CHAPTER FOUR

SMEs, innovation and technological development

This chapter analyses the position of small and medium-sized enterprises (SMEs) in Latin America in terms of their capacity for innovation and technological development. It addresses the obstacles that hinder SMEs from accessing technology and benefiting from knowledge dissemination and transfer. The chapter pays special attention to SMEs' use of information and communication technologies (ICTs) and their reaction to the innovation policies being implemented. It looks at how these restrictions lead to productivity gaps and structural heterogeneity. The chapter concludes by presenting a series of recommendations and identifying opportunities and challenges for the design of public policy.

Introduction

The new techno-economic paradigms, which are creating a "third industrial revolution", increase the dependency of economic growth and development on capacities to create value by incorporating knowledge, innovation and the dissemination of productive technology use (ECLAC, 2012). These are essential factors to accelerate growth and make productivity gains, create good-quality jobs, reduce structural heterogeneity and move forward in long-term processes to improve income distribution and increase equality. Technological development and innovation play a leading role in this dynamic. It is a complex social process that evolves from the interaction between individual people who create social ties and relationships.

In 2009, investment in R&D in Latin America was equal to 0.7% of GDP, way below the level of investment seen in OECD countries (2.4%). This gap and the concentration of R&D in only a few countries help explain why the region is lagging behind in this area.

This chapter focuses on the factors that determine to what extent firms, particularly SMEs, are able to innovate and incorporate new technologies into their production activities, as well as on the key policies and instruments to achieve this. In particular, increasing the intensity and changing the orientation of the innovation process requires: *i)* developing firms' and institutions' technological and organisational capacities; *ii)* strengthening the architectures of the networks that the companies belong to and creating "small-world networks";[1] *iii)* creating a more virtuous connection between the parts of existing networks (companies, universities and technology centres, and consultancies and intermediate institutions); *iv)* creating larger markets and a broader division of labour to bring about a cumulative causation;[2] *v)* taking into consideration the form of competition (how salaries are set and the relative importance of "creative destruction"); and *vi)* analysing institutions open to innovation (if they exist) and their capacities. An innovation process is necessary both because of the characteristics of firms and because of the macroeconomic environment and the socio-economic characteristics that are defined by the national innovation system (NIS). The system of competition and the processes of structural change and creative destruction, as well as the dynamics of learning and the linkages and capacities of firms, determine business innovation (ECLAC/SEGIB, 2008).

This chapter is structured as follows. The first section analyses the state of innovation region-wide. The next section focuses in on SMEs' capacities and what they are doing to foster innovation. The third section identifies SMEs' strengths, weaknesses, results and main obstacles. In the fourth section, the focus shifts to the access and use of ICTs and new opportunities for the computerisation of SMEs and regional broadband connectivity. In the fifth section, we present some recommendations on the institutional structure and public policies needed to drive forward innovation and dissemination of technology in Latin American SMEs.

Innovation in the regional context

Latin America is lagging behind the OECD economies in terms of innovation and technology adoption, but performance varies from country to country across the region

(OECD/ECLAC, 2011). This is in contrast to developing countries such as China, which have narrowed their technology gaps by making their production structures more complex, more sophisticated, more knowledge-intensive and more technology-intensive. Latin America has made little progress in this area and remains well behind advanced countries (ECLAC, 2010).

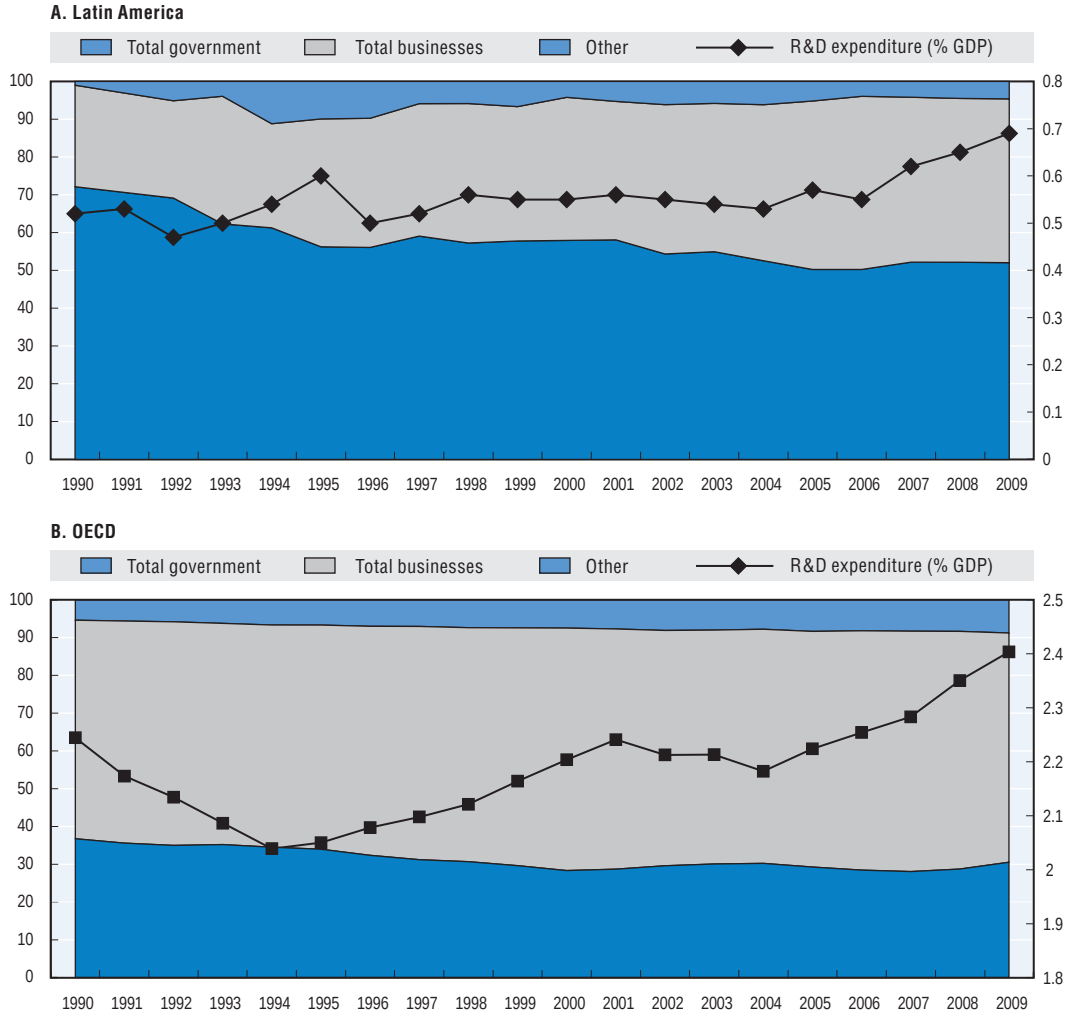
One reason the region still lags behind is because investment in research and development (R&D) is low and is concentrated in only a few countries. In 2009, OECD economies invested 2.4% of gross domestic product (GDP) in R&D, more than three times the figure for Latin America (0.7%). The gap has remained over the past few decades (Figure 4.1). There are also large differences among countries in the region. For instance, in 2009 Brazil invested 1.2% of GDP in R&D, while Bolivia spent less than 0.2%. Even *within* Latin American countries there are equally large differences in the nature of investment in R&D depending on the type of company and the economic sector. Moreover, Latin America is also lagging way behind in terms of the sources of investment in innovation. While in OECD countries businesses provide 60% of investment in R&D, in Latin America the business sector tends not to prioritise innovation and technological development, providing only around 40% of investment in R&D.

Various factors influence a firm's capacity to innovate. A general factor is the institutional environment, which has a bearing on the firm's innovative behaviour. A sector-specific factor is the characteristics of the business activity and its linkages with organisations involved in the national innovation system [businesses, universities, technology centres, consultancies, government institutions, non-governmental organisations (NGOs) and civil society]. A company-specific factor is the firm's internal capacities and the efforts it makes. Innovation improves the quality of products and processes, increases productivity and competitiveness, and helps a company better position itself in national and international markets and move towards activities with a higher added value (Cimoli *et al.* 2011; Dini and Stumpo, 2011). As firms strive to innovate, they need good learning and knowledge-accumulation processes developed within the company and through their relations with other actors.

Companies are key stakeholders in an NIS because they use scientific and technological advances in production to develop new products and processes or improve upon existing ones, enabling greater productivity and competitiveness.

Four factors, among others, determine a firm's innovative capacity: its ability to absorb knowledge, the size of its workforce, its sector and the context in which it operates. Given the business diversity and the importance of SMEs in the production fabric of Latin American countries, we must examine companies' innovation capacities and limitations. Innovation by SMEs is usually a spontaneous reaction to competitive pressure from large firms, and their innovative strategies and activities are often part of informal strategies rather than the result of planning. Given their limited capacities, they usually seek to capture market niches rather than work their way into mass markets.

Figure 4.1. **Latin America and the OECD: investment in R&D and distribution by origin of finance, 1990-2009**



Source: Based on RICYT and OECD.Stat.

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A company's size directly affects its capacity to innovate. While large firms benefit from growing profits from R&D activities, SMEs are heavily restricted by their size, so their innovations are weaker and they are less likely to use technologies productively. Despite their heterogeneity, SMEs share many constraints. These notably include access to credit and qualified human resources, a lower tendency to export, a lower capacity to interact with other companies and institutions that train human resources and carry out research, and their limited membership in networks. Diversity among and within sectors influences their tendency to innovate. Latin American SMEs are usually concentrated in sectors whose characteristics in the region mean they require little knowledge (trade, informal services and basic manufacturing).

Companies are key stakeholders in an NIS because they use scientific and technological advances in production to develop new products and processes or improve existing ones, enabling greater productivity and competitiveness.

