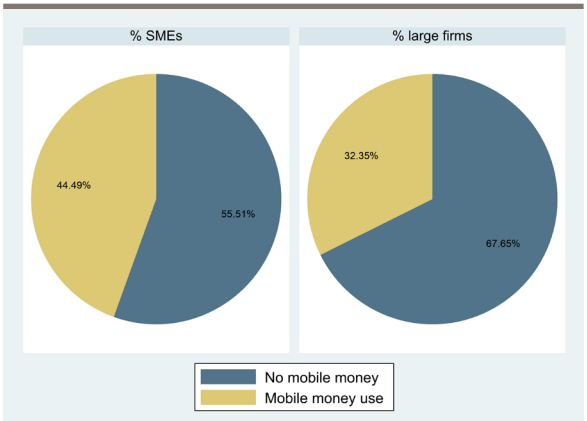
Figure 1: Internet technology diffusion across firm sizes



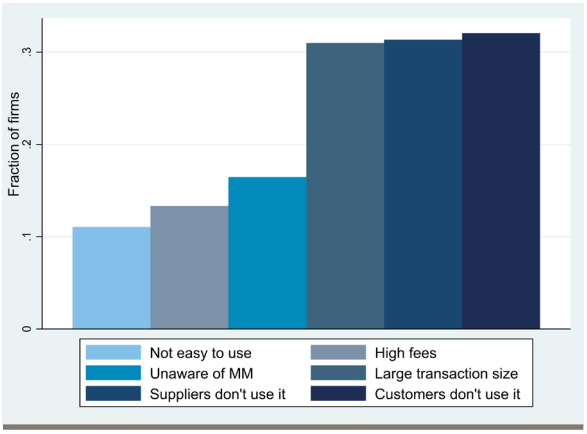
Data on SMEs from the standard surveys conducted between 2013 and 2018 in seven African countries. SMEs sample: 12,239 (Internet), 11,497 firms (Email), 12,197 (Website). Large firm sample: 1,531 (Internet), 1,377 (Email), 1,563 (Website).

Figure 2: Mobile money diffusion across firms

A: Penetration



B: Obstacles



A: 5,778 firms (5,046 SMEs). B: 2,245 SMEs using mobile money. Firms were asked if they have failed to use mobile money because of one of the six reasons mentioned in the figure (Yes/No).

The spillover effects of digital technologies: econometric evidence

We provide an empirical assessment of the spillover effects of digital technologies, commonly used in the conduct of business by African SMEs – i.e. Internet technologies and mobile money – on various indicators of their performance: total revenue, labor productivity, exports, and workforce size. A first novelty in this analysis is that we emphasize the separate effects of different types of Internet technologies, namely email and website adoption. Email is one of the most basic usages of Internet with probably the greatest impact on firm-level outcomes. This variable has the advantage of reflecting the use of digital technologies for an organization's internal matters, but also for external relationships with clients, suppliers, or administrations. On the other hand, the website use variable reflects a strategic use of Internet, costlier and therefore riskier, and depending on the nature of activities carried out by the firm, the intensity of the competition environment, and external support for the adoption of such technologies (Sadowski et al., 2002).

An additional empirical novelty is the distinction between the firm-level effect of a digital

technology adoption by firms from the spillover effect resulting from its diffusion at the industry or local levels. It is indeed of great interest to separate the effect of firm's individual decision to use email and website from the spillover effect of the industry and location-level diffusion of these technologies. To test the existence of industry and spatial spillovers, we assume that digital spillovers rely on the digital technologies' network size, and build on Paunov and Rollo (2015, 2016) to construct variables of industry-level and geographic-level incidence of email and website use by firms (in share of firms). Following Paunov and Rollo (2015, 2016), these incidence variables are computed excluding firm i's own technology adoption.[5] Therefore, these spillover variables reflect the effect of a higher or lower diffusion of digital technologies, irrespective of firm i's technology adoption, which besides lowers the concern for an eventual reverse causality bias.[6]

