



An Alternative to Mercantilism: Manufacturing Extension Services in Latin American and Caribbean Countries

BY SCOTT ANDES, STEPHEN EZELL, AND JESÚS LEAL

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INTRODUCTION

Latin American and Caribbean (LAC) economies have long looked to manufacturing as a source of economic competitiveness. Across LAC countries, the manufacturing sector drives exports (which helps to balance LAC countries' terms of trade) and generates labor opportunities, including both low-skill and high-skill, high-paying jobs. Manufacturing also produces important spin-off industries and business clusters through complex supply chains and intermediary capital goods markets. Indeed, there is evidence of manufacturing's impact on LAC countries' economic growth throughout the economic literature.¹

A strong manufacturing sector is particularly important for developing economies because manufacturing links traditional low-value commodity markets with high-value export markets. This is particularly true in LAC economies. Food and beverage manufacturing, along with machinery and automobiles, comprises half of LAC manufacturing output. In years past, commodities such as coffee, sugar, and other agricultural products created large-scale employment, albeit at low wages, and an avenue into export markets. Today, LAC manufacturers are successfully changing the structure of production of traditional commodities, incorporating activities with higher levels of productivity and faster productivity growth. Starting from primary product manufacturing, LAC manufacturers generate capital, intermediary technologies, and know-how to springboard emerging markets into more advanced manufacturing such as machinery, automobiles, and even biotechnology and nanotechnology (as is the case in Brazil).²

Within LAC economies, small- and medium-sized enterprises (SMEs) dominate manufacturing, accounting for the vast majority, over 98 percent, of manufacturing firms and about one-third of manufacturing output, as Table 1 illustrates.

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Country	Employment	Production
Argentina	45%	36%
Brazil	67%	61%
Chile	53%	37%
Costa Rica	13%	13%
El Salvador	18%	15%
Jamaica	44%	N/A
Mexico	45%	31%
Peru	53%	36%
Average	42%	33%

Table 1: SMEs in the LAC Manufacturing Economy, Share of Employment and Production, 2006³

Boosting productivity is a central challenge for LAC SME manufacturers—just as it is for SME manufacturers in all countries.

SMEs thus represent a vital component of any successful LAC manufacturing ecosystem. As a recent report by the Economic Commission for Latin America and the Caribbean explains, “SMEs in the manufacturing sector are not marginal players in industrial structures in the region but have a high profile, particularly in terms of employment.”⁴ SMEs also promote industrial diversification. Many large manufacturers throughout the region are domestic subsidiaries of larger global firms heavily involved in low-skill, natural resource extraction. In contrast to the simple notion of Ricardian competitive advantage and specialization, diversification within the manufacturing sector is a growth factor; recent economic work shows that low- and middle-income countries grow fastest when the industrial sector is comprised of a diverse mix of products, particularly capital goods that can be integrated into complementary global supply chains.⁵

Boosting productivity is a key challenge for LAC SMEs—as it is for SME manufacturers in all countries. The reason SME manufacturers in LAC countries account for 42 percent of manufacturing workers but only one-third of manufacturing output is because they are less productive. As Table 2 shows, from 1990 to 2008, manufacturing labor productivity grew in four Latin American countries—Argentina, Brazil, Chile, and Mexico—by 2.7 percent per year on average. Among manufacturing sectors, productivity grew fastest in engineering-intensive and knowledge-intensive sectors (3.6 percent per year on average), while natural resource-based and labor-intensive manufacturing industries grew by just 2 percent per year on average.⁶ As this report will show, LAC manufacturing productivity growth over the past two decades has trailed both that of developed economies and other developing nations (particularly Southeast Asian nations), in large part due to the slow rate of productivity growth among LAC SME manufacturers.