Public research centres and universities provide essential support for the development of technology and innovation for SMEs. A central theme for innovation is co-operation and linkages between public and private actors (Nelson, 1993; Dosi and Cimoli, 1994; ECLAC/SEGIB, 2010). Alongside institutions and current regulations, these actors form the national innovation system (NIS). This system sets out the processes for incorporating technology and determines the rate at which technological knowledge will be generated, adapted, acquired and disseminated in production activities (Lundvall, 1992). The linkages and interaction between NIS actors are important for a country's scientific and technological development and the drive that knowledge can give to the production sector (Nelson, 1993; Dosi and Cimoli, 1994; ECLAC/SEGIB, 2010).

Other key players include government bodies, higher education institutions, research centres and businesses. Businesses are essential, since in collaboration with other actors they use scientific and technological advances in production, developing new products and processes and improving existing ones to increase productivity and competitiveness (ECLAC/SEGIB, 2010). Large firms generally develop different levels of co-operation within Latin American NISs, but SMEs often have neither the resources to carry out research nor the capacity to link up with other NIS actors.

The weaknesses of the region's NISs make it harder for companies, especially smaller ones, to have the capacities to compete when technology is moving forward so quickly and there is growing specialisation. Latin American NISs are faced with restrictions in the capacities of their members, whose diversity makes co-ordination difficult. In science, technology and innovation (STI), Latin America is lagging way behind more developed economies because demand for STI by the production sectors is low and investment in R&D is scant, especially in the private sector. SMEs can only achieve the capacities they need by working in networks, where information and technology can flow between businesses and organisations as abundantly as inputs and goods. The SMEs can thus increase their added value and markedly boost productivity (ECLAC, 2010).

Innovations and SMEs: activities, strengths and weaknesses

Economic development and innovation processes are associated with companies generating and accumulating the technological capacities to function and trade. They are also associated with knowledge flows, which greatly impact the results of innovation activities, which in turn impact the flows. Learning and knowledge accumulation are essential for a firm to develop its skills and innovative capacities. A company's experience and its interaction with other companies and other types of agents influence its learning process. Innovation processes are brought about by complex social interactions that do not occur spontaneously, in isolation, but are the cause and consequence of knowledge flows and interaction between NIS agents. Other important variables also exist, especially sector-specific and region-specific variables and the competition dynamic among companies.

SMEs and their capacities to innovate

Despite the differences among countries, sectors and companies and their effects on a firm's export prospects, innovation is always important to drive forward productivity and competitiveness (Box 4.1).

Compared to larger firms, SMEs face major constraints that make it harder for them to innovate. Investment in R&D requires large-scale initial spending and there is much uncertainty regarding the resulting benefits. This is not an obstacle for larger firms, but it is for smaller ones. Restrictions on access to domestic and foreign financing, as well as requests for guarantees and high interest rates, represent major barriers to innovation and the incorporation of knowledge in smaller firms. Furthermore, innovation requires economies of scale and of scope, adding a further difficulty for SMEs. Large companies are better placed to take on the high risks associated with innovation and benefit from its returns (Box 4.1). SMEs have to team up with other firms to promote and facilitate the integration of learning and knowledge. Despite these constraints, SMEs bring flexibility to innovation processes, thanks to their more malleable organisational structure. They can respond quickly to changes and they make decisions quickly, with their staff participating in the process.

Innovation processes do not occur spontaneously, in isolation, but are the cause and consequence of knowledge flows and interaction between the actors that form the NIS. The sector in which a company operates, its location and the competition it faces are factors that influence innovation.

Differences in innovative behaviour also exist among SMEs. Those targeting international markets have a greater capacity to innovate, and indeed innovate more, especially if they operate in sectors dominated by dynamic efficiencies (Schumpeterian and Keynesian).[3] Access to international markets requires technologies, encourages firms to strengthen their technology skills and improve their organisational and business models, making it easier for them to innovate. Qualified human resources (absorption capacity) are essential to improve firms' innovative capacity in products and processes. Some sectors are more likely to innovate, often because they have a greater capacity to accumulate knowledge.

Government support is good for business innovation, with significant "crowding-in" effects on investment in innovation.

Box 4.1. **Innovation, exports and productivity: a positive relationship in Latin American and OECD countries**

Large firms perform more innovation than SMEs, according to comparative studies on Latin American and OECD countries. The effects that larger production units have on innovation are similar in several countries. For instance, large firms are 10% more innovative than small ones in Argentina, Chile, Colombia and Costa Rica, 8% in Panama, and 17% in Uruguay (where the figure is highest). As in Latin America, in OECD countries there is a clear positive correlation between company size and propensity to innovate. While in Norway (the country with the largest gap) large firms are 32% more innovative, in the UK the figure falls to 4.6%.

Several studies confirm that companies that export are more likely to engage in innovative activities than those that serve only the domestic market. This relationship is evident in Latin American countries including Argentina (15%), Chile (11%) and Colombia (7%). The same pattern is found in OECD countries, especially in France (78%), Norway (64%), Denmark (64%) and Belgium (62%). The OECD countries where the relationship is least evident are Canada (29%), Switzerland (31%) and New Zealand (35%), but these figures are still higher than those found in Latin America.

There is a positive correlation between innovation and productivity. After controlling for relevant variables such as human capital, the relationship between these variables in OECD countries is positive and statistically significant. In European countries, the correlation between sales from product innovations and productivity is high for large firms, while in Canada and New Zealand this correlation is more pronounced among SMEs.

Government financial support for innovation has positive effects on businesses. In Latin American countries such as Chile and Colombia, the firms that received financial support invested 80% more in technological development than other firms. Costa Rican firms benefit most, with those receiving such funding investing twice as much as those that do not. A similar pattern occurs in OECD countries. In Germany, Finland, the Netherlands and Italy, firms that receive government financing invested 40-50% more than average, while in Austria, Belgium, Denmark, France and Norway the difference rises to 70%. This shows the tremendous impact public innovation policies have on companies' innovative effort, which has a strong "crowding-in" effect on investment in innovation.

Source: Based on OECD (2009) and Crespi and Zúñiga (2010)

Two features stand out in relation to the innovative capacity of SMEs:

- SMEs' innovation strategies are less formal than those of larger firms. These differences also exist between SMEs, as well as between different sectors of the economy. Generally, companies operating in knowledge-intensive sectors have more formal strategies and consistently invest more money in R&D.
- There is little interaction with their peers, other institutions and other agents, which prevents their innovation strategies from having a greater impact. SMEs can access formal innovation strategies through their linkages with other economic agents that do not face restrictions of scale, such as large firms (Dini and Stumpo, 2011).

Access to international markets for SMEs increases their propensity to innovate because they need new technologies, greater technological skills and better organisational and business models.

Activities, results and obstacles

Companies innovate to increase their productivity and competitiveness and reduce their operational costs. When analysing business-innovation activities and production structures in Latin America, the concept of innovation should be used "in the broadest sense", since most of the companies operate in non-knowledge-intensive and non-technology-intensive industries. SMEs generally focus their efforts on informal, incremental innovation activities, investing little in radical innovation activities such as investment in R&D, so unless we expand the definition of innovation we will underestimate the innovative capacity of SMEs and non-technology-intensive sectors.

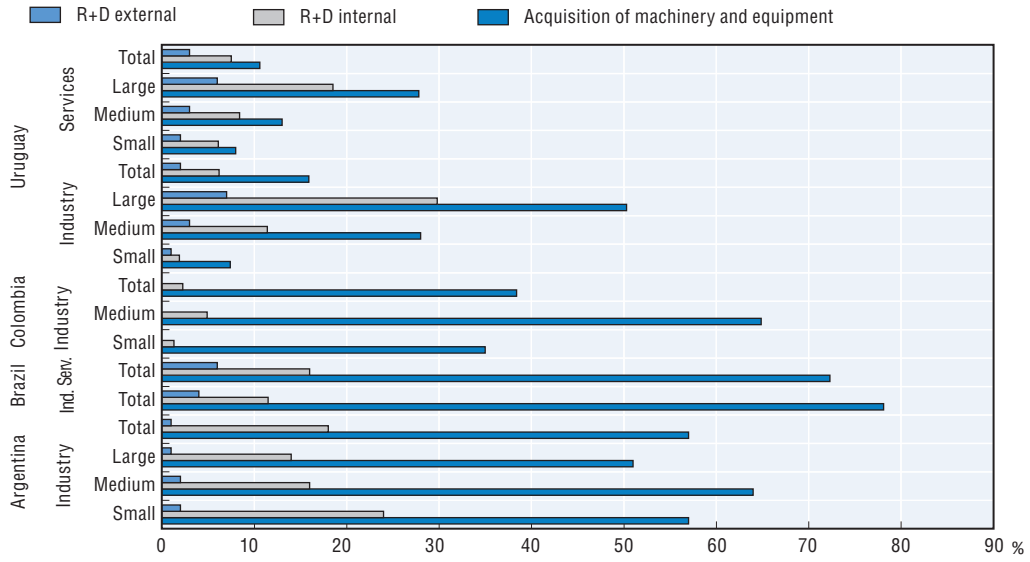
The latest innovation surveys carried out in several Latin American countries reveal certain patterns in the behaviour of SMEs. Company innovation processes have only just started being measured in the region, through national innovation surveys. Based on data from surveys in five countries (Argentina, Brazil, Chile, Colombia and Uruguay), the next section analyses and describes the main innovation and technological dissemination activities conducted by Latin American companies. But we must remember that much work still needs to be done in the region for surveys to provide homogeneous, comparable data that can be used to obtain true measures of firms' technological and organisational capacities and their ability to absorb technology and connect with other firms. The surveys need an improved design and the focus of the data extracted needs to shift in order to capture companies' innovation capacities, effort and obstacles. This would make the surveys and other tools for obtaining data useful for developing and evaluating public policies to innovate and develop technology (Cimoli *et al.*, 2011).