Within-industry and spatial spillovers

Email, website, and mobile money adoption dummy variables are included together as interest variables of a general econometric equation of firm performance. Email, website, and mobile money spillover variables are also interest variables that are included separately, contrary to adoption variables. Performance variables are the firm's total annual sales, total sales per worker, direct and indirect exports, and workforce size. When email and website spillovers are estimated, the mobile money variable (MM) is not included in the estimation equation to avoid sample attrition.[7] Control variables include the state ownership, the foreign ownership, the share indirect exports in sales, the firm's age, the initial number of employees when the firm was created, the manager experience (in years), the access to bank loan, power outages losses, and insecurity losses. The risk of omitted variable bias is lowered by the inclusion of i) country-industry and location-year fixed effects when industry spillovers are estimated, or ii) country-industry-year and location fixed effects when location (or spatial) spillovers are estimated. Last, Standard errors are robust to heteroscedasticity and clustered by country-year-industry.

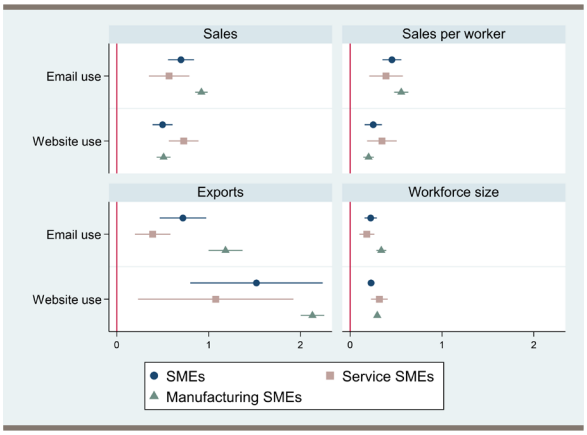
First, putting aside for a moment the question of digital spillovers, OLS estimations stress that the benefits of firm-level email and website adoption in terms of sales, exports, and employment are in general significant and positive (Figure 3). Looking at differences between services and manufacturing SMEs, performances are somewhat higher when manufactures adopt emails. Website adoption is found to be associated with larger sales and labour productivity in the service sector, but with higher exports in the manufacturing sector. Therefore, internet technologies seem to be particularly beneficial to small and medium manufactures through boosted export activities. Regarding mobile money adoption, estimates are reported in Figure 4 and stress that this technology is only instrumental to SME's export activities. In particular, further estimations, not reported in this brief[8], suggest that mobile money mostly benefits to small firms, involved in small export transactions.

Second, looking now at the digital spillovers on SMEs' performance, it turns out that the diffusion of Internet technologies – i.e. email and websites – within industries is found to yield subsequent benefits in terms of revenue, labour productivity, exports, and employment, separate from those of firm-level adoption (Figure 5). The industry spillovers of website diffusion on exports and employment are particularly strong. This evidence supports that websites diffusion among firms from the same industry is instrumental

5. These variables therefore exhibit firm-level variability.
6. But does not fully lift it out, as evidenced in Cariolle and Carroll (2020).
7. Including the mobile money (MM) variable in eq.(1) results in significant sample attrition, restricting the initial sample of around 15,000 firms from 40 African countries to some 3,000 SMEs from14 countries.
8. See companion report (Cariolle & Carroll, 2020).

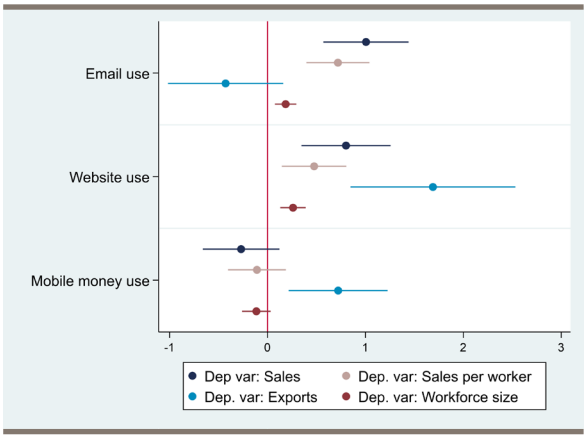
to the firm's positioning on foreign markets, possibly by increasing firm's market visibility and fluidizing business-to-business interactions.

Figure 3: Internet technology adoption and firm performance, manufactoring VS services



Source: Cariolle & Carroll (2020). Note: OLS estimations. Sample: from 14,762 SMEs (sales per worker) to 16,548 SMEs (workforce size).