	1990-1995	1996-2000	2001-2005	2006-2008
Argentina	7.8	2.6	4.8	1.1
Brazil	4.4	3.2	-2.2	-3.2
Chile	5.2	6.2	0.4	2.7
Mexico	3.1	0.9	2.9	5.1

Table 2: Manufacturing Productivity Growth in Select LAC Economies, 1990-2008⁷

Despite their importance, a host of market failures continue to hinder the competitiveness, productivity, and innovation potential of LAC SME manufacturers. These include a lack of access to capital, lack of knowledge about manufacturing best practices, latency in adopting new technologies, difficulty in integrating into global supply chains, and a dearth of market-based advisory services for SMEs. Consequently, governments throughout the region (and around the world) are developing policies to boost the productivity of SME manufacturers. LAC countries are implementing programs to help SME manufacturers adopt new technologies; streamline shop floors with lean operations and production processes; promote research and development (R&D) and technology transfer; enter global supply chains and foreign markets; and deal with a host of other challenges, from training existing personnel to acquiring new, high-skill talent. Such programs fall under the general

rubric of manufacturing extension services (MES). Many LAC economies use MES to help SME manufacturers overcome traditional market failures and compete with rapidly emerging manufacturers in Southeast Asia.

Manufacturing extension services are common in developed economies such as Canada, Germany, Japan, the United Kingdom, and the United States. SME manufacturers in both developed countries and LAC countries tend to be less productive than large manufacturers due to a variety of market failures, including limited access and exposure to global manufacturing best practices. Accordingly, in virtually all countries, the primary goal of manufacturing extension services is to help close the productivity gap between small and large manufacturers. Before engaging in broader assignments such as boosting exports, integrating SMEs into global supply chains, bolstering their innovation capacity, and facilitating technology transfer, MES programs focus foremost on bolstering the productivity of SME manufacturers.

This report begins by highlighting the use of manufacturing extension services in developed countries. It explains the economic reasons for implementing such programs and analyzes the degree to which they have been successful in developed economies. It then applies the lessons learned from established MES programs to LAC economies. Four key themes emerge as central goals for LAC manufacturing extension services: increasing productivity, boosting innovation (i.e., creation of new products), facilitating supply chain management and integration, and spurring exports. The report proceeds to identify strong examples of these four MES practice areas across eight LAC countries: Argentina, Brazil, Chile, Costa Rica, El Salvador, Jamaica, Mexico, and Peru. It then offers a summary of the documented economic impact of MES programs, both in LAC and developed economies, and provides a set of policy recommendations to improve manufacturing extension services and programs in LAC economies. Finally, the report concludes with detailed case studies of the eight LAC countries' MES programs.

THE ECONOMIC CASE FOR MES

There has been some discomfort among LAC policymakers regarding the role of government in manufacturing policy, in part due to the inefficient and heavily bureaucratic manufacturing policies that dominated economic policymaking in many LAC countries prior to 1980. Policymakers readily acknowledge the existence of market failures that preclude SMEs from adopting advanced manufacturing practices, yet they are often wary of the policy solutions needed to address these failures. Some fear government policies will exacerbate the problems. They argue, “If SME manufacturers are so important, why does the government need to promote them—shouldn’t the private sector be willing to do so itself?” However, market incentives are not sufficient to alleviate such problems. That’s why policymakers in many developed countries recognize these market failures for what they are—complex roadblocks demanding smart and proactive public policy.

Indeed, a number of systemic market failures and externalities affect manufacturing activity in general, and SME manufacturers in particular. First, there are several supply-side market failures impacting the provision of information and advisory services for SMEs. Second, on the demand side, SME manufacturers underinvest in R&D and innovation relative to

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societally optimal levels. Third, smaller manufacturers are less likely than larger manufacturers to implement new technologies, adopt modern manufacturing processes, invest in worker training, adopt new forms of work organization, and deploy improved business practices.⁸ In other words, SMEs lag in adopting new strategies to improve productivity. Finally, since SME manufacturers play a key role in most manufacturing supply chains, their competitiveness (or lack thereof) has an impact on the competitiveness of other firms in those supply chains and on the broader economy as a whole.

On the supply side, small manufacturers face significant market failures relating to the provision of public information and advisory services to SMEs.⁹ These failures take several forms. “Inappropriate take-up of business support services” occurs when SMEs do not know the range of business support services available to them. Inefficiencies and discrepancies pertaining to the exchange of information can lead to adverse selection issues, as SMEs lack the scale and experience necessary to adequately assess the value of services and the quality of service providers. A second form of business support market failure occurs when private sector firms do not provide manufacturing extension services to SMEs due to a perceived lack of sufficient financial return.