The data from these surveys provide only a partial view of innovation activities in companies, especially SMEs. While they do not allow an exhaustive analysis of the region and the different aspects of scientific and technological development at the company level, these surveys do reveal certain common characteristics of their innovative capacities, as well as the main results of those activities and the obstacles that companies face.

Latin American SMEs concentrate their innovation activities on technology transfer and imitation. This is reflected in the high level of investment in machinery and equipment compared to investment in radical innovations such as R&D (Figure 4.2). While large firms share their investments more evenly between R&D and capital goods, SMEs invest more heavily in the latter. Furthermore, company size and sector are key factors in determining the type of innovation activity carried out. The nature of the innovation activities also varies from country to country in Latin America. Some countries, like Uruguay, are increasing the percentage of investment used to acquire machinery and equipment, while others, like Argentina, have shifted the balance more towards R&D.

Latin American SMEs concentrate their innovation activities on technology transfer and imitation. This is reflected in the high level of investment in machinery and equipment compared to that in R&D.

Figure 4.2. **Investment in capital goods and R&D according to company size and sector**
(percentage of innovative companies)



Note: The company sizes are those defined by each country for their surveys.

Source: National Business Survey on Innovation, R&D and ICTs (2002-04) Argentina, Survey of Innovation Technology in Brazil (IBGE, 2010), (Gutiérrez, 2011), 3rd Uruguayan Industry Innovation Survey (2004-06) (ANII, 2008a) and 1st Uruguayan Services Innovation Survey (2004-06) (ANII, 2008b)

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There is a strong correlation between company size and the results of innovation activities, with large companies obtaining better results than SMEs.

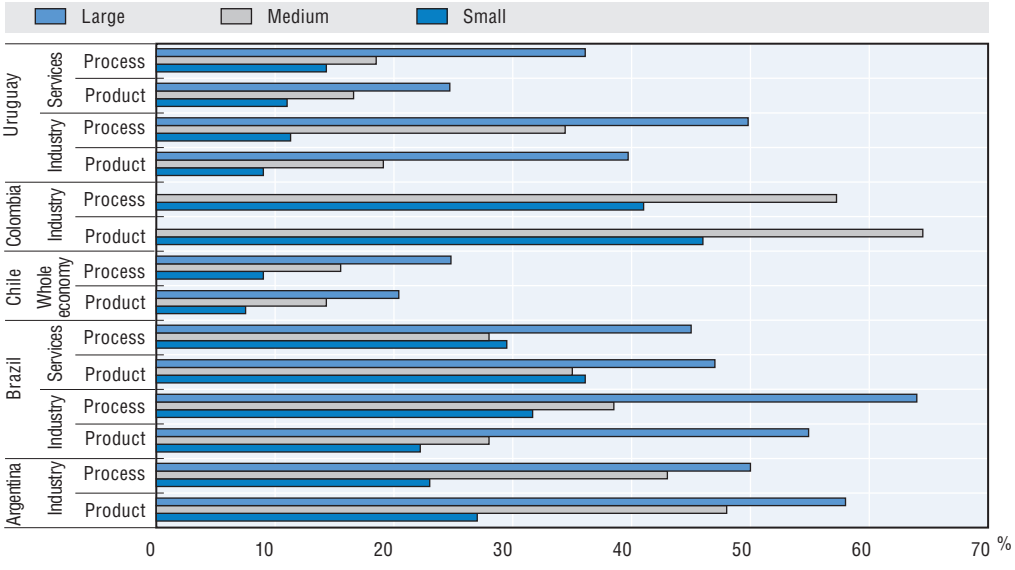
Turning to human resources and sources of funding, in these areas too there are vast differences according to company sector and company size. Human resources devoted wholly or partially to innovation activities are an indicator of companies' commitment to technological and organisational innovations. In the countries surveyed, firms devoted to innovation in the strictest sense of the term allocated more staff to this area than firms that innovate in a broader sense. In Uruguay, in 2006, firms devoted to innovation in the narrow sense allocated 7% of their staff to developing innovation activities, while firms that innovate in a broader sense allocated just 3% (ANII, 2008a). Moreover, the proportion of workers engaged in innovation activities is higher in large firms. This is because those firms' human resources are more qualified, have greater access to finance and have formal organisational structures and innovation strategies. SMEs employ relatively less-skilled workers in their innovation activities, who generally conduct their activities in informal units or departments. In addition, SMEs have financial constraints that restrict their capacity to innovate. Latin American companies, especially SMEs, generally have to fund their own innovation activities, since they are faced with obstacles in accessing the financial system and being included in government programmes to promote business innovation.

According to the results of innovative activities in selected Latin American countries, companies mainly make incremental innovations in products and processes aimed at the production unit itself or the local market. There is a strong correlation between company size and the results of innovative activities, with large companies obtaining better results than SMEs. SMEs' focus on marginal, incremental innovations in products, processes and activities produces very little impact, if any, on their access to international markets. This is mainly due to the stronger investment in machinery and equipment by Latin American companies and weaker investment in radical innovation activities such as R&D (Figure 4.3).

A company's sector is also a crucial factor. In Argentina, for instance, engineering-intensive activities and the car industry are the sectors of industry with the highest proportion of innovative firms, while in the tertiary sector IT services are most innovative (Barletta *et al.*, 2011). In Colombia too, innovation varies greatly among different industrial sectors. SMEs that produce machinery and electronic goods innovate the most in products, while SMEs involved in manufacturing cars, trailers and semi-trailers innovate the most in processes (Gutiérrez, 2011). The situation is similar in Brazil and Uruguay.

Among SMEs, the sector of activity determines the level of innovation. In Argentina, innovation is led by the car industry and engineering-intensive companies, while in Colombia it is led by SMEs that manufacture machinery, electronic goods, cars, trailers and semi-trailers.

Figure 4.3. **Innovation results by company size and sector**



Note: The company sizes are those defined by each country for their surveys.

Source: National Business Survey on Innovation, R&D and ICTs (2002-04) Argentina, (Barletta *et al.* 2011,) Brazilian Technological Innovation Survey (2010), (Gutiérrez, 2011), 7th Chilean Innovation Survey (2012), 3rd Uruguayan Industry Innovation Survey 2004-06 (ANII, 2008a), 1st Uruguayan Services Innovation Survey 2004-06 (ANII, 2008b).

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Microeconomic, sectoral and macroeconomic factors affect innovation processes by influencing whether firms choose to innovate, how much they choose to innovate and the quality of the innovation. In Latin America there are several common elements that hinder innovative behaviour, including the difficult access to credit and the shortage of qualified staff. These are particularly relevant to SMEs and must be taken into account when designing or implementing policies and instruments to promote science, technology and innovation.

The poor linkages and co-operation among companies and agents belonging to the NISs create an obstacle to technology and knowledge transfer, innovation processes and co-ordination between the production sector and academia. The smaller the company, the greater these difficulties become.

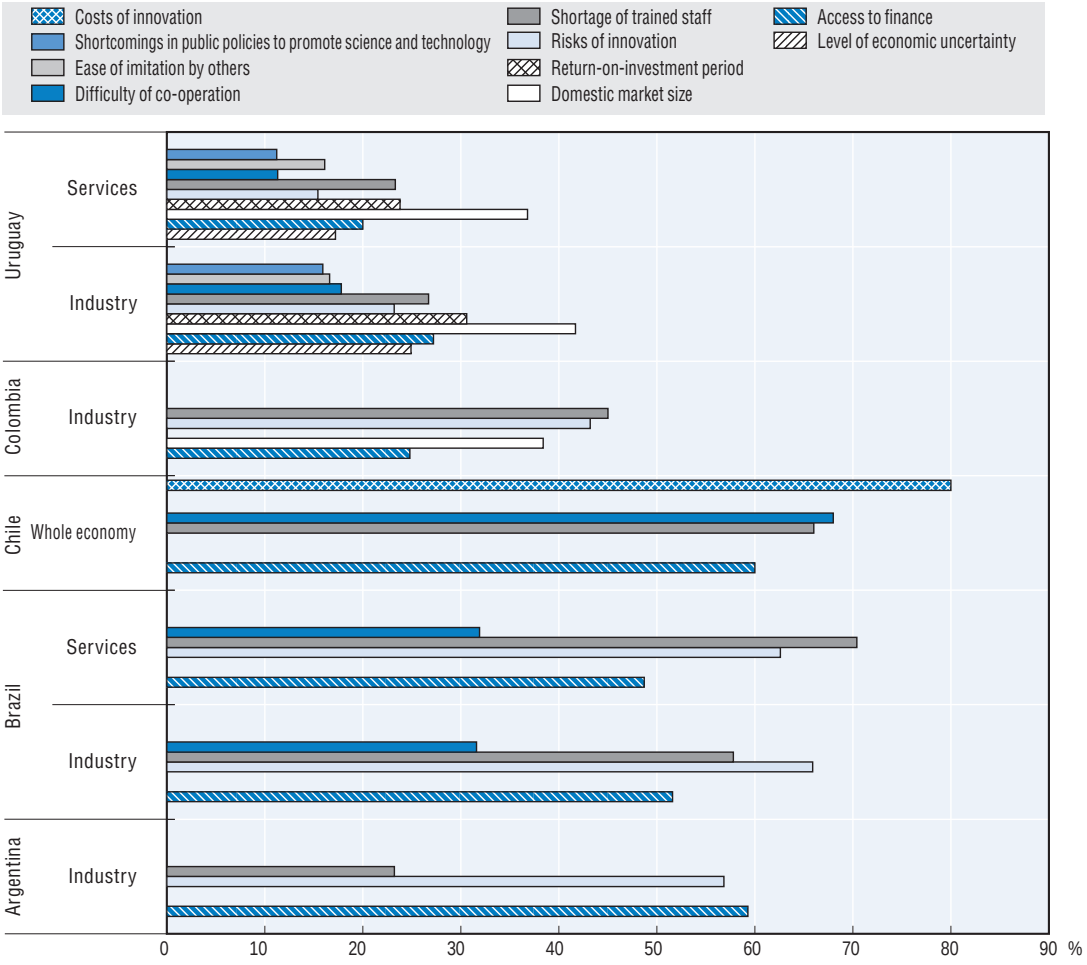
The high costs and risks of innovation are the main factors that hold back this activity, especially among SMEs. In Brazil, service companies also point to the lack of qualified staff as an obstacle.