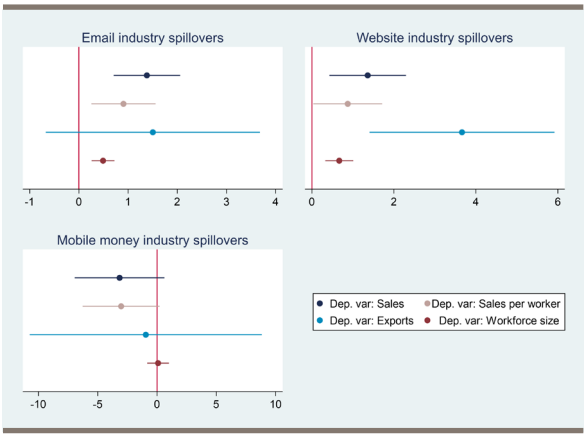
Figure 4: Mobile money adoption and firm performance



Source: Cariolle & Carroll (2020). Note: OLS estimations. Sample: from 2,854 SMEs (sales per worker) to 3,390 SMEs (workforce size).

By contrast, the industry spillovers of mobile money diffusion on sales and employment are found to be negative (Figure 5), as are the effects of this technology adoption by firms on its sales and labour productivity (Figure 4). One possible explanation for the negative effects of MM money firm-level adoption is that MM is more prevalent among smaller firms, which have lower sales and workforce size, thereby pointing a plausible reverse causality bias in estimated relationships. One explanation for the negative spillover effects of mobile money, less prone to reverse causality bias, is the lack of absorptive capacity of this relatively new technology and the delayed benefits of its diffusion among firms (Marsh et al. 2017), so that the adverse competition effects from MM adopting firms prevail over the network effects and other positive spillovers expected from this technology.

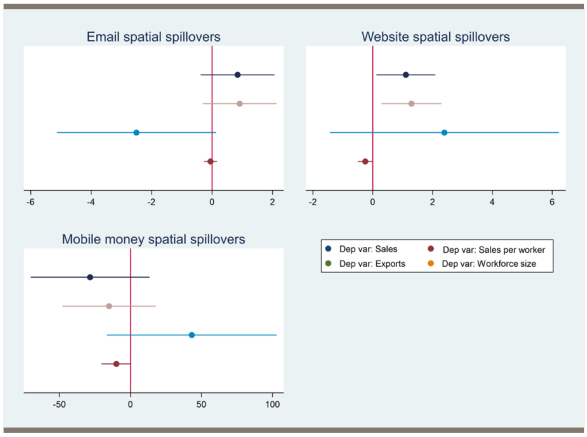
Figure 5: Industry spillovers



Source: Cariolle & Carroll (2020). Note: OLS estimations. Sample email/website spillovers: from 14,762 SMEs (sales per worker) to 16,548 SMEs (workforce size). Sample mobile money spillovers: from 2,854 SMEs (sales per worker) to 3,390 SMEs (workforce size).

Third, estimations provide mixed evidence on the spatial spillovers of Internet technology diffusion (Figure 6). First, they support the existence of a significant positive location spillovers of email diffusion on sales per workers and of website diffusion on both firm sales and sales per workers. By contrast, negative spatial spillover effect of email diffusion on exports, and of website and mobile money diffusion on the firm's workforce size are evidenced. This result contrasts with the positive spatial spillover effects of Internet technology diffusion among large firms reported in Cariolle and Carroll (2020), which are more inclined to adopt and absorb digital technologies, and are also geographically mobile firms (Dollar et al., 2006ab) able to better exploit agglomeration economies.

Figure 6: Spatial spillovers



Source: Cariolle & Carroll (2020). Note: OLS estimations. Standard errors are robust to heteroscedasticity and clustered by country-year-location. Sample (email/website spillovers): from 14,762 SMEs (sales per worker) to 16,548 SMEs (workforce size). Sample (mobile money spillovers): from 2,854 SMEs (sales per worker) to 3,390 SMEs (workforce size).

