Enterprise Surveys
THE WORLD BANK IFC

Innovating in the Manufacturing Sector[1] in Latin America and the Caribbean[2]

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Basic Definitions

Countries surveyed in 2010 and how they are grouped for analysis:

In 2010, Enterprise Surveys (ES) interviewed 12,855 enterprises in 30 Latin American and Caribbean countries. In addition in 2009, 1,802 firms were interviewed in Brazil also following the standard ES global methodology.

For analytical purposes, the 31 countries are categorized into 3 groups:

Small Caribbean countries: Antigua and Barbuda, The Bahamas, Barbados, Belize, Dominica, Grenada, Guyana, Suriname, St. Kitts and Nevis, St. Lucia, and St. Vincent and the Grenadines

Medium-size countries: Bolivia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Jamaica, Nicaragua, Panama, Paraguay, Uruguay, and Trinidad and Tobago

Large countries: Argentina, Brazil, Chile, Colombia, Mexico, Peru, and República Bolivariana de Venezuela.

Two waves of Enterprise Surveys, 2006 and 2010:

Fifteen countries were surveyed in 2006 using the ES global methodology: Argentina, Bolivia, Chile, Colombia, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay, and República Bolivariana de Venezuela. In total, 10,930 firms were interviewed in 2006, of which 3,535 were re-interviewed in 2010.

Reference periods of the survey data:

The information collected in the surveys refers to characteristics of the firm at the moment of the survey (2006, 2010 and 2009 for Brazil) or to the last completed fiscal year (2005, 2009, and 2007, respectively). In addition, sales, employment, and labor productivity annual growth rates are calculated comparing data from the last complete fiscal year of each survey and recall data. Consequently, growth rates refer to the period 2002-05 for the 2006 surveys, 2004-07 for the 2009 Brazil survey, and 2007-09 for the 2010 surveys.

In the 21st century, economies are becoming more knowledge-based, with innovation increasingly the driver of national competitiveness, development, and long-term economic growth. At the firm level, innovation—the transformation of ideas into new products, services, and production processes—leads to more efficient use of resources, creating sustainable competitive advantages. The Enterprise Surveys define innovation rates as the share of firms introducing product or process innovations. The surveys also measure the proportion of firms investing in research and development (R&D) and filing for any type of intellectual property rights (IPR), such as patents, trademarks or copyrights applications.

Innovation is essential to spur economic growth and to raise living standards. Higher R&D spending, innovation, productivity, and per capita income reinforce each other and lead to sustained long-term growth (Hall & Jones 1999; Rouvinen 2002). Evidence of the important relationship between R&D, innovation, and productivity has been found in studies based on industrialized countries (Griffith et al., 2004; Griffith et al., 2006; Mairesse & Monhen 2010; OECD 2009). The evidence shows that firms that invest in R&D and other innovation-related activities are better equipped to introduce technological advances and tend to have higher labor productivity than those that do not.

Large countries in Latin America and the Caribbean exhibit higher innovation rates than the rest of the region

The Enterprise Surveys include data on the development of new or significantly improved products and processes as well as investment in R&D. Firms are considered to be innovators if in the last three years they introduced either a product innovation (defined as a new or significantly improved product that was also new to the establishment's market), or a process innovation (defined as a new or significantly improved process that was also new to the industry).

The average innovation rate among manufacturers—that is, the share of firms introducing a new or significantly improved product or process—is 29 percent in LAC. This rate is highest in the region's large countries (Figure 1), and is lower in the medium-sized countries and the small Caribbean countries. Moreover, 16 percent of firms in LAC's largest countries report both a product and a process innovation—compared to 11 percent of firms in medium-sized countries and only 6 percent in small Caribbean countries. The fact that 32 percent of firms in the large countries innovated a production process (16 percent with a product innovation and 16 percent without) suggests that firms in the region's large economies are adapting more complex products and possibly exploiting economies of scale. By contrast, 13 percent of firms in the small Caribbean countries report a product innovation without an associated innovation in process. This could imply higher rates of adapting either less complex products and/or simply replicating existing products.