The very characteristics of innovation discourage innovative behaviour, especially among SMEs (Figure 4.4). The high costs and risks hold back or inhibit this activity, especially among SMEs and non-innovative companies. For example, non-innovative companies in Argentina cite the high costs (57%), excessive economic risks (55%) and lack of funding (49%) as the main obstacles, which can be explained by their high risk aversion (Barletta *et al.* 2011). In Brazilian industry, innovative companies identify as their obstacles to innovation the high cost (73%), the high risks (66%) and poor access to finance (52%). In the service sector, the obstacles are the lack of qualified staff (70%) and, as for industrial companies, the high cost (72%), the associated risk (63%) and the restricted access to finance (49%) (IBGE, 2010). The major obstacles identified by innovative Colombian SMEs are finding and training human capital (45%), the risks (43%), organisational and management problems (40%), problems with the market structure and size (38%) and information problems (37%) (Gutiérrez, 2011).

Public policies to support innovation vary greatly across the region. Although progress has been seen in several countries, SMEs are still faced with obstacles and restrictions that make it difficult for them to benefit from government policies and programmes.

In addition to the obstacles mentioned above, there are also country-specific factors. In Uruguay, for instance, the small domestic market makes it harder for firms to develop innovations, since they are faced with diseconomies of scale.

Figure 4.4. **Major obstacles to business innovation, by country and sector**
(as percentage of innovating firms)



Note: The company sizes are those defined by each country for their surveys. For Chile, "Limited co-operation with other institutions/companies" is calculated as the simple average of limited co-operation with institutions and limited co-operation with companies. In the Uruguayan services sector, "Macroeconomic instability" was replaced by "Level of economic uncertainty".

Source: 3rd Uruguayan Industry Innovation Survey (2004-06), 1st Uruguayan Services Innovation Survey (2004-06), Brazilian Technology Innovation Survey (2008), 5th Chilean Innovation Survey, *Innovación y sus determinantes en la pequeña y mediana empresa: el sector manufacturero colombiano* (Gutiérrez, 2011) and *La conducta innovativa de las pymes industriales y de servicios argentinas* (Barletta *et al.* 2011).

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Box 4.2. **Awareness of policies to promote innovation in Chile and Brazil**

Although participation rates in innovation activities in Chile are below other regions like the European Union (26.5% in Chile vs 28.5% in the European Union), the knowledge and use of public programmes has increased between 2005 and 2010. So, as one would expect, innovative firms are more aware of public support programmes for innovation and use them more than non-innovative firms. Specifically, knowledge of public programmes increased 10 percentage points among innovative firms (vs. 3 percentage points for non-innovative), with the use increasing 13.8 percentage points (vs. 4.5 percentage points).

Table 4.1. **Knowledge and use of government support programmes by innovative and non-innovative Chilean companies**
(as percentages)

Chile	2005		2009-10	
	Awareness of public programmes	Use of public programmes	Awareness of public programmes	Use of public programmes
Non-innovative companies	20.5	1.5	24.0	5.6
Innovative companies	38.3	5.2	47.8	18.7

Source: Based on data from the V Innovation Survey of Chile (2009), and VII Survey of Innovation, Ministry of Economy (2012).

In Brazilian industry, 22.8% of innovative firms have obtained at least one piece of government support to help them innovate products or processes. However, the percentage is lower among small firms than among large ones. While 36.8% of large firms have received at least some government support, the figure falls to 23.7% among medium-sized firms and 22.2% among small firms. Among industrial companies, the most common thing that grants are spent on is purchasing machinery and equipment (14.2%).

Box 4.2. (contd).

Table 4.2. **Use of support programmes by Brazilian companies, by company size**
(as percentages)

Support programmes used by innovative companies, by company size												
	Small			Medium			Large			Total		
	Industry	Services	R&D	Industry	Services	R&D	Industry	Services	R&D	Industry	Services	R&D
Funding for R&D and for purchase of machinery and equipment	14.3	3.3	0	14.7	4.6	10.5	12.1	1.3	16.7	14.2	3.4	10.3
Research projects in association with universities and research centres	0.7	0.9	37.5	1.1	2.5	78.9	4.2	2.5	83.3	0.8	1.1	71.8
Research projects not associated with universities and research centres	1.3	0.9	50	0.9	2.1	52.6	4.7	1.1	83.3	1.4	1	61.5
Financial subsidies for R&D and employment of researchers	0.4	3.1	12.5	0.9	4.1	21.1	4.1	3.6	50	0.5	3.2	28.2
Computer Technology Act	1.8	0.6	25	1.6	3.1	57.9	3.2	5	33.3	1.8	90	43.6
R&D and Technology Innovation Act	0.5	0.5	0	1.9	6.7	26.3	16.2	16.5	33.3	1.1	1.5	23.1
Other support programmes	7	7.6	37.5	7.6	12.9	57.9	9.2	2.5	83.3	7.1	7.9	61.5
TOTAL	22.2	14.1	75	23.7	26.2	100	36.8	25	100	22.8	15.3	94.9

Source: Based on Ministry of Economy, Chile (2009) and IBGE (2010) figures.

There are few linkages between Latin American businesses and other NIS participants. Multidisciplinary collaboration and linkages through interaction with these agents generates forums to address, disseminate, transfer and acquire knowledge and information and technology. However, universities and businesses have had a complex, difficult relationship with each other because of their different roles in society and their respective characteristics. Universities have not played a significant or dynamic role in the innovation of business. There is little co-ordination between the two, which means little scientific and technological knowledge is transferred to the production sector and instilled in businesses' innovation strategies (ECLAC/SEGIB, 2010). Given the constraints faced by SMEs restricting them from increasing their potential for innovation and technological modernisation, they need platforms for linking and communicating with other NIS firms and institutions to reduce their costs and uncertainty, access new knowledge and strengthen their internal capacities. There are major advantages for

firms establishing such links, which can take many different forms with varying levels of frequency and intensity.

In Chile, 55% of innovative firms believe the lack of government incentives is an obstacle to innovation. Although nearly 40% of firms are aware of public support programmes, only 5% have used them.

Box 4.3. SMEs and their linkages with the NIS

The degree of linkage between firms in the service and industry sectors and NIS agents is positively correlated with the company size. In Brazil, a breakdown by sector and size reveals that 9% of small innovative industrial firms and 12% of small service-sector firms had linkages with other NIS actors; in medium-sized companies, the figures rise to 15% in industry and 14% in the service sector; and in large firms the figures jump to 35% in industry and 24% in the service sector.

Although there are few linkages between Brazilian firms (industry and services) and universities, firms view such linkages as important. Indeed, 30% of industrial firms and 43% of service-sector firms consider it important to co-operate with universities (IBGE, 2010). In Colombia, there are very few linkages with universities. Only 6% of small firms and 10% of medium-sized firms have such linkages. In both countries, linkages and co-operation with NIS agents increases as the company's size increases. As in other Latin American countries, Colombian universities have not helped boost innovation among SMEs in the manufacturing sector (Gutiérrez, 2011). Similarly, in Uruguay innovative companies in industry and the service sector develop linkages with various NIS agents, but co-operation between them and universities and research centres is very low, though it is higher among larger firms. About 4% of small firms, 10% of medium-sized firms and 24% of large firms have such linkages. The importance of this form of co-operation for innovation is highlighted by the fact that 32% of firms that innovate in the strict sense of the word have linkages with universities, compared with just 12% of firms that innovate in a broader sense. Similarly, government bodies responsible for operating STI programmes have very few linkages with Latin American firms.

It is vital to develop policies focused on strengthening the capacity for co-operation between NIS agents and innovation in the region. Although few countries have strong NISs, there is a consensus that innovation is important to improve economic growth and competitiveness. Several Latin American countries have thus bumped the topic up their agenda, introducing policies to foster linkages among NIS agents in national STI plans.

Source: Based on data from innovation surveys.

In short, the innovation survey results bring to light a series of characteristics shared by SMEs and the main factors that hinder innovation activities. Innovations introduced by SMEs have a far narrower scope than those introduced by larger firms. SMEs generally allocate few resources to radical innovation activities such as investment in R&D, focusing instead on acquiring machinery and equipment, with ICTs playing a prominent role. This, they say, is due to the obstacles they face because they are not large companies and the high costs and risks associated with innovation activities, along with their limited access to financing. Innovation activities exhibit economies of scale,

making it difficult for SMEs to make any profit from them. The poorly qualified human resources and unfavourable characteristics of the sectors in which they operate – with little incorporation of technology, knowledge acquisition and information – discourage them from investing in innovation. These factors are constraints that must be taken into account by policy makers and those who design instruments to promote innovation and the incorporation of knowledge into production processes.

These conclusions reaffirm the need for governments to step up and broaden the scope of public policies to promote and support SMEs, because without such support they have been unable to undertake complex, wide-reaching innovation activities.

Although some Latin American firms have come close to the international technology frontier in some fields, such firms tend to be "technology islands" in a region characterised by a highly diverse production structure.

Although in Latin America there are some firms, production clusters and sectors that have come close to the international technology frontier, they tend to be "technology islands" in a region characterised by a highly diverse production structure. For Latin American countries to converge upon a pathway of inclusive development, it is essential that they increase business investment in innovation and R&D to significantly boost productivity and competitiveness. It is therefore important that they make progress in designing and implementing industrial policies accompanied by science, technology and innovation policies. These policies must take into account the specificities of SMEs, encourage complementarity among NIS agents and facilitate linkages between SMEs and all other production and innovation firms and organisations to improve their access to new technologies and their capacity to innovate. Policies should help these companies overcome the barriers they face, expand the spillover effects into other sectors and foster productive links in both directions. This will increase the added value and improve income and salaries in SMEs and the wider economy.