Threshold spillover effects

A critical mass of Internet users in a given location or industry might be necessary for network effects, knowledge spillovers, and related agglomeration economies to yield the expected digital dividends for SMEs (Grace et al, 2004). 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 technology introduction may increase the profitability of ICT-intensive industries at the expense of less ICT-intensive industries, with possible adverse consequences on local productive capacity and on the labour market (WDR, 2019; Choi et al., 2020). Interestingly, Marsh et al. (2017) argue that it may take time for a technology to be widespread and fully exploited within a given industry, which points to the possibility of threshold spillover effects induced by the delayed diffusion of digital technologies within industries. This possible delay in the transmission of positive digital spillover could also play at the local level, within and across industries.

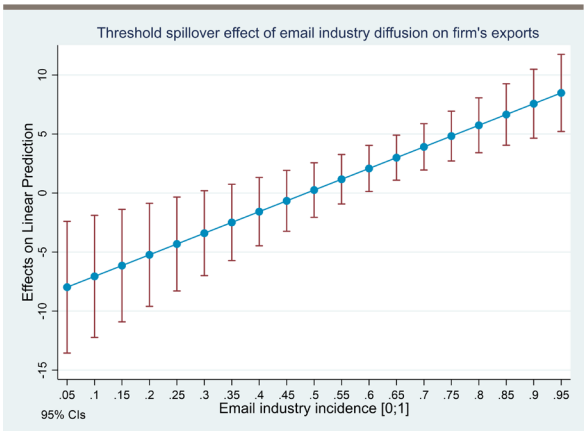
As a result, negative spillovers may prevail below a certain threshold of industry or location technology use incidence, when the diffusion of digital technologies benefits a limited number of first-movers or dominant firms, or when firm from "old industries" are challenged by rising ICT-intensive industries; while positive spillovers may prevail above this threshold when digital technologies are ubiquitous. As such, because of the large (spatial) digital divide prevailing in SSA (Cariolle, 2020; Cariolle & Carroll, 2020), it is therefore of great interest to test the existence of threshold, and eventually U-shaped, spillover effects in Internet technology diffusion, and to identify the threshold beyond which the positive externalities of these technologies start prevailing.

To investigate these nonlinear spillover effects on firm's performance, we introduce in the performance equation the squared term of the spillover variable of interest. Only significant evidence of nonlinear industry and spatial spillovers are represented in Figure 7. They stress the existence of a significant U-shaped spillover effects of email diffusion, with turning points lying around 50% of email industry/location incidence. Figure 8A shows that an increased incidence of email users within industries has a significant negative effect on firm-level exports below an approximate 50% email penetration rate for a given industry, and a positive significant effect beyond this threshold.[9] Evidence in Figure 8B and 9C also supports the existence of similar U-shaped spatial spillover effects of email on sales and labour productivity with a turning point around the same threshold of email penetration within locations. These U-shaped industry and spatial digital spillovers may result from the advantage taken by first-movers or new ICT-intensive industries on Internet technologies over their competitors or "old" industries, at low levels of Internet use incidence in the industry.

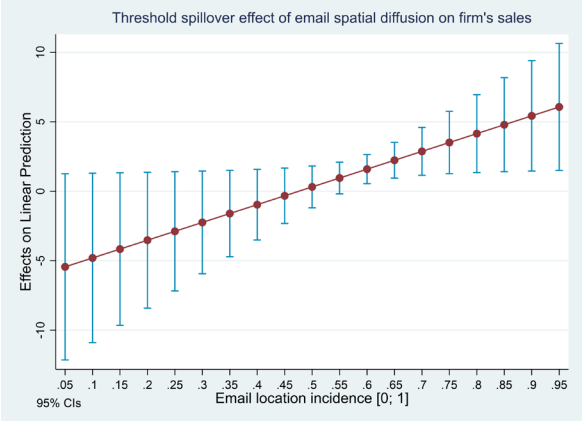
9. The samples are relatively well balanced below/beyond estimated thresholds.