Britain’s manufacturing extension service, the Manufacturing Advisory Service (MAS), justifies its role precisely by addressing these information irregularities. It recognizes that SMEs lack the information required to make optimal purchasing decisions. As a 2010 review of the MAS program found, “[UK] SMEs are not accessing business advice that would help them achieve productivity growth, for two reasons. First, SMEs underestimate the benefits of external advice because they have limited or no knowledge of or access to best practice and therefore do not seek advice. Second, they may have limited or no access to affordable best practice information and advice.”¹⁰

Indeed, even when SMEs can find consultants focused on boosting the competitiveness of small manufacturers, they often cannot afford to hire them. The consultancy industry in most countries is driven by large firms that can justify significant upfront costs through marginal increases in productivity due to sheer output. In many cases, consultants do not adjust costs to reflect a client’s size. An SME manufacturer’s ability to procure advisory services is severely constrained by the inability or unwillingness of suppliers to scale-down their services to meet the needs of smaller firms.

A related challenge for SMEs is lack of information about new markets, particularly foreign markets. In fact, access to timely and reliable information on foreign consumer preferences is one of the largest barriers to foreign market entry for small manufacturers. To enter foreign markets successfully, firms must first identify foreign opportunities, understand foreign business practices, reach out to and communicate with foreign consumers, access appropriate distribution and advertising channels, and in many cases understand unique foreign technology or phytosanitary standards. These requirements are overwhelming for many SME manufacturers.¹¹

On the demand side, SME manufacturers (like large manufacturers) underinvest in R&D and innovation-generating activities because they cannot reap the full societal returns of such innovation.¹² Indeed, a plethora of studies have found that the rate of return to

society from corporate R&D is at least twice the estimated rate of return to the company.¹³ In addition to spillovers from R&D performed to create new products, there are also significant spillovers from process R&D, which is the R&D conducted to help organizations produce output more efficiently. However, the inability of firms to capture all the benefits of their own investments in R&D and new capital equipment means that, left on their own, they will produce much less innovation than is optimal for society. This is the key rationale for policies such as the R&D tax credit and accelerated depreciation of new equipment investments.¹⁴ It is also why so many countries are directly supporting their SME manufacturers' investments in R&D and innovation activities.

Finally, SMEs lag in adopting new technologies that would make them more productive, leading to a substantial productivity gap between SMEs and large manufacturers. This gap, seen in virtually all countries—developed and developing—has been growing over time. For example, in the 1960s in the United States, value-added per employee in SMEs was on average about 80 percent of that of large establishments. But by the early 2000s, value-added per employee in SMEs dropped to less than 60 percent of that of large establishments, as Figure 1 shows.

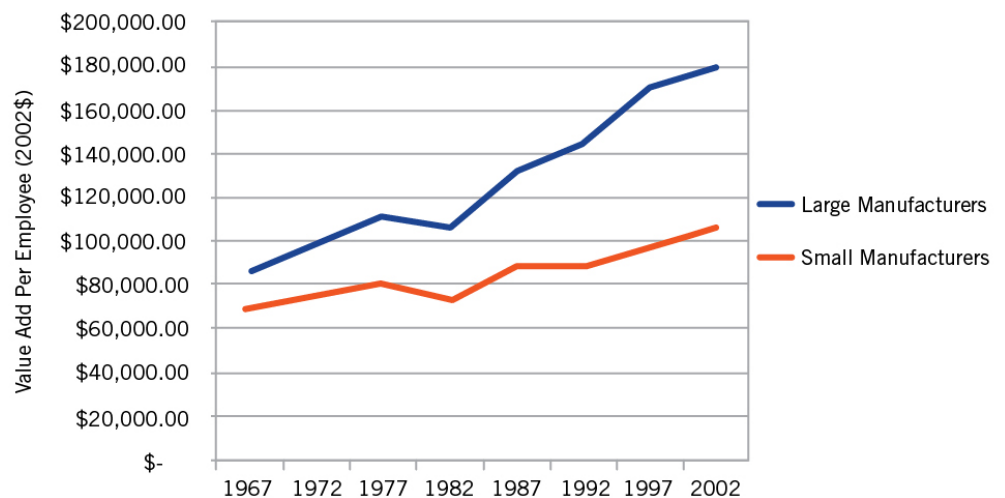


Figure 1: The Productivity Gap between Small and Large Manufacturing Establishments in the United States, 1967-2002¹⁵