ICTs in Latin American SMEs: access and adoption

As we have seen, one of the fundamental innovation activities that occurs in Latin American firms, especially smaller firms, is the incorporation of technologies through investment in machinery and equipment. ICTs have become particularly prominent in recent years. Therefore, it is important to analyse the penetration rate of ICTs in SMEs, what access SMEs have to more complex technologies, what limitations they face, and the potential of these new applications.

ICT penetration in SMEs

Although more SMEs have adopted and begun using basic tools (personal computers, Internet and e-mail), there is still a wide gap between Latin America and OECD countries in terms of the sophistication of the ICTs they use. Although SMEs have narrowed the gap in terms of basic ICT infrastructure, they are now lagging even further behind in their use of complex technologies.

Formal Latin American SMEs do not lag very far behind in terms of access to basic ICTs such as mobile and fixed-line phones, computers, ordinary software and Internet use.

Data on ICT access and use in the region is sparse and difficult to compare among and within countries because of the different methodologies and coverage. Data tend to be for basic indicators (Internet access and number of computers), and very little information is available on complex applications and effective use of ICTs in businesses. This makes it difficult to identify gaps between Latin American and OECD countries from which to draw lessons.

In recent years, there have been several initiatives to improve how ICT use in the region's businesses is measured. Current methods focus on basic data, and new indicators are still in the early stages of development. Generally the data available in the region are as follows: computer availability, intranet and Internet access, online sales and purchases, and human resources who use these technologies, sometimes including information on the type of Internet connection, how the connection is used, and extranet access, without details on the hardware or its use. In several cases, the data only cover the manufacturing sector, rather than all production sectors, and in other cases data from microenterprises are not included or are not proportionally represented. For instance, statistics often do not measure the incorporation of ICTs in agricultural SMEs.[4]

Despite these limitations, we can analyse certain indicators that provide a partial view of the extent to which ICTs have spread in Latin American companies of different sizes. The adoption of these technologies is the result of an evolutionary process that requires certain minimum thresholds for technology infrastructure, which are necessary to move into maturer, more advanced stages (Peirano and Suárez, 2006; Kotelnikov, 2007; Rivas and Stumpo, 2011). Completing one phase and moving onto the next requires additional efforts and complementarities in firms' skills and organisation. Firms can make progress in the ICTs they adopt and use by moving from unsophisticated technologies such as mobile and fixed-line telephones and computers with basic software to more advanced technologies like e-commerce and information and communication systems.

Compared to large firms, formal SMEs do not lag very far behind in terms of access to basic ICTs, which represent the first stage of adoption and use. This is attributable to the sharp drop in the cost of access to these technologies. Although there are very few follow-up surveys to investigate the dissemination of ICTs among firms of different sizes, existing surveys show that in several countries SMEs have gradually been acquiring computers and their level of Internet access is similar to that of larger firms. The gap is minimal for the use of basic tools such as e-mail, with data across the region indicating around 98% of small firms and 99% of large firms using this means of communication.

Many Latin American SMEs seem to have entered the second stage of incorporating ICTs. The second stage involves creating and managing databases that, with a small amount of investment in computer infrastructure, can be used to speed up and standardise administrative procedures, which has an impact on information-generating activities. Changes in computer and communications infrastructure mainly affect routine operations. The main benefit for the company is that procedures are automated,

improving the productivity of human resources and lowering costs for the company itself and for third parties. This stage involves relatively advanced uses of technology, such as transactions with government bodies and banking and financial services. Although many smaller firms do use these technologies, the gaps among firms of different sizes are beginning to widen (Table 4.3). The gaps in ICT use are also widening among firms that have their own website, but the statistical data do not indicate how firms use their website, and include in this category those who use their site solely for informational purposes rather than to form a link with their customers or suppliers.

Table 4.3. **Use of intermediary ICTs, by company size**
(as percentages)

	Country	Microenterprises	Small enterprises	Medium enterprises	Large enterprises
% of companies using the Internet for transactions with government agencies	Argentina*	-	50	66	82
	Brazil	-	66	78	87
	Chile	70	83	95	97
	Colombia	39	53	68	78
% of companies using the Internet for banking and financial services	Brazil	-	83	91	94
	Chile**	-	77	89	93
	Colombia	67	84	91	93
% of companies with their own website	Argentina	-	62	76	83
	Brazil	-	50	75	91
	Chile	9	21	53	75
	Colombia***	2	23	60	77
	Uruguay	-	45	60	75

Notes: (*) Average for businesses that undertake transactions (independent of the frequency) of a) liquidation and payment of AFIP, b) assessment and payment of contributions and c) other transactions with the state-based OEDE-DGEYEL-MTEySS (2011). (**) Survey Data Access and use of Information and Communication Technologies in Chilean companies (2006). The stages of firm size are used in the surveys of the respective countries, based of their respective definitions. (***) For Colombia, data based on their Core Indicators Study of Information and Communication Technologies ICT (2006 and 2007), DANE (2008).

Source: Produced by author based on several surveys. For Argentina, data based on OEDE-DGEYEL-MTEySS (2011), ICT-EIL module. For Brazil, data based on homes and businesses ICT 2011 (CETIC, 2012). For Colombia, based on DANE ICT Survey (2008). For Chile, based on 2nd Business Longitudinal Survey, Business Centre, Ministry of Economy (2012). For Uruguay, based on ICT module developed by the INE (2007).

In the third stage, ICTs support decision making and allow changes to be made to how information is processed and how it is co-ordinated with the firm's strategic areas. For these more advanced applications and uses, there is a much wider gap between SMEs and larger firms. Relatively speaking, the effort required of SMEs to incorporate and use these tools is much greater in terms of training up staff and acquiring the prerequisite skills. The staff's skills even become more important, since new tools need to be used for management tasks in order to be effective. One indicator of how well firms can co-ordinate their different areas is whether they have an intranet, and the vast differences among agents of production in their adoption of an intranet is significant for the region's production fabric.

Table 4.4. **Frequency of ICT use**
(as percentages)

	Country	Microenterprises	Small enterprises	Medium enterprises	Large enterprises
% of companies placing online orders	Argentina	-	22	24	25
	Brazil	-	56	68	68
	Chile	5	10	15	14
	Colombia	33	43	49	49
	Uruguay	-	36	49	54
% of companies receiving online orders	Argentina	-	18	22	23
	Brazil	-	11	14	18
	Chile	4	6	10	9
	Colombia	35	45	49	46
	Uruguay	-	37	47	44
% of companies with an intranet	Argentina	-	18	34	61
	Brazil*	18	35	49	72
	Colombia**	19	21	37	62
	Uruguay	-	22	38	56

Notes: * For Brazil, the values correspond to the percentage of companies that have ICT. For other countries, the values are with respect to the Internet. (**) For Colombia, value based on a study of Basic Indicators of Information and Communication Technologies ICT (2006 and 2007), DANE (2008).

Source: Values based on data from various surveys. For Argentina, data based on OEDE-DGEYEL-MTEySS (2011), ITC-EIL module. For Brazil, based on homes and businesses ICT 2011(CETIC, 2012). For Colombia, based on DANE ICT Survey (2008). For Chile, based on the second Business Longitudinal Survey, Business Centre of the Ministry of Economy (2012). For Uruguay, based on an ICT module developed by the INE (2007).

Firms that use ICTs more intensively and for more complex applications, and therefore need an intranet combined with highly specialised software such as enterprise resource planning (ERP) and customer relationship management (CRM), are in the fourth stage of adopting ICTs. In this stage, investment focuses on technology infrastructure and highly qualified staff. Firms fully adopt ICTs when the technology enables them not only to carry out the activities described above for the previous stages but also to innovate better. Innovations can be enhanced by greater interaction among different areas of the company or by fluid, permanent contact with suppliers and customers.[5] There are differences in the use of these systems, which are related to the technological, organisational and absorption capacities of each company, and not just its size or lifetime. For example, in Argentina, ERP systems are used by 25% of small firms, 32% of medium-sized firms and 60% of large firms, while in Brazil the respective figures are 31%, 51% and 72%.

Much of the production sector in Latin America, especially SMEs, is in the first or second stage of using ICTs. Such firms mainly operate in industry, basic services and business. At the third stage are a small proportion of firms, especially medium-sized and large firms, with a higher proportion of industrial activities or more specialised services. Finally, the fourth stage, in which ICTs are used to adapt equipment and human resources' skills, has been reached by only a very small proportion of businesses in the region, mainly large companies (especially transnational and large domestically owned corporations) and other firms of various sizes operating in more technology-intensive sectors, in industry and in specialised services.[6] Some companies often incorporate more complex technology without having the internal resources to use it productively, which creates organisational problems (Breard and Yoguel, 2011).

When firms use ICTs to help them develop innovations, they are considered to have fully adopted ICTs.

New opportunities to digitise SMEs

ICTs have revolutionised various aspects of modern life. One of these aspects is the business sector, with ICTs becoming ever more vital in making companies competitive. Thanks to their ability to speed up communication, streamline management processes, generate market information and knowledge and open up new distribution channels and business models, businesses have rapidly adopted them, especially large firms. For SMEs, using the Internet provides new opportunities to supplement or replace traditional advertising. And with e-commerce applications, they can expand their markets, especially internationally.

Latin American SMEs have been slower to take up ICTs because many are unaware of their benefits for business, and more importantly, because they find them expensive. For example, the early development of integrated management programmes and applications, such as knowledge management systems (KMSs) and, as mentioned above, ERPs and CRMs, are better adapted to large firms than to SMEs, which have a much simpler business structure. Also, the high cost of computer software and hardware remains an obstacle, despite ever-falling prices. Finally, to adopt these technologies firms must invest in giving staff the technical training they need to use, benefit from and maintain them.