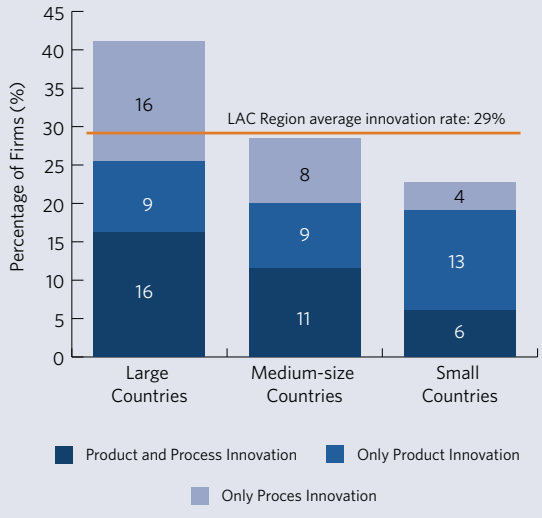
Large differences in innovation rates across LAC reflect cross-country differences in the structure of economies as well as in business and policy environments for innovation. Large countries, such as Argentina, Chile, Colombia, and Peru, rank well above the regional average for innovation indicators.[3] The exceptions are Mexico and the República Bolivariana de Venezuela, which had weak performance on all innovation indicators.

Within large countries, where the size of the economy allows for comparisons across selected industries, there is further variation across specific manufacturing sectors (Table 1). Chemical and plastics manufacturers innovate at the highest rate, and have appreciably higher product and process innovation rates.

R&D in Latin America and the Caribbean is low and concentrated in a few large firms

Given the lack of experience reporting R&D expenditures in the region and the general trend to over-report these expenditures in survey questions, a minimum threshold of expenditure was used to "trim" self-reported R&D spending. For small firms this threshold is the annual cost of one researcher; for medium firms it is the annual cost of one researcher and one technician; for large firms the threshold cost covers two researchers and

FIGURE 1 **INNOVATION RATES**



Source: Enterprise Surveys.

TABLE 1 **PRODUCT AND PROCESS INNOVATION RATES BY INDUSTRY**

Industry*		Average**
Food/Beverages	Only product	10.3
	Only process	12.5
	Product and process	7.5
Textiles & Garments	Only product	14.9
	Only process	12.6
	Product and process	14.1
Chemicals & Rubber/Plastics	Only product	15.2
	Only process	11.5
	Product and process	23.1
Fabricated Metals & Machinery/ Equipment	Only product	10.6
	Only process	14.8
	Product and process	16.3

* Average among large countries with comparable data and survey designs (Argentina, Chile, Colombia, Mexico, and Peru)

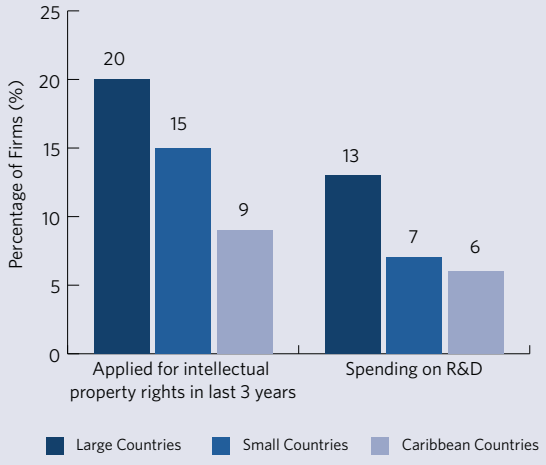
**Chosen based on stratification designs in selected large countries

Source: Enterprise Surveys.

two technicians. Costs are calculated using data from the Chilean National Innovation Survey for 2009 and represent the cost of a typical employee for a typical Chilean firm that spends on R&D, by firm size, by employee type. These costs are adjusted for the relative GDP per capita in each country. This approach may under-report R&D expenditures by small firms, some of which may be highly innovative. However, an adjustment was needed to examine the data systematically given the extremely high and likely over-reported rates of R&D investment by smaller firms.

The region exhibits interesting patterns in R&D spending (Figure 2). Eight percent of firms in LAC report R&D expenditures, and this figure is notably higher in the region's largest countries, double the rate of medium-sized and small Caribbean countries. However, the amount of R&D expenditure is low. On average, R&D expenditures are equivalent to less than 1 percent (0.5 percent) of annual sales. In large countries, R&D expenditures are valued at 0.6 percent of annual sales, while the average is 0.4 percent elsewhere in the LAC region. R&D investments in the region are also skewed: a few, very large investors generally represent a significant proportion of the total national effort on R&D. Indeed, on average across LAC, the firms that spend the most on R&D account for about 30 percent of total national manufacturing sector R&D spending. Among the 8 percent of firms in LAC that report spending on R&D, one in four spent more than $150,000 in 2009.

