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Teresa de Noronha Vaz (Ed.)

Centro de Investigação sobre o Espaço e as Organizações
Centro Regional de Inovação do Algarve
Universidade do Algarve

ICT Diffusion, inward foreign direct investment, and entrepreneurship in developing countries: A research note

Rui Baptista
Pedro M. Faria

Introduction

The last decades have established the fundamental importance of technological progress for economic growth and wealth creation. Most new technology is created in developed countries. For these countries, the fundamental problem for growth is to harness the economic value of new inventions by converting them into new products, processes and organizational means. Entrepreneurship plays a fundamental role in this course of events (Shane 2001; Michelacci 2003; Acs *et al.* 2004; 2009).

In developing countries the diffusion of new technologies plays an essential role in fostering growth. However, entrepreneurial skills are also required in order to convert the acquired knowledge into wealth. In this paper, we argue that, besides contributing to general economic growth by improving productivity, information and communication technologies (ICTs) may represent, together with inward foreign direct investment (FDI), an important driver of entrepreneurship, by serving as channels for the transmission of knowledge spillovers that widen the awareness of business, opportunities and making it easier for small businesses to increase their market reach.

The paper proceeds as follows. The next section discusses the role played by ICTs and entrepreneurship in the process of economic growth. Section 3 examines the role played by ICT diffusion in developing countries and discusses how inward FDI can contribute to technology transfer. Section 4 considers how ICTs and inward FDI can act as a driver of increasing entrepreneurial activity. Finally, section 5 concludes.

ICTs, Entrepreneurship and Economic Development

The Impact of ICT Diffusion on Development

In developing countries, the increasing dependence on the acquisition of technology for growth means that economic policies must be conceptualized with special attention to issues related to technology diffusion. While the concept of "digital economy" is too wide to be characterized, and the technological dynamics associated to it are far from being established, one fact is undisputed: the emergence of technological platforms of ICTs is determining significant and unprecedented changes in many aspects of our social and economic life (Corrocher and Ordanini 2002). In view

of this evidence, Castells considers that social development is driven by the ability to establish a synergistic interaction between technological innovation and human values (Castells 1998).

There is a lack of consensus in the literature with regard to the impacts of ICTs diffusion on social and economic development. An often debated issue is the effect of ICTs on productivity. On one hand, some authors hold that this impact is of little significance. Gordon (2000) presents a skeptical view of the real effects of ICTs on society, arguing that the dynamic burst of productivity growth that took place in the last decades was only noticeable in the manufacturing of computers and semiconductors sectors themselves and was insignificant in the rest of the economy. In an overview of the available evidence on the importance of ICTs for productivity growth in the Euro area, Vijselaar and Albers (2002) conclude that the positive spillover effects of the use of these technologies on general efficiency in the economic process were very limited. On the other hand, a significant stream of literature holds that the diffusion of ICTS has had a significant positive impact on productivity and development. In an examination of the contribution of computers and related inputs for growth, Oliner and Sichel (2000) conclude that ICTs have been the key factor behind the improved productivity performance of the U.S. economy in recent years. Gong and Keller (2002) argue that these technologies have diffused relatively faster in the United States and this fact might help explaining why the US lead in per-capita income over Japan has increased from 10% in 1990 to 20% by 1999.

Another significant issue raised by the diffusion of ICTs is the generation of skill-bias technological and organizational change (see Piva *et al.*, 2005). Krueger (1993) examines whether workers who use a computer at work receive higher incomes than non-users finding that workers using computers as part of their job earn 10 to 15 percent higher wages. Moreover, this author notices that the expansion in computer use in the 1980s could account for up to one-half of the increase in the rate of return to education. Results of empirical studies focusing on this issue are, however, also mixed. For instance, DiNardo and Pischke (1997) replicate Krueger's analysis using data on German workers. Their estimates of the computer wage premium are similar to those found by Krueger. However, since their data contain much more detailed information on the tools used by workers on their jobs, they apply the same techniques to estimate the wage differentials associated with the use of a calculator, a telephone, writing materials like pen or pencil, or sitting on the job. They find that the measured wage differentials associated with these executive tools are almost as large as those measured for computer use. They also find a wage penalty associated with the use of labor-intensive tools. The wage differential could, therefore, be explained by a variety of factors beyond computer use. These authors suggest two alternative explanations for the wage differential associated with computer use: i) that computer users possess unobserved skills which might have little to do with computers but which are rewarded in the labor market; ii) and/or that computers were first introduced in higher paying occupations or jobs (DiNardo and Pischke 1997).