Driven by the recent expansion of broadband services, cloud computing is an opportunity for SMEs, since it significantly reduces the weight of ICTs in their cost structures. Cloud computing is the provision of standardised, configurable, on-demand, online computer services. These services include computing, storage, software and data management using shared physical and virtual resources (networks, servers and applications, among others). Since cloud computing takes place online, with shared resources and on-demand services, it offers major advantages over traditional computing. Being online, the service is constantly available, allowing users to access their data and applications using various types of devices wherever they are located, provided they have a suitable Internet connection.

Cloud computing gives SMEs the opportunity to access low-cost, standardised, configurable online computer services. These services include computing, storage, software and data management using shared physical and virtual resources (networks, servers and applications).

Since they are on-demand services and you pay for what you use, users can access a catalogue of services and pay only for those ones they need for their business, adapting what they use to their demand and workflow. Providers of cloud services, meanwhile, use economies of scale, user-demand aggregation and the diversity of demand patterns to offer a scalable, customised service more cheaply, since the cost of the computer resources is shared among a wider user base. Finally, the cloud-computing model minimises management efforts, as the service can be provided without users knowing details about the infrastructure, such as where it is located. This brings down the cost of managing and maintaining equipment and systems.

The main impact of cloud computing is that it reduces costs, especially for SMEs.[7] Businesses benefit from greater flexibility to respond to cyclical fluctuations and a lower cost of entry. In some countries the use of SaaS CRM solutions reduces costs by an estimated 20-25% compared to conventional applications, while migrating infrastructure to cloud services can reduce costs by over 50%.[8] The impact on the number of businesses started up varies from country to country and sector to sector, but the greatest impact takes place where SMEs are strongest and ICTs are adopted quickest, and in sectors in which the fixed cost of ICTs is very high, such as wholesale and retail trade, and property.

Cloud computing can have a very positive effect in Latin America, given the strong presence of SMEs in the business sector and the slow adoption of ICTs. The extent to which the model is used in the region is marked by the characteristics of the region's businesses, including their capacity to adopt the technology, and by the development of cloud computing services that meet business needs, and the expansion of broadband services and the quality of the connection. These factors form the platform for enabling cloud computing.

Regional broadband connectivity

A critical factor for efficient, productive use of ICTs is the availability and quality of broadband services, which facilitates the development of complementarities in social and production sectors. Analysis of broadband Internet connectivity and its determining factors in Latin America shows that certain problems restrict access to the service, both for home and business users, by affecting connection speed and quality, teledensity and prices.[9] These problems include:

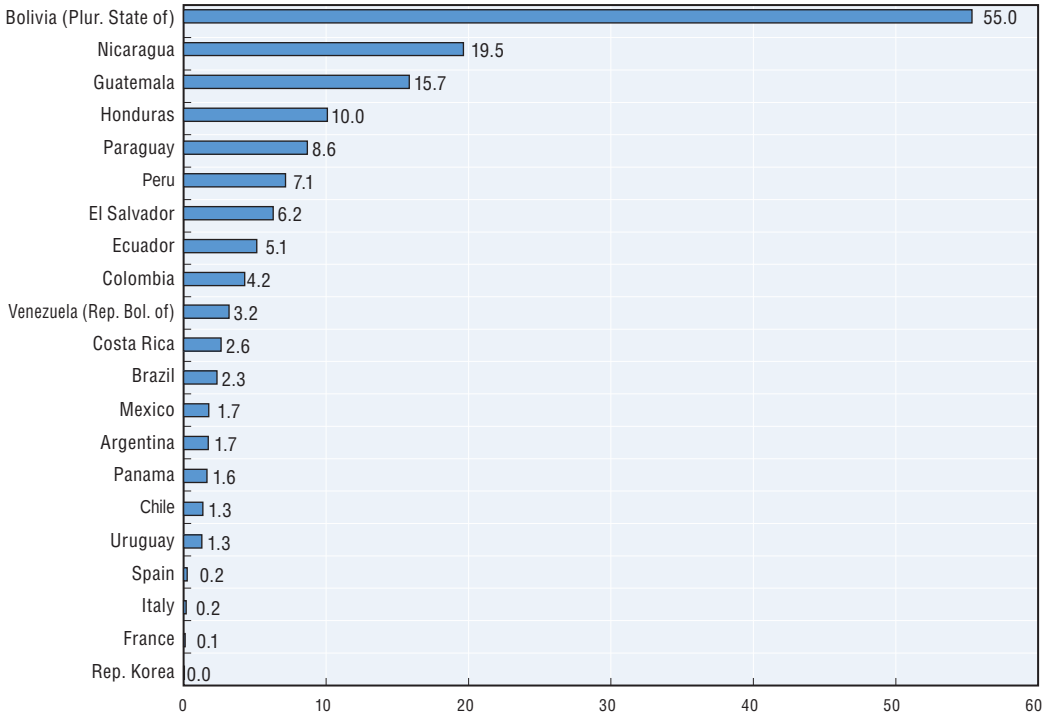
- Economies of scale: Due to the low purchasing power of most Latin Americans and the high cost of broadband in the region, Latin America does not achieve the economies of scale seen in developed countries. Broadband is significantly more expensive than in developed countries, both in absolute terms and relative to per capita income. Both factors severely limit broadband services from spreading through market mechanisms.
- Cost of international Internet access: The greater distances involved in connecting Latin American countries to the global network raises the cost of broadband access. The transmission capacity required to access the Internet, usually via the United States, is high. Furthermore, low traffic prevents better use of the infrastructure deployed, making relative costs more expensive than in other regions. The cost of international access has an impact of between 20% and 40% on the end cost of broadband services.
- Non-optimal regional connectivity: The limited direct connectivity among Latin American countries raises the cost and reduces the quality of Internet access due to the two-way, long-distance international transport needed to move data from one country to another, usually via the United States. Often, data moving from one Internet service provider (ISP) to another ISP in the same country must go through foreign-based Internet exchange points. If regional traffic were to increase significantly, economies of scale would justify direct links among Latin American countries.

According to the International Telecommunication Union (ITU), the penetration of fixed broadband in the region is well below that of more developed countries and regions. This means the benefits of using broadband are available only to a small part of the population.[10] The positive effects of broadband on GDP growth exhibit returns to scale:

broadband makes a greater contribution as its penetration rate increases, and must reach a critical mass of users to maximise profits. In this context, the large access gaps among countries in the region and between the region and developed countries, both in absolute terms and relative to per capita income (Figure 4.5) are a major hindrance to the development. For output, given the financing problems encountered by SMEs, costs are also a key factor in determining their capacity to access broadband services.

Broadband penetration in Latin American countries is well below the rate in developed countries and other regions around the world. It is available only to small segments of the population.

Figure 4.5. **Cost per megabit per second of fixed broadband, relative to GDP per capita, February 2012**
(percentage of GDP)

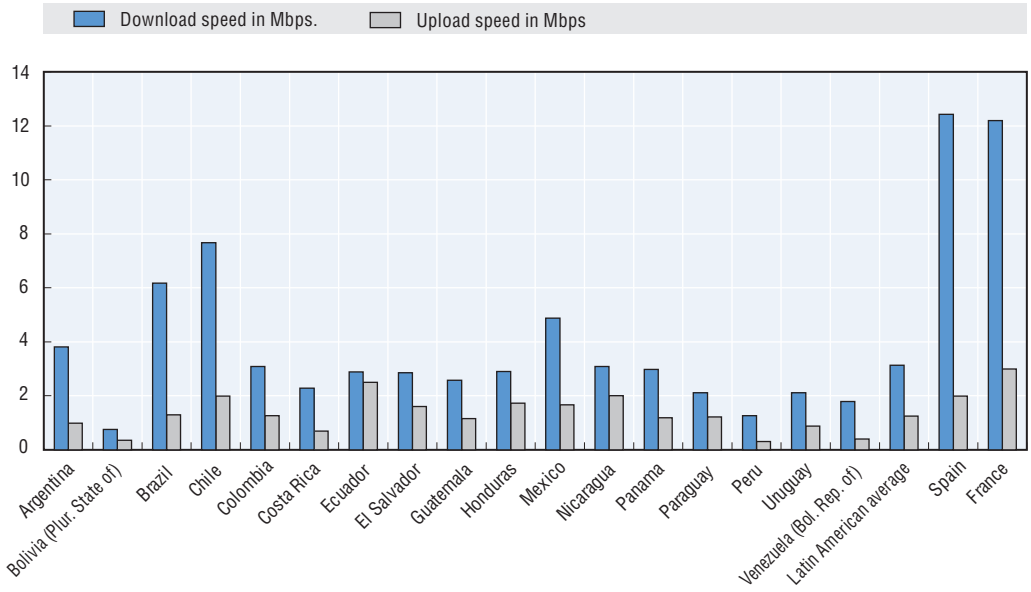


Source: ECLAC Regional Broadband Observatory (ORBA).

StatLink http://dx.doi.org/10.1787/888932732899

Connection quality also restricts broadband use in the region. A traditional measure of quality is bandwidth speed. Bandwidth is important because many applications can be inaccessible with slow connections, including most advanced applications, which provide the most benefits. Such applications are highly interactive, require real-time communication and use video-based multimedia tools. High levels of connectivity are needed to ensure services are provided without interruptions. Although sometimes high speeds are not required, broadband improves users' Internet experience, so they use it more often and more intensively and are able to benefit more from the electronic services (OECD, 2009).

Figure 4.6. **Average broadband Internet connection speeds**
(in megabits per second, as of 1 April 2012)



Note: Mbps.: megabits per second.
Source: ORBA, based on information from Ookla.
StatLink http://dx.doi.org/10.1787/888932732918

There is an important space for policies and strategies aimed at expanding network infrastructure and improving access and quality of service. But until the aforementioned problems have been solved, broadband use in Latin America will remain limited to small segments of the population, and the region will not be able to fully benefit from ICTs. This situation could even widen the technology-access gaps, hindering the potential interaction among different production sectors, especially between small and large firms.