FIGURE 2 **PARTICIPATION IN INNOVATION ACTIVITY**



Source: Enterprise Surveys.

About 14 percent of LAC firms filed for intellectual property rights (IPR) between 2008 and 2010, with the large economies showing higher application rates (Figure 2).[4] This figure is significantly lower than the percentage of innovative firms (29%). The low level of IPR use by manufacturing firms suggests a lack of novelty in innovation. Even when talking about products or processes that are new to the firm's market or industry, much of the innovation in the region is based on the adoption and adaptation of technologies developed elsewhere. This fact implies that, to some extent, these innovations may not qualify when it comes to the international standards of novelty required for the granting of intellectual property rights.

The rate of firms applying for IPR, however, differs strongly across industries: in large economies, rates for patent applications mirror patterns in innovation. In these large economies, 36 percent of chemicals and plastics manufacturers applied for IPR, while less than one in four textile or food manufacturers did so. The lowest share of IPR applicants, 13 percent, occurred among fabricated metal and equipment and machinery manufacturers (Table 2).

Innovation in Latin America and the Caribbean is more prevalent among large, exporting or older firms

Firm size, productivity, and export orientation are often associated with a firm's propensity to innovate. Large firms have been found to spend more on R&D relative to output (Cohen & Levinthal 1989; Acs & Audretsch 1988), though it has been argued that small firms have more

TABLE 2 **SHARE OF FIRMS APPLYING FOR INTELLECTUAL PROPERTY RIGHTS IN LARGE COUNTRIES**

Industry*	Average
Food/Beverages	21.2
Textiles & Garments	24.1
Chemicals & Rubber/Plastics	35.7
Fabricated Metals & Machinery/Equipment	13.3

* Average among large countries with comparable data and survey designs: Argentina, Chile, Colombia, Mexico, and Peru

Source: Enterprise Surveys.

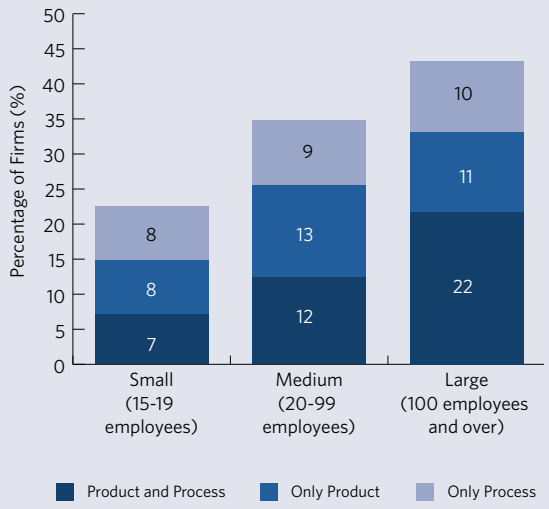
flexibility and adaptability—favoring the development of new projects. The correlation between innovation and size remains an empirical question.

Data from the Enterprise Surveys shows that large firms are more innovative than small and medium-sized firms (Figure 3). Almost half (43 percent) of large manufacturing firms innovated—introducing either a new or significantly improved product or process. Thirty-four percent of medium firms and 23 percent of small firms reported innovation. Moreover, 22 percent of large manufacturing firms in LAC report both a product and a process innovation—compared to 12 percent of medium firms and only 7 percent of small firms. Exporting firms tend to innovate—either product or process—more than non-exporters: 39 percent of exporters reported innovation versus 25 percent of non-exporters (Figure 4).

Finally, incumbent firms (those created more than 10 years ago) report innovation rates slightly higher than those of younger firms, although the difference is not very large (30 vs. 25 percent respectively). To some degree, this result contradicts findings in the literature that suggest that young firms are more likely to innovate.