Elsewhere, data from Korea's Ministry of Science and Technology show that large Korean manufacturers produced twice as much value-added per capita as Korean SME manufacturers in 1990, and three times as much by 2002. In addition, "UK manufacturing SMEs are comparatively weak performers in important areas such as productivity and market winning dimensions."¹⁶ These productivity gaps occur in part because SMEs tend to invest less in equipment than large firms. They are also less likely to adopt new business and manufacturing practices.¹⁷ Small manufacturers lack the resources, scale, experience, and wherewithal to stay abreast of the latest emerging technologies, manufacturing processes, and business management practices. Manufacturing extension services play a critical role in closing this knowledge and best practices gap (and thus, often, the productivity gap) between small and large manufacturers.

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Finally, many governments in developed countries support SME manufacturers because they play a critical role in supporting healthy manufacturing ecosystems and supply chains. These countries recognize that if their SMEs are not competitive, entire supply chains and local regions will suffer, impacting the broader national economy. As the U.S. Manufacturing Extension Partnership (MEP) explained in its 2008 annual report:

The relationship between large and small firms is becoming more complementary and cooperative rather than competitive. As large firms increase their dependence on suppliers for parts and services, the performance and capabilities of small manufacturers is even more important to the competitiveness of all manufacturers. Further, large manufacturers are requiring small firms within their supply chains to meet increasingly rigorous quality standards, to reduce costs, and to become sources of innovation.¹⁸

Likewise, Piore and Sabel find that the combination of small firms with regions that support flexibility and inter-firm linkages encourages innovation and promotes competitive advantage.¹⁹ Thus, SME manufacturers are critical components of regional economies and broader industrial value chains. By supporting SME manufacturers, governments help generate positive spillovers and externalities for the rest of the economy.

Manufacturing Market Failures in LAC Economies

Some argue that LAC economies should not follow the lead of more advanced economies in supporting SME manufacturers through manufacturing extensions services, despite the lack of global competitiveness and advanced manufacturing among LAC SMEs. They suggest that while such problems might indicate market failures in more developed countries, in LAC countries they constitute an appropriate market response given the low rate of return from innovation in LAC SMEs. Therefore, they argue that LAC SMEs should avoid high-skill manufacturing and instead focus on low-skill labor where they have a comparative advantage, such as in the agricultural or light manufacturing sectors. Others argue that encouraging LAC countries to mimic the practices of extension services in advanced countries is tantamount to forcing markets where the preconditions for competitiveness do not exist. And some go so far as to suggest that advocating for advanced manufacturing, R&D, and innovation policy in LAC economies requires a level of development that ignores economic realities in developing countries.

The economic literature tells a different story, however. For example, in a comprehensive study of 41 emerging economies across Latin America, the Caribbean, and Asia, Laderman and Moloney find that the rate of return from R&D and technology transfer is higher in developing countries than in advanced economies.²⁰ The authors conclude that given the high rate of return for R&D and advanced technologies, LAC countries should double investments in these activities.²¹ More substantial investments would bolster the productivity, innovation, and competitiveness potential of large and small LAC manufacturers alike.

The productivity gap between LAC and East Asian SME manufacturers has widened in recent decades.