In terms of connection speed, the quality of broadband services is lower than in developed countries.

Conclusions and recommendations: institutional structure and policies for innovation and the dissemination of technology

Business leaders and policy makers in Latin America are showing increasing concern for innovation. Innovation is also working its way on to government agendas, although often this does not translate into action. Innovation plays an increasingly more important role for entrepreneurs as well as policy makers in Latin America, thus gaining added importance in national agendas, but often discourse translates into few concrete activities that promote technical change, innovation or technological development. Creative actions taken by firms explain their innovative behaviour, and although these

reactions are not spontaneous, they are strongly influenced by and dependent upon internal capabilities and the environments in which they are embedded. Institutions, laws, regulatory frameworks and public policy play a crucial role in promoting, or inhibiting, technological innovation and dissemination, just as relations between institutions and agents facilitate access to knowledge for the most disadvantaged sectors and exchanges with other agents. Innovation activities and activities to create knowledge-based added value involve trial and error; there is great uncertainty as to the results, the costs are high, and the time frame is often unpredictable. For all these reasons, it is crucial to promote an effective, efficient, focused public policy for the long term that will foster linkages between the public and private sectors and knowledge-production centres. This will lead to synergies and complementarities, economies of scale and knowledge spillovers.

In general, national science, technology and innovation plans in Latin America now explicitly mention SMEs, but this does not translate into instruments and actions to close the technology and innovation gap. The institutional structure is hugely complex, with different bodies connected together in this area, thus reinforcing the presence of the private sector in co-ordination with the public sector. A key feature that largely explains why the institutional fabric is so complex is the lack of institutions dedicated exclusively to promoting and financing innovation in SMEs (Ferraro, 2011). In some countries, this role is the responsibility of institutions and bodies that promote innovation, such as the Financier of Studies and Projects (FINEP) in Brazil and the National Research and Innovation Agency (ANII) in Uruguay, while in others it is the responsibility of bodies that promote production, such as the Production Development Corporation (CORFO) in Chile. In some countries in the region, the institutions responsible for policies to support SMEs and innovation are of little importance in the government structure and have deficiencies such as a lack of resources to sufficiently manage the programmes. Part of the finance comes from international co-operation, which often poses a challenge to the continuity of public policies. Other problems are the lack of available human resources and weaknesses in the training system. These programmes are often determined by governments for their term of office, and there are not enough true state policies in this area (Ferraro and Stumpo, 2010).

While the budget for science, technology and innovation policies has increased in several countries in the region, such as Brazil and Uruguay, the funds earmarked specifically for this activity in SMEs, though difficult to quantify, seem to have changed very little (Dini and Stumpo, 2011).

Latin American countries' policies to promote innovation in SMEs can be summarised as being instruments that directly or indirectly encourage innovation, focusing on demand, supply and linkages among actors. The policies and instruments to support innovation generally do not discriminate in favour of smaller firms or give them any special treatment (see Annex 4.A1).

Regarding policies to facilitate ICT access and use, since the mid-2000s most of the 26 Latin American countries have drawn up a digital agenda, but only 11 of them have included ICTs and the production sector as a strategic line of action (albeit only a minor one).[11] Generally their digital strategies attach great importance to ICTs as a means of social integration and improving the population's quality of life, yet there are few references to the possibility of using these technologies to boost economic development.[12] Some programmes try to promote the integration of ICTs in the production sector, particularly in SMEs. Two years ago, programmes were introduced

in the region to stimulate the digital inclusion of SMEs in order to bring ICT supply in line with the demand. The programmes were a step forward towards policies that approach the problems associated with incorporating and using ICTs from an integrated perspective (Box 4.4).

Most Latin American countries have defined digital agendas since the mid 2000s. However, only 11 of 26 countries have incorporated ICTs into the production sector as a strategic line of development, albeit only marginally.

The way SMEs innovate varies greatly between one firm and another, with little use of technologies and at a lethargic pace. Development policies recently introduced in Latin America have been too weak and have failed to significantly abate the companies' difficulties. The structural diversity persists and SMEs have not raised their productivity relative to that of large firms, so they still cannot dynamically join the production structure. However, there is a consensus that STI policies need designing and implementing to help develop the economies in the long term and eradicate the gaps that exist.

To achieve this, they must focus those public policies on reducing the gap between firms of different sizes. These policies must deal with the restrictions and entry barriers faced by SMEs when innovating. Among other factors, the policies are based upon variables inherent to innovation activities, such as high sunk costs and high risks, which affect SMEs the most (Dini and Stumpo, 2011). Similarly, policies should consider the lack of qualified human resources, poor access to credit and international markets, and their linkages with government programmes to promote STI. It is important to strengthen the NISs to encourage linkages, co-operation, scientific and technological capacities and bring about closer ties between knowledge-production centres and the production sector. This will create business opportunities, improve competitiveness and create good jobs.

Box 4.4. New programmes to improve SMEs' ICT competitiveness

Despite the progress made by some countries in the region to incorporate ICTs into their production strategy, the common denominator is a lack of an integrated policy. Below are some of the innovation programmes that have shifted their focus to developing a new strategy that will have a greater impact on the production fabric.

Table 4.5. **New direct programmes for incorporating ICTs into businesses: co-ordinating supply and demand**

Country	Programme	Institution	Objetives
Brazil	PROIMPE	Brazilian Development Bank (BNDES)	To promote greater competitiveness among SMEs by stimulating digital inclusion and developing a market for ICT solutions for SMEs.
El Salvador	Promoting digital maturity in small companies and microenterprises	National Micro and Small Enterprise Commission (CONAMYPE)	A training programme for ICT consultants providing tools for managing and delivering ICT services to Salvadoran craftsmen and craftswomen
Uruguay	Pilot Project (promoting the incorporation of ICTs in SMEs to support modernisation and technological development)	Ministry of Industry, Energy and Mining (MIEM))	To identify sectoral technology solutions and link suppliers with their clients to improve take-up of ICTs by industrial value chains.

Brazil's and Uruguay's programmes focus on equating ICT supply and demand to open the way for concrete solutions for SMEs, improving their competitiveness and creating specific markets for ICT solutions.

In Brazil, the PROIMPE stimulus programme aims to match ICT supply and demand, focusing on micro, small and medium-sized enterprises (SMEs). Its objectives are to stimulate SMEs' digital inclusion, improve the competitiveness of SMEs that use and develop ICTs, and stimulate the production of applications for SMEs. It also aims to create finance and capitalisation mechanisms for SMEs that develop and deliver ICT services and guide SMEs in purchasing ICT solutions.

In Uruguay, as part of the sector-by-sector intervention strategy through the Tripartite Boards promoted by the Ministry of Industry, Energy and Mining (MIEM), the overall objective of technical assistance is to support the National Industries Directorate (DNI) in defining programmes geared at incorporating ICTs into businesses. The goal is to provide tools to help increase productivity. An institutional structure is being built and reinforced in which the public areas of productive development, participating sector-specific chambers of commerce (private sector), and ICT firms are involved.

Digital training programmes include, in particular, the programme recently developed by El Salvador, which has a different objective from the Brazilian and Uruguayan programmes. The National Micro and Small Enterprise Commission (CONAMYPE) is carrying out a training process with technical institutions to give these programmes the technical skills to develop digital maturity in micro and small enterprises in the craft sector. The areas that are being addressed are: the profile of the technology consultant, ICTs in SMEs in the craft sector, online marketing, the use of social networks in business, technology trends in the craft sector and the implementation of ecommerce activity.

Source: Authors' work.

While Latin American countries have added the subject of innovation to their agendas and realised its importance, and they have moved towards a more solid institutional structure for development, many challenges remain, and efforts need to be channelled towards concrete actions (OECD/ECLAC, 2011). Governments in the region should focus their action on promoting and drawing attention to their business innovation instruments and programmes, especially among SMEs. According to innovation surveys conducted by various Latin American countries, entrepreneurs cite the poor awareness of public instruments as one of the factors holding back innovation. This is particularly true for SMEs, among which awareness of such programmes is even lower.

In Latin America, policies are needed to promote innovation in SMEs and include microenterprises too. Since there are no appropriate programmes for less-dynamic SMEs, or if there are any they are inaccessible to them, the gap between them and larger firms, where most innovation takes place, widens.

Co-ordination and greater co-operation among institutions seeking to promote SMEs is also necessary. In particular, policies are needed to promote innovation among smaller firms, where there is little innovation, and even among microenterprises, which are generally outside the scope of institutions to promote SMEs. Business-innovation development programmes are normally fashioned for the most dynamic companies, which can use and benefit from the programmes and instruments made available. However, for many less dynamic SMEs there are no appropriate programmes or they do not have access to them, which serves to widen the gap between them and larger firms. Consequently, those who design and introduce policies to stimulate innovation need to take into account the characteristics of smaller, less dynamic firms, thus opening the way for innovations in such firms, resulting in productivity gains (Dini and Stumpo, 2011).