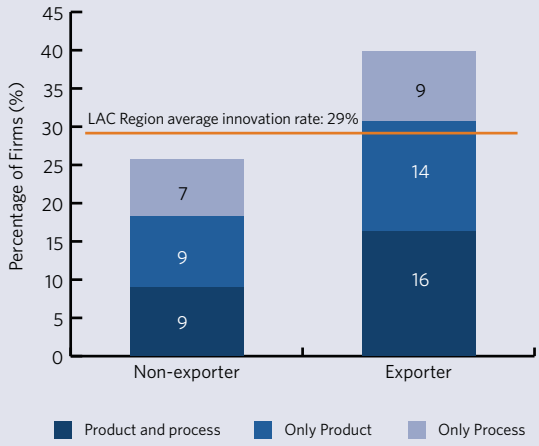
The data from the Enterprise Surveys reveal that in LAC young firms, those created in the last 10 years, are heterogeneous in their innovative profile, with wide

FIGURE 3 **INNOVATION RATES BY FIRM SIZE**



Source: Enterprise Surveys.

FIGURE 4 **INNOVATION RATES BY EXPORT PROFILE**



Source: Enterprise Surveys.

dispersion in the share of firms innovating. However, this volatility can be understood by grouping young firms by their dynamic profiles. Young firms are considered to be dynamic if they sell output in foreign markets, were founded based on new products, or have created more employment since their start-up than the median firm in their countries (Acs & Szerb 2011). Dynamic young firms exhibit significantly higher innovation rates than other young firms. This result somewhat reconciles the results with the literature, given that the innovation rates of young dynamic firms are higher compared to old firms, and considerably higher than young, non-dynamic firms.

Large and exporting firms in Latin America and the Caribbean are more likely to invest in R&D and to file for intellectual property rights

An association between size and propensity to invest in R&D has been reported for firms in most countries in the Latin America and the Caribbean region, where systematic innovation surveys have been conducted (Benavente 2006; Crespi & Peirano 2007). The ES data confirms that firm size plays a big role in R&D spending and in a firm's likelihood of filing IPR applications. Twice as many large firms spent on R&D compared to small- and medium-sized enterprises (SMEs). Twenty-four percent of large firms invested in R&D, almost eight times

TABLE 3 SHARE OF FIRMS SPENDING ON R&D

Firm Size	Average
Small Firms	3.0
Medium Firms	9.9
Large Firms	23.9
Export Profile	
Non-Exporter Firms	5.1
Exporter Firms	17.3
Age and Dynamism	
Young Non-Dynamic Firms	3.9
Young Dynamic Firms	7.0
Old Firms	9.1

Source: Enterprise Surveys.

the share of small firms doing so (Table 3). Nearly 30 percent of large firms reported applying for an IPR, which is four times the rate of small firms and two times that of medium firms.

Exporting firms in LAC are three times more likely than non-exporting firms to perform R&D (17 percent of exporters vs. 5 percent of non-exporters). Almost 30 percent of exporters file for IPR, compared to 10 percent of non-exporters. Older firms are also more likely to spend on R&D and to file for IPR than young ones—though dynamic young firms engage in R&D nearly as much as older firms and file for IPR at higher rates. Thus young dynamic firms appear to be highly innovative, to invest in R&D and to introduce innovation in their processes and products at high rates.

TABLE 4 SHARE OF FIRMS SPENDING ON R&D IN LARGE ECONOMIES

Industry*	Average
Food/Beverages	12.0
Textiles & Garments	6.9
Chemicals & Rubber/Plastics	31.4
Fabricated Metals & Machinery/Equipment	10.7

* Average among large countries with comparable data and survey designs: Argentina, Chile, Colombia, Mexico, and Peru

Source: Enterprise Surveys.

There are also notable differences in the share of firms spending on R&D across industries. In large economies, a higher share of firms in the chemicals and plastics sector spend on R&D (31 percent) compared to the share of firms in other manufacturing activities. Roughly one out of every ten manufacturers in food manufacturing as well as in fabricated metals and equipment spend on R&D, while only 7 percent of textile manufacturers spend on R&D (Table 4).

Endnotes

1. All ES data reported in this note refer to manufacturers, as the survey only included innovation questions for manufacturing firms.

2. Lead authors: Elena Arias-Ortiz, Ezequiel Tacsir and Fernando Vargas with the collaboration of the LAC report team.

3. No data are provided for Brazil because the latest round of Enterprise Surveys from Brazil, in 2009, did not include the innovation module used in 2010.

4. Intellectual property rights include the purchase of licenses to use patents, trademarks, industrial designs, copyrights or specialized consultancy services.

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