To be sure, LAC countries' SME manufacturers are a major source of employment and value added; nevertheless, LAC SMEs face virtually all of the same market failures that those in developed countries do—not to mention some additional unique challenges of their own. System-wide externalities hinder SMEs in LAC countries. Public and private education programs are limited, requiring small firms to fund the cost of training high-skill talent. SMEs lack access to universities, national laboratories, and technology centers, increasing the cost of productivity-enhancing technologies.²² Many large high-tech manufacturers in LAC countries are subsidiaries of multinational firms with offshore R&D facilities, reducing the benefits of knowledge spillovers from sector clustering to LAC SME manufacturers. Knowledge spillovers are further limited in LAC economies due to the fact that knowledge is best transferred through close firm relationships, and SMEs are often isolated. Guiliani et al. find that technological know-how is tacit within traditional LAC manufacturing sectors. Therefore, firm upgrades depend on the intensity of coordination among SMEs and international firms at the local level. By contrast, advanced manufacturing in developed countries relies on more codified learning that can be transferred through arm's length collaboration.²³

As in developed countries, these market failures are clearly expressed in the low productivity of LAC SME manufacturers. While SME manufacturers account for over 40 percent of the total manufacturing employment in LAC countries, they account for only 33 percent of output. Indeed, across the LAC region, SME manufacturers achieve much lower productivity levels than large manufacturers. The disparity in sales and revenue per employee between large and small manufacturers is even greater. Because SMEs help sustain large original equipment manufacturers (OEMs) through domestic value chains, reduced productivity and innovation levels among SMEs impact the manufacturing sector as a whole.²⁴ This may partly explain the decline in manufacturing in LAC economies over the past three decades. In 2008, manufacturing accounted for only 15 percent of the region's GDP, down from 20 percent in 1990 and 27 percent in 1980.²⁵ While LAC manufacturing saw some productivity growth in the last decade (as Table 2 noted), other developing economies and advanced economies surpassed the manufacturing productivity growth rates of LAC economies. For example, Abeles and Rivas find that, from 1998 to 2007, the manufacturing productivity gap between several LAC countries and the United States widened by 31 percent.²⁶ However, as the Information Technology and Innovation Foundation has pointed out, from 1998 to 2007, official figures from the U.S. Bureau of Economic Analysis on U.S. manufacturing productivity growth were likely twice as large as actual manufacturing productivity growth.²⁷ Given this, as Figure 2 shows, the productivity gap between LAC and the United States is probably closer to 16 percent (although this remains a significant gap).

LAC SME manufacturers are less productive than SME manufacturers in leading manufacturing countries such as Germany, Japan, and the United States for three key reasons. First, within LAC economies, the gap between small and large manufacturers is even more pronounced than in OECD countries, limiting the potential for commercial relationships between SMEs and large firms. Second, SMEs in LAC countries have fewer linkages to international suppliers; they are generally more isolated and less specialized. Third, SMEs within LAC economies have a far higher degree of informality.²⁸