For public policies designed to break down the barriers to adopting technologies and encourage innovation and the effective introduction and use of technologies in Latin American business, especially among SMEs, major steps forward need to be taken in various directions at the same time. These steps are related to improving the business environments and factors associated with companies' technologies and specific characteristics.

a) **Infrastructure:** There are still problems with the coverage and cost of certain major infrastructures and the quality of service they offer. Any innovation strategy involving SMEs requires good-quality laboratories and public research centres to support and work with those firms. For ICTs, it is particularly important to have high-quality broadband so that applications based on these technologies can be utilised. Regulations to increase competition among suppliers are also needed, as well as differentiated pricing to improve access to basic services provided by laboratories and specialist centres, and even to Internet services and computer tools.

b) **Human-resource training:** Using new technologies and inciting firms to adopt them is vital for innovation, and must become a higher priority in countries' strategies to improve business performance. In addition to improving general education plans, specific training programmes must be developed in areas related to production processes and management and business techniques.

c) **Specific programmes:** Latin American countries need SME-focused programmes to promote business innovation, because SMEs are very often unable to access or benefit from government innovation programmes. They also need to create incentives to adopt ICT-based solutions that will help improve business management, especially among smaller firms.

d) **Other indirect instruments:** Other initiatives that can promote business innovation and the dissemination of technology are indirect instruments that can stoke up the creation of the types of environments needed for businesses to innovate and NIS actors to co-operate with each other. Such initiatives can also target a specific sector, for instance with the aim of promoting better quality goods and services for exporting. Improving access to high-quality infrastructure services will improve innovation capacities and access to new markets while protecting consumers and improving well-being (Göthner and Rovira, 2011).

e) **Information system:** Designing policies and specific instruments requires vast knowledge to adapt them to each country's sectoral and business specificities and to companies' characteristics and needs. If a system is built providing information on firms' innovative behaviour and their adoption and use of technologies, follow-up studies will be able to analyse the results of the policies and tie them to company performance. The system's design and application can then be fine-tuned. This means moving towards a solution to the problems currently identified by surveys held in the region (duplication of efforts, lack of continuity in data collection, and poor coverage, representativeness and comparability). It also means taking steps towards defining indicators to analyse in greater depth aspects that better represent the complexity of innovation processes and the use and dissemination of technology in the production fabric, as well as the impact of technologies on business performance.

In Latin America, industrial policies are needed to encourage the development of new sectors and technologies, co-ordinate public and private efforts, increase investment in innovation (quantity and quality), create the right environment for innovation, provide finance for these high-risk activities, and encourage the training of qualified human resources.

It is imperative that policies have targets at different levels to ensure that modernisation spreads throughout the production sector, especially among smaller firms, and to respond to the more stringent demands of larger firms and more advanced sectors. Such policies will make it possible to expand productive inclusion, reduce structural heterogeneity and speed up productivity growth.

Annex 4.A1. Policies directly affecting business innovation in SMEs

The following table, though it does not cover the full depth of innovation in Latin America, provides an overview of what happens in some countries in the region. The table reveals a shortage of instruments and programmes to support innovation in SMEs, especially those tailored specifically for this type of company. These factors should be especially promoted to ensure that modernisation reaches the entire production sector in the region.

Table 4.A1. **Policies directly affecting business innovation in SMEs**

Country	Institution	Managed by	Type of institution	Purpose of the SME innovation support programme or fund							Support for innovation	Financing method
				Supply	Demand					Transfer / linkages / co-operation		
				Human resources	Innovation	Equipment	Improvement to business productivity/ competitiveness	Technology transfer	R&D	Transfer / linkages / co-operation		
Argentina	National Science and Technology Promotion Agency	Ministry of Science, Technology and Productive Innovation (MINCyT)	agency to support science, technology and innovation				Argentinian Technology Fund (FONTAR), Argentinian Sector Fund (FONARSEC)				direct	loans, tax incentives and subsidies
	National Scientific and Technical Research Council (CONICET), through the Technology Transfer Office	MINCyT	agency to support science, technology and innovation	grants, researchers in companies					researchers in companies	consultancy, agreements, high-technology services	direct and indirect	loans and subsidies
	National Agricultural Technology Institute (INTA)	Ministry of Agriculture, Livestock and Fisheries	agency to support innovation in farming and livestock					technology transfer agreements	R&D agreements	technology-transfer agreements through specialist technical support agreements	direct	loans and subsidies
	National Industrial Technology Institute (INTI))	Ministry of Industry	government ministry	human-resource training						technical services/ support	indirect	subsidies
	Secretariat of Small and Medium Enterprises and Regional Development (SEPYME)	Ministry of Industry	agency to support SMEs	SME experts			Programme for Access to Credit and Competitiveness (PACC) for companies, National Fund for the Development of Micro, Small and Medium-Sized Enterprises (FONAPyME)				direct and indirect	loans and subsidies

Table 4.A1. (contd.)

Brazil*	Studies and Projects Funding Agency (FINEP)	Ministry of Science, Technology and Innovation (MCTI)	support agency		Economic Subsidy Program, PAISS****		Innova Brazil		Innova Brazil	Innova Brazil	direct	loans and subsidies
	Brazilian Development Bank (BNDES)		national development bank			BNDES cards					indirect	loans
	Ministry of Science, Technology and Productive Innovation (CTI)	Ministry of Science, Technology and Innovation (MCTI)	government ministry	HR training for innovation	SIBRATEC*****		SIBRATEC		SIBRATEC, financial support for R&D and investment	Brazilian Technology System (SIBRATEC), Pro Innova	direct and indirect	loans and subsidies
Chile	Production Development Corporation (CORFO)	Ministry of Economy	agency to support production	innovation management	high-tech business innovation programme	CORFO credit for micro and small enterprises	InnovaChile	technological dissemination programme		innovation hubs, transitory basal funding programme for technology consortia	direct and indirect	loans, tax incentives and subsidies
	National Research, Science and Technology Commission (CONICYT)	Ministry of Education	agency to support science, technology and innovation				Science and Technology Development Fund (FONDEF)				direct	subsidies
	Foundation for Agricultural Innovation (FIA)	Ministry of Agriculture, Livestock and Fisheries	agency to support innovation in the food and forestry industries		national innovation systems					consultancies	direct and indirect	loans and subsidies
	Innova Bío Bío				business innovation	technological equipment for SMEs		technology transfer centres		consultancies and technology missions	direct and indirect	loans and subsidies
Colombia	Modernisation and Innovation Fund for MSMEs (FOMIPYME)	Ministry of Commerce, Industry and Tourism	government ministry	Innova Prize	INNpulsa MiPyme***		INNpulsa MiPyme***			Innova Prize	direct and indirect	subsidies

Table 4.A1. (contd.)

Mexico*	National Council on Science and Technology (CONACYT)	Ministry of Education	agency to support science, technology and innovation		INNOVAPYME**		INNOVAPYME**, INNOVATEC**, Technology Innovation Fund			INNOVAPYME, PROINNOVA**, AERIS	direct	subsidies
Uruguay	National Research and Innovation Agency (ANII)	Ministerial Bureau of Innovation (GMI)	agency to support innovation	qualified human resources for companies	wide-coverage innovation projects, high-impact innovation projects, projects to support innovative potential prototypes		certification projects and new export markets			projects to stimulate technology demand, in-house experts, supplier-development programme	direct	subsidies
	National Bureau for Crafts and SMEs (DINAPYME)	Ministry of Industry, Energy and Mining (MIEM)	agency to support SMEs	human-resource training							indirect	subsidies

Notes: FONTAR and FONARSEC are funds.
* National funds and programmes are considered, not those from the states (regions) or the Federal District.
** They form the three schemes in the Innovation Stimulus Programme.
*** iNNpulsa MiPyme has replaced the Modernisation and Innovation Fund for MSMEs. It is managed by BANCOLDEX.
**** Programme to support innovation in the sugar-energy and sugar-chemical industries together with FINEP-BNDES
***** Brazilian Technology System; joint programme with FINEP-MCTI.

Source: Produced by the author based on official information provided by each institution as well as by Dini and Stumpo (2011) and Ferraro and Stumpo (2010).

Notes

1. These are networks in which non-contiguous hubs (companies and people) can be reached from any source hub via a relatively small number of links (knowledge/relations) between them (Albert-Laszlo Barabasi, 2003).
2. Myrdal's theory of cumulative causation (Myrdal, 1957) warns that regional growth is an unbalanced process. He predicts that greater initial development in one region rather than a neighbouring region results in a relative stagnation in growth, because investment and the more productive resources are attracted to the more developed region. This contributes to a greater geographic concentration of the economy and explains the natural trend for differences in per capita income among regions to expand. Such an effect is of particular concern to smaller companies.
3. "Schumpeterian efficiency" is related to the presence of sectors leading innovation with faster-growing productivity and greater transfer of knowledge and skills to the economy. The resulting productivity boosts spread to other sectors. "Keynesian efficiency" is associated with specialisation in sectors that benefit from higher rates of growth in domestic and external demand, which has a positive impact on output and employment. (Cimoli *et al*., 2010; ECLAC, 2012).
4. According to data from the Brazilian Geography and Statistics Institute (IBGE) and the Chilean National Statistics Institute (INE), there is a significant lag in the agricultural sector in the use of basic information technologies, particularly among smaller establishments.
5. When ICTs can replace learning processes with trial-and-error processes in simulations that require developing special applications, innovation is boosted.
6. This analysis should be supplemented by information on what these technologies are used for, which is related to the firms' internal capacities.
7. The drastic change in the model is from supplying products to providing on-demand services. The result is that the fixed costs associated with investing in ICT capital become operational and may be adjusted depending on production needs.
8. See McKinsey & Co. (2011), *Winning in the SMB Cloud: Charting a Path to Success*, Zoe Diamadi, Abhijit Bora, Darren Pleasance and Ashish Vora.
9. See de León (2012).
10. According to a study by Katz (2012), the benefits of broadband on GDP growth depend on the widespread availability of the service.
11. Bolivia, Chile, Colombia, the Dominican Republic, Ecuador, El Salvador, Guatemala, Mexico, Peru, Trinidad and Tobago, and Uruguay.
12. There is an important difference between the approach taken by European Union countries and that taken by the Association of Southeast Asian Nations (ASEAN). For example, Spain's digital strategic plan (Avanza 1 and Avanza 2) has two key features. First, there is an interconnection and integrity among four major areas that are central to the plan: the digital citizen, the digital economy, the digital context (infrastructure) and digital public services. Second, the digital economy (production) and the digital context (infrastructure, security and digital content) are prioritised (mainly through the allocation of budgetary resources) above the other two areas.

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