Entrepreneurship and Economic Growth

The wide acknowledgement of the role played by technological progress (through the introduction and diffusion of innovations) on economic growth has been a product of the

evolution of economic theory. Ever since Solow (1956) based his model of economic growth on the neoclassical production function with its key factors of production - capital, labor, and exogenous technological progress - economists have relied upon the model of the production function as a basis for explaining the determinants of economic growth. Romer's (1986) critique of the Solow approach was not with the basic model of the neoclassical production function, but rather with what Romer perceived to be omitted from that model – knowledge. Not only did Romer, along with Lucas (1988) and others argue that knowledge was an important factor of production, along with the traditional factors of labor and capital, but because it was endogenously determined as a result of externalities and spillovers, it was particularly important.

The endogenous growth model perceives knowledge as an internal variable – *i.e.* technological change takes place because of intentional actions taken by profit maximizing actors in response to market stimuli. Any agent performing some form of knowledge-generating research and development - including any creative, systematic activities intended to increase the stock of knowledge and the use of this knowledge to devise new applications - contributes to the creation of a good that can be shared with few bounds, meaning that the production of knowledge has increasing returns.

Increasing returns arise because the creation of knowledge also generates opportunities for third-party firms (Jaffe *et al.* 1993; Thompson and Fox-Kean 2005), which are often entrepreneurial start-ups (Shane 2001). This occurs through knowledge spillovers. However, endogenous growth models fail to incorporate the actual mechanism of transmission of knowledge spillovers (Acs *et al.*, 2004). Knowledge by itself is only a necessary condition for the exercise for successful growth. To convert knowledge into wealth requires a set of skills, aptitudes, insights and circumstances that is neither uniformly nor widely distributed in the population. Entrepreneurial ability is therefore also a necessary condition for growth (Acs *et al.*, 2009). Entrepreneurial activity involves both arbitrage of opportunities (Kirzner 1973) and exploitation of new opportunities created, but not appropriated by incumbent firms (Schumpeter 1934).

ICTs, Inward FDI, and Developing Countries

The Role Played by ICT Diffusion

In the context of developing countries, widespread diffusion of new technologies is an essential process for social change and economic growth. Diffusion is a type of social change, defined as the process by which alteration occurs in the structure and function of a social system (Rogers, 1995). This author speaks about the innovativeness-needs paradox, through which those individuals who most need the benefits of a new idea, (the less educated and less wealthy) are the last ones to adopt an innovation. This paradoxical relationship tends to result in a wider socioeconomic gap between the individuals of higher and lower socioeconomic status. Thus one consequence of many technological innovations is to widen the socioeconomic gaps in a social system.

Extensive investment in ICT allows countries to leapfrog stages of economic growth by being able to modernize their production systems and increase their competitiveness faster than in the

past. However, those economies or (sub-sets of the population) that are unable to adapt to the new technological paradigm have little chance of development. The astonishing development of ICT and the creation of a global technological infrastructure required the world to function as a unit, making possible the existence of a multidimensional globalization (Castells 1998). Knowledge transfer associated to technology diffusion plays a major role in the relationship between countries and especially from the less developed countries point of view.

The implications of the Internet revolution on third world countries are deep, being both an opportunity and a threat - on the one hand, it allows countries to leapfrog stages of economic growth but on the other, for those that are late, their retardation becomes cumulative. The Internet presents the occasion to set communications into a new level, a level that goes beyond voice communications and incorporates entirely new applications and services. By allowing small companies to internationalize their operations, the internet presents the chance to improve social and economic conditions, and has the potential to foster convergence in the social and economic status of nations. However, while some developing countries may have the prospect to begin a path of convergence, most are hindered by social and economic constraints, low connectivity and environments that delay participation in the Internet revolution.

Archibugi and Pietrobelli (1999) argue that developing countries can benefit from globalization of technology if they implement active policies planned to increase learning and improve access to knowledge and technology. However, successful cases of ICT integration in these countries represent an exception, not the rule. These authors argue that the import of foreign technology, either embodied or disembodied, has a negligible learning impact per se, unless when accompanied by local policies to promote learning, human capital and technological capabilities.