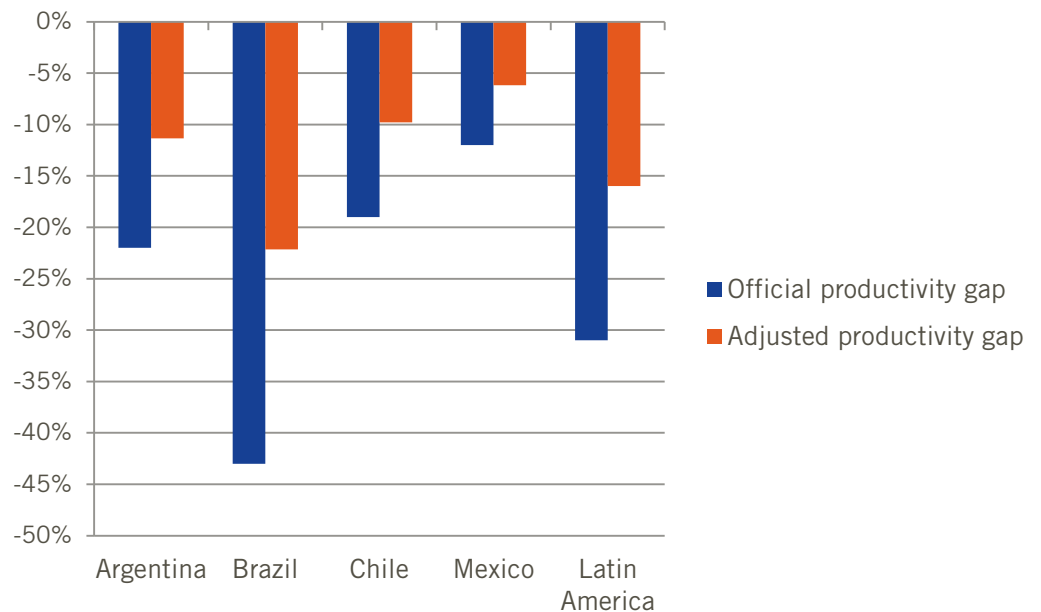


Figure 2: Percent Increase in Manufacturing Productivity Gap between Latin America and the United States, 1998-2007²⁹

The increased productivity gap between OECD and LAC countries, along with rapid productivity growth in South and East Asian economies, implies that, despite absolute growth in productivity, LAC economies are falling behind in relative terms to both peer developing countries in South and East Asia and also to developed economies when it comes to manufacturing competitiveness.

Role of MES in Developed Economies

The primary function of manufacturing extension services in developed economies is to improve SMEs' productivity and thus to help close the productivity gap between SMEs and larger firms. Manufacturing extension services achieve this by promoting collaboration, innovation, and competitiveness. Ultimately, manufacturing extension services seek to "create and deploy outreach mechanisms in the field to stimulate manufacturers to acquire or improve their use of technology and stimulate innovation."³⁰

In general, MES programs in leading countries work to:

- Enhance the efficiency of "shop floor" manufacturing processes and techniques;
- Incentivize SMEs to adopt higher-tech plant and equipment to improve productivity;
- Create training programs to increase productivity and promote best practices;
- Promote technological adoption among SME manufacturers;
- Support technology transfer and commercialization;
- Promote knowledge transfer from universities or national laboratories to SMEs;
- Directly perform or incentivize SMEs to perform R&D;
- Help SME manufacturers link into global supply chains;

- Create training programs for digital technologies, including those related to digital transactions (e-commerce), or to the use of information technology (IT) in manufacturing production processes.

Another subtle goal of most developed countries' SME manufacturing support programs is to expose SME manufacturers to the value of private consulting services. MES programs assist manufacturers with productivity improvements such as lean manufacturing, Six Sigma (i.e., quality improvement practices), technology uptake, new product development methodologies, and other quality control and continuous improvement processes. By demonstrating the value of such projects, MES programs encourage SMEs to procure additional services on their own in the future. As Petar Stojic, the former Director of Business Support Policy for Britain's Department for Business, Innovation and Skills (BIS), which oversees the Manufacturing Advisory Service, comments:

The market failure we are trying to address is the information asymmetry market failure. SMEs do not always know what they do not know, and they do not know how useful business expertise can be. And even when the SME manufacturer knows it has a problem, it does not always know how to procure the right solution. After they have worked with MAS, they understand the value of lean principles and/or better innovation practices and the value of external expertise in general, so when they have to pay the full rate in the future, they now know what to look for and have greater confidence in approaching the market.³¹

Thus, far from supplanting private market advisory services, MES tend to help SME manufacturers understand the value of those services, and thus perform a "market-making" function for the private sector.³²

An important characteristic of MES programs in developed nations is that they are designed explicitly to respond to the specific current challenges, skills, and capabilities of their country's SME manufacturing base. A critical implication of this is that a country's manufacturing extension service must constantly evolve its own capabilities to serve SME manufacturers, as the challenges SME manufacturers themselves face are constantly evolving in a dynamic market landscape. In countries with leading manufacturing extension services, programs are oriented toward both productivity and innovation while remaining tailored to the specific needs of countries' manufacturing sectors.