Figure 7: U-shaped email spillovers

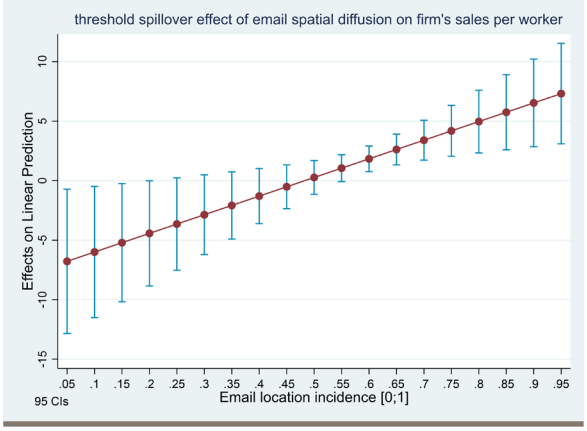
A: Industry email spillovers and exports



B: Spatial email spillovers and sales



C: Spatial email spillovers and sales per workers



Source: Cariolle & Carroll (2020). Note: OLS estimations. Standard errors are robust to heteroscedasticity and clustered by country-year-industry in graph A, and country-year-location in graph B and C.

However, when digital technologies are widely disseminated within industries or locations, positive spillovers, induced by forces such as network effects or knowledge spillovers, may prevail over the competition effect. Overall, our results suggest that the low diffusion of digital technologies, in other words the digital divide, is a strong impediment for African SMEs to exploit the potential of digitization.

Concluding remarks

The purpose of this brief was to provide an overview of the contribution of digital technologies in the conduct of business by SMEs: email, websites, and mobile money. An important empirical novelty of is the separation between the individual effect of digital technology adoption by firms from the spillover effects resulting from its diffusion at the industry or local levels. It turns out from this analysis that the diffusion of digital technologies in locations and industries is likely to yield subsequent benefits in terms of revenue, productivity, exports, and employment. Our analysis of digital spillovers also stressed the existence of threshold effects in these digital spillovers. In fact, U-shaped relationships are evidenced, stressing that below (above) a certain threshold of digital technology incidence in a given industry and location, a larger diffusion of that technology may be detrimental (beneficial) to firms, whether they have adopted this technology or not.

However, the numbers presented in this brief only partially mirror the reality of digital transformations bourgeoning within the subcontinent's private sector. A closer look at first movers and key digital players is indeed necessary to grasp the contours in the digitalisation landscape of Sub-Saharan Africa. For instance, Jumia is a well-known successful e-commerce multinational firm offering buyers and sellers an online platform to make digital transactions,

overcoming barriers to communication, imperfect information, and reducing high transaction costs on trade in over 15 countries across the African continent. African job platforms are currently booming, as evidenced by the success of Lynk, a mobile application connecting informal or gig economy workers in Kenya with individual and SME clients seeking their services. Digital innovations also spread in the insurance sector, since Insurtech firms such as WorldCover are able to offer blockchain-enabled weather-indexed crop insurance to farmers in Ghana, Kenya, and Uganda. Digital transformations also operate in the logistic and transport sector, as illustrated by the blockchain-enabled mobile application Kobo360, which links truck drivers, truck owners, cargo owners, and cargo recipients in Nigeria to improve optimisation of logistics and transportation networks in the country. In the Health sector, Zipline provides blood and medical supplies to health centres and hospitals in Ghana and Rwanda. In the agricultural sector, Investiv Group uses drones equipped with sensors and aerial cameras to provide precision agricultural services to farmers in Côte d'Ivoire. In the energy sector, Lumos Global's provides off-grid solar home systems (SHS) to household and SME clients in Nigeria and Côte d'Ivoire.

Overall, the digital solutions concocted by these firms show a glimpse of the current digital transformations in SSA, that numbers are probably unable to restore. These solutions are often contextualized, multifaceted and innovative in nature, designed to overcome barriers created by imperfect information, high transaction costs, underdeveloped market structure, and missing infrastructures. But evidence of thresholds in the spillover effects of digital technologies diffusion tend to suggest that these innovations have to reach a critical mass of users to fully unleash their potential in terms of wealth and job creation.