Mayer (2000) argues that globalization has drastically improved access of technological latecomers to advanced ICT and, despite the large cross-country discrepancies in technology upgrading within the low-income countries, developing countries as a group have substantially increased the ratio of technology imports to GDP over the past decades. To raise the benefits reaped from globalization, governments might need to make additional efforts towards a simultaneous increase in technology imports and the skill level of the domestic labor force. The opportunity for technological integration offered by globalization should help to reduce the technology gap and to raise the level of total factor productivity and per capita income in developing countries.

Sachs (2002) examines the relevance of technology diffusion, defining three groups of countries: i) countries enjoying endogenous growth (innovative activity takes place on a significant scale, and patented products and technologies are produced and sold domestically and on world markets); ii) technological diffusers (countries that absorb new technologies developed in the endogenous growth countries); and iii) excluded countries (the level of penetration of new technologies, the rate of diffusion, and the extent of use of new technologies in domestic production, are all extraordinarily low). Considering that the divide between the technology innovators and the non-innovators is considerably wider than the global divide in terms of income, and that there are few countries that successfully converted from low to high innovative capacity in the last few decades, technology diffusion represents the dominant paradigm for developing nations. These countries need to master their process of technology diffusion since they do not have the competence to develop competitive technologies (Papageorgiou 2002). In order to understand the real impact of the diffusion of ICT in poor nations Pigato (2001)

examined the patterns of utilization, ownership and affordability of ICT in sub-Saharan Africa and South Asia, reaching results that confirm the Sachs perspective.

Rodríguez and Wilson (2000) build an index of technological progress in which information on five indicators of technological outputs is combined – personal computers, mobile phones, internet hosts, fax machines, and television sets. Based on their empirical investigation, these authors find that economies which have evolved technologically differ from the laggards in two vital ways: an economic environment favorable to investment, and a climate of civil liberties conducive to research and spreading out of telecommunications. As a result, they argue that substantial support for diffusion of ICT to underdeveloped countries is necessary (Rodríguez and Wilson, 2000).

The Role Played by FDI as a Channel for Knowledge Spillovers

Inward FDI represents one of the most important links between developed and developing countries and therefore plays a central role in the process of technology transfer and diffusion. Inward FDI is playing an increasingly important role in global economic growth rates (Al-Qasem 2001). Multinationals that undertake the bulk of the world's industrial research and development (R&D), are key actors in the international diffusion of technological knowledge.

Loungani and Razin (2001) argue that, in addition to reducing the risk faced by investors by allowing them to diversify their investment, the global integration of capital markets can contribute to the spread of best practices in corporate governance, accounting rules, and legal traditions. Also, the global mobility of capital limits the ability of governments to pursue bad policies. In addition to these advantages, FDI is an instrument for technology transfer – particularly in the form of new varieties of capital inputs – that cannot be achieved through financial investments or trade in goods and services. Recipients of FDI may provide employee training that contributes to human capital development.

Borensztein *et al.* (1998) examine the role played by FDI in the process of technology diffusion and economic growth in developing countries. These authors find that multinational companies possess advanced knowledge which allows them to introduce new capital goods at lower cost, but the application of these more advanced technologies also requires the presence of a sufficient level of human capital in the host economy, *i.e.* the stock of human capital in the host country limits the absorptive capacity of a developing country.

Saggi (2000) surveys the literature on trade and foreign direct investment examining in particular the role played by wholly owned subsidiaries of multinational firms and international joint ventures - as channels for technology transfer. He finds that the benefits that developing countries can take from technology transfer depend on three factors: i) how well educated and well trained is the country workforce; how much will be invested in research and development; and how much protection is offered for intellectual property rights.

Xu (2000) finds that, while MNC by American firms abroad investment is an important conduit for technology spillovers towards other developed countries, the intensity of technology transfer is much less significant for developing countries. The author explains this disparity with the gap on the level of human capital. technology transfer of US MNCs is found to increase host country productivity growth only when the country has reached a minimum human capital threshold.

ICT Investment, Inward FDI, and Entrepreneurship

According to Baumol (1968:p.69), public policies should be directed to "induce the appearance of increased supplies of entrepreneurial skills" and the policy-maker should be "interested primarily in what determines the supply of entrepreneurship and in the means that can be used to expand it."