For example, Germany specializes in bringing new technologies to what might otherwise be written-off as low-technology manufacturing industries, such as textiles, steel, or electrical appliances, by infusing emerging technologies (e.g., advanced materials/composites, advanced machining, nanotechnology, and microelectrical mechanical systems) into these once-legacy sectors. As Dr. Rainer Jäkel of Germany's Federal Ministry of Economics and Technology explains, "A key component of Germany's industrial success is infusing cutting-edge technology into legacy industries. For example, we're now integrating nanotechnology and even biotechnology into textiles and ceramics. We're good at integrating high-tech into otherwise low- and medium-tech sectors, allowing SMEs to renew themselves and to find profitable high-tech niches in these otherwise legacy industries."³³

Germany is different from Canada, Japan, the United Kingdom, and the United States in that it does not have a specific manufacturing extension agency. However, Germany's nearly 70 Fraunhofer Institutes, which bring businesses and universities together to conduct industrially relevant translational research in specific advanced technology areas (such as IT, robotics, nanotech, sensors, and surface materials), perform many similar functions to MES agencies. The Institutes disseminate best manufacturing practices, promote technology and knowledge transfer, and support the development of advanced manufacturing processes and products. Germany's Industrielle Gemeinschaftsforschung program, a counterpart to the Fraunhofer Institutes, ensures that "old industries" such as textiles or steel remain competitive by providing grants of up to 100 percent of the cost for research projects designed by industry and research associations. Germany's MES approach also tailors innovation strategies for SMEs through innovation grants and vouchers. Several German states—including Baden-Württemberg, Bavaria, Brandenburg, and North Rhine Westphalia—have implemented small-scale vouchers (€25,000) which SMEs can use to conduct technology feasibility studies, address specific R&D challenges, or even develop internal innovation methods and processes.³⁴

The United States' Manufacturing Extension Partnership has evolved from an initial focus on boosting SMEs' productivity to now also bolstering SMEs' new product development, innovation, and advanced manufacturing capabilities.

Manufacturing extension programs in Japan are provided by some 262 Kohsetsushi Centers ("Public Industrial Technology Research Institutes"), which offer a range of services to Japanese SME manufacturers, including technology guidance; technical assistance and training; networking; testing, analysis, and instrumentation; and access to open laboratories and test beds. Kohsetsushi Centers facilitate the adoption of a range of emerging technologies, from sensors and embedded intelligence to robotics and automation. The Centers encourage SMEs to apply the new technologies to both their manufacturing processes and to the products they manufacture. Kohsetsushi Centers also provide a centralized research function for regional SME manufacturers clustered in specific manufacturing industries. SMEs can send employees to the Centers to work on collaborative R&D projects of relevance to the regional manufacturing cluster. Japan funds its SME manufacturing support programs more robustly than any other country in the world.

The United States' Manufacturing Extension Partnership, like the British Manufacturing Advisory Service, focuses on direct interventions at the firm level to bolster the productivity, competitiveness, and innovation potential of SME manufacturers. With 1,300 technical experts operating out of over 60 regional centers, MEP provides resources and in-depth audits to SME manufacturers across the United States. In recent years, MEP has evolved from a sole focus on boosting SMEs' productivity to also adding a focus on bolstering SMEs' new product development, innovation, and advanced manufacturing capabilities. For example, MEP introduced a new training program, the Innovation Engineering Management System, which includes a digital toolset, online collaborative workspace, and formal curriculum to help U.S. SME manufacturers innovate and grow.

With thousands of universities and laboratories in the United States and hundreds of thousands of SME manufacturers, a particular challenge for MEP is to facilitate connections between organizations, both to transfer emerging technologies to SMEs and to provide a platform for SMEs to showcase innovative products and new technologies. MEP

introduced the USA National Innovation Marketplace (Figure 3) to allow SMEs to post their innovative products and technologies online in a concise, easily comprehensible format. The service helps manufacturers to: (1) highlight and promote their capabilities to make supply chain connections; (2) reach a wider audience of potential buyers or investors; (3) search for expert help or assistance; and (d) search for innovation-driven business opportunities. To date, one in five SMEs using the National Innovation Marketplace report successful connections with an investor, buyer, or partner.³⁵