Références

- **Aker, J. C.** (2010). Information from markets near and far: Mobile phones and agricultural markets in Niger. *American Economic Journal: Applied Economics*, 2(3), 46-59.
- **Aker, J. & Blumenstock, J.** (2014). The Economic Impacts of New Technologies in Africa, in Eds Monga, C. & Yifu Lin, J. *The Oxford Handbook of Africa and Economics: Policies and Practices, 2,* 354-371.
- **Aker, J. C. & Fafchamps, M.** (2014). Mobile phone coverage and producer markets: Evidence from West Africa. *The World Bank Economic Review, 29*(2), 262-292.
- **Bresnahan, T. F., & Trajtenberg, M.** (1995). General purpose technologies "Engines of growth?". *Journal of Econometrics, 65*(1), 83-108.
- **Cariolle, J.** (2020). *The Use of Digital for Public Service Provision in Sub-Saharan Africa*. Ferdi report, Digital Trust Chair.
- **Cariolle, J., & Carroll, D.A.** (2020). *Digital Technologies for Small and Medium Enterprises and job creation in Sub-Saharan Africa*. Ferdi report, Digital Trust Chair.
- **Choi, J., Dutz, M. A., & Usman, Z.** (Eds.). (2020). The Future of Work in Africa: Harnessing the Potential of Digital Technologies for All, Africa Development Forum Series, Agence Française de Développement / The World Bank, Washington D.C.
- **Crémer, J., Rey, P., & Tirole, J.** (2000). Connectivity in the commercial Internet. *The Journal of Industrial Economics, 48*(4), 433-472.
- **Duncombe, R., & Heeks, R.** (2002). Enterprise across the digital divide: information systems and rural microenterprise in Botswana. *Journal of International Development: The Journal of the Development Studies Association, 14*(1), 61-74.
- **Duranton, G. & Puga, D** (2004). Micro-foundations of Urban Agglomeration Economies, chap. 48, 2063-2117. in J. V. Henderson and J. F. Thisse (Eds.), *Handbook of Regional and Urban Economics*, Vol. 4, Elsevier.
- **Fafchamps, M.** (2004). *Market institutions in*

sub-Saharan Africa: Theory and evidence. MIT press.

- **Frenken, K., Van Oort, F., & Verburg, T.** (2007). Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies*, 41(5), 685–697.
- **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.
- **Grace, J., Kenny, C., Qiang, C. Z. W., Liu, J., & Reynolds, T.** (2004). Information and communication technologies and broad-based development: A Partial Review of the Evidence. World Bank Working Paper 12, Washington, DC: World Bank.
- **Harrison, T., & Waite, K.** (2006). A time-based assessment of the influences, uses and benefits of intermediary website adoption. *Information & management, 43*(8), 1002-1013.
- **Harrison, B., Kelley, M. R., & Gant, J.** (1996). Innovative firm behavior and local milieu: exploring the intersection of agglomeration, firm effects, and technological change. *Economic geography, 72*(3), 233-258.
- **Islam, M. M., Habes, E. M., & Alam, M. M.** (2018a). The usage and social capital of mobile phones and their effect on the performance of microenterprise: An empirical study. *Technological Forecasting and Social Change, 132*, 156-164.
- **Islam, A., Muzi, S., & Meza, J. L. R.** (2018b). Does mobile money use increase firms' investment? Evidence from Enterprise Surveys in Kenya, Uganda, and Tanzania. *Small Business Economics, 51*(3), 687-708.
- **Kpodar, K., & Andrianaivo, M.** (2011). *ICT, financial inclusion, and growth evidence from African countries*, IMF Staff Paper No. 11-73, International Monetary Fund, Washington DC.
- **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.
- **Malmberg, A., Malmberg, B., & Lundequist, P.** (2000). Agglomeration and firm performance: economies of scale, localisation, and urbanisation among Swedish export firms. *Environment and Planning a, 32*(2), 305-321.
- **Paunov, C., & Rollo, V.**6). Has the internet fostered inclusive innovation in the developing world?. *World Development, 78*, 587-609.
- **Paunov, C., & Rollo, V.** (2015). Overcoming obstacles: the internet's contribution to firm development. *The World Bank Economic Review, 29* (suppl_1), S192-S204.
- **Patnam, M., & Yao, W.** (2020). The Real Effects of Mobile Money: Evidence from a Large-Scale Fintech Expansion. IMF working paper, International Monetary Fund, Washington D.C.
- **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.
- **Van der Panne, G.** (2004). Agglomeration externalities: Marshall versus jacobs. *Journal of evolutionary economics, 14*(5), 593-604.
- **World Bank** (2019). Changing the Nature of Work. World Development Report 2016, International Bank for Reconstruction and Development, The World Bank Group, Washington: World Bank.

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