The attraction of FDI plays an important role in public policies for entrepreneurship promotion since the presence and activity of MNCs have been argued to impact positively on indigenous entrepreneurial activity (Acs *et al.*, 2009). FDI is also associated with technology transfer and knowledge spillovers, channelled through product and process technology, management practices, information about access to foreign countries and intensified competition (Rasiah, 1995; Blomström and Kokko, 1997; Markusen and Venables, 1999). Several authors have argued that the economic activity of a foreign investor will help to accelerate technological development in the host economy to some degree (Hunya, 2000; Lim, 2001; Dyker and Stolberg, 2003).

ICTs promote economic growth and act as a technological driver that 'pulls' both technological and non-technological innovations associated with FDI (Leitão e Baptista, 2009). Antonelli (1998) analyzed the co-evolution of ICT and the knowledge intensive industries, finding that ICTs affect the actual conditions of information, in terms of their basic characteristics of appropriation and tradability, by favoring the role of business services as forces of interaction amongst knowledge components in the generation of new technologies.

There is noteworthy empirical evidence linking inward FDI and entrepreneurship. De Backer and Sleuwaegen (2003) study the relationship between FDI and domestic entrepreneurship, and their findings are in line with theoretical occupational choice models that predict FDI would crowd out domestic entrepreneurs through their selection in product and labor markets. Nevertheless, other studies find that this crowding effect may be moderated or even reversed in the long run due to the long term positive effects of FDI on domestic entrepreneurship as a result of experience, learning, demonstration and networking effects between foreign and domestic firms (Rodriguez-Clare, 1996; Markusen & Venables, 1999). Barbosa and Eiriz (2007) examine whether FDI had a positive impact on entrepreneurial activity in the Portuguese economy. They find that the impact of the first wave of foreign investment by a MNC is, in general, positive, but that the marginal impact of additional investments appears to be negative. These authors also argue that the weak evidence of positive effects of MNCs on entrepreneurial activity may hide their role as levers of technological development and industrial re-structuring.

Evidence of the relationship between ICT investment and entrepreneurship is less profuse. Leitão and Ferreira (2009) analyze the impact of the liberalization of European telecommunications markets on the business ownership rate. In the case of Portugal, the business ownership rate seems to "pull" for additional investments in ICT. Leitão e Baptista (2009) find that, for the case of Portugal, FDI plays an important role in the long term, since it impacts positively on investment in ICTs which are a catalyst of sustainable and inclusive technological change. However, no evidence is found that both ICT investment and inward FDI impact positively on entrepreneurship.

Conclusion

According to Silveira (2001), there is a need to understand the mechanisms and approaches that may characterize innovation and technical change in developing countries, to define the managerial practices and skills required to accomplish this task in that context, and to gather empirical evidence on cases and practices of innovation there.

While the existent of a global "digital divide" that is significantly wider than the income gap between developed and developing countries is an irrefutable fact, evidence on the benefits and drivers of ICT investment, and their relationship with another important source of technology diffusion - inward foreign direct investment - remains mixed. One important aspect that seems to condition developing countries' capacity to absorb the diffusion of new technologies is the lack of human capital capable of taking advantage of these technologies. In this context, it is essential to implement policies oriented to bridge this knowledge gap.

One element associated with human capital and technological knowledge which may contribute significantly towards economic development is entrepreneurial ability. Entrepreneurship represents an important channel for developing countries to take advantage of the technologies being diffused through ICT investment and inward FDI. Developing countries with greater degrees of entrepreneurial ability and a better environment for new venture creation are more likely take advantage from knowledge spillovers and create new wealth.

There is a lack of work connecting the two spillover sources discussed here - ICT investment and inward FDI - and entrepreneurial activity in developing countries. Evidence for developing countries is mixed. Human capital is likely to play an important role in this transmission mechanism. It is impossible to take advantage of knowledge spillovers if one is unable to understand and absorb them. However, entrepreneurial ability also plays a role. Like human capital associated with education and technological knowledge, entrepreneurial ability - the set of skills, aptitudes, insights and circumstances that favor the recognition of opportunities through new venture creation - is neither uniformly nor widely distributed in the population. In developing countries, where most small businesses are born out of necessity rather than opportunity, entrepreneurial skills and motivation are likely to be dormant, needing greater general human capital (*i.e.* education) to arise.

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