Figure 3: USA National Innovation Marketplace³⁶

Lessons Learned from Global Leaders

World-leading manufacturing support programs can offer lessons for LAC countries. Perhaps the most valuable lesson of successful MES programs is that policy needs to first and foremost address low productivity among SMEs. While structural issues obviously impact productivity levels, MES in countries such as Germany, Canada, Japan, Korea, the United Kingdom, and the United States have successfully increased SME manufacturers’ productivity. MES programs support specific productivity-enhancing efforts that otherwise would simply not occur. For example, a program review of the United Kingdom’s Manufacturing Advisory Service found that “if MAS did not exist, no other service/product in the market could deal with the very technical nature of many requests received from manufacturers [that are] currently dealt with by MAS.”³⁷ Similarly, a recent study of Canada’s Industrial Research Assistance Program (IRAP), which offers highly-targeted technical services to Canadian SMEs, found that a 1 percent increase in IRAP assistance to SMEs led to a 12 percent increase in their productivity.³⁸

Agencies such as the United Kingdom’s MAS, Canada’s IRAP, and America’s MEP focus on a wide range of novel policies to address the market failures hindering SME productivity. These are productivity-building programs that teach SMEs lean production principles on the shop floor and help them adopt technologies to improve their process

Countries need to dedicate a specific government agency or program to provide manufacturing extension services.

efficiency. In LAC countries, it is common for one project to focus on training, another to focus on technology transfer and R&D, and another to tackle credit constraints, with few institutional linkages between the programs. Such services represent ad hoc measures that address only parts of the productivity problem of small firms. There is no comprehensive policy narrative for productivity improvement among SMEs. Without a national agenda (albeit including regional considerations), it is almost impossible to identify market failures and create targeted programs. Many LAC governments do not understand what firms actually need to do to improve shop floor performance. By contrast, leading nations have extensive program evaluations with robust SME input to assess the practical value of MES. The second lesson of successful MEP programs is that innovation policy follows productivity. Some LAC governments, having failed to promote productivity growth in SMEs, assume they can “leapfrog” into innovation policy by increasing SME access to public R&D. Yet R&D, advanced technologies, and know-how (innovation) require organizational complexity and coordination to generate profits. The policies rely on managerial and technical best practices—core components of productivity growth. Indeed, world-class manufacturers are highly integrated into global supply chains. They know how to seek out new markets and improve productivity through Sigma Six or other lean practices. These firms are able to leverage technology *because* of their organizational sophistication. Offering R&D assistance to SMEs that do not understand how to adapt to changing product models is akin to offering ICT to managers without computer literacy. Indeed, manufacturing extension services that stimulate new product development in leading countries emerge from policies designed to increase lean practices within current production. Put another way, productivity policies are “manufacturing extension services 1.0” that must be mastered before countries can successfully implement “manufacturing extension services 2.0”—innovation policies.

If productivity and innovation are the first and second pillars of MES in leading countries, then supply chain management/integration and export promotion are the third and fourth pillars. Outside of micro, low-skilled artisan markets, solely domestic manufacturing sectors no longer exist anywhere in the world. Manufacturing supply chains have globalized, and it is vital that LAC manufacturers—especially SMEs—integrate themselves into global markets for both manufacturing production and consumption. In developed economies, the end goal of extension programs oriented toward exports and supply chain integration is to assist SMEs in acquiring new, superior functions in the supply chain, such as advanced production, design, or marketing. In many cases, this means abandoning existing low-value-added functions and applying the competence acquired in a particular sector to a new sector.³⁹ These functional upgrade programs are also particularly important to LAC economies because most LAC SME manufacturers are in traditional or natural-resource sectors. They are highly vulnerable to global commodity markets and competition from new entrants with lower production and labor costs (such as China).⁴⁰

The following are summary lessons LAC economies can take from developed economies’ manufacturing extension services:

- Dedicate a specific government agency or program to provide manufacturing extension services.

- Focus foremost on boosting SME manufacturers' productivity. Later, expand the mission to include broader goals such as bolstering innovation, facilitating exports, integrating SMEs into global supply chains, or joining multi-firm R&D consortia.
- Engage SMEs at the firm level. Conduct reviews and audits of manufacturers' actual processes, and provide specific recommendations for improvement.
- Be responsive to the unique needs of the country's SME manufacturing base, whether by manufacturing industry sector, region, or current technological capacity.
- Create communities of best practice: leverage web-based tools to disseminate best practices and occasionally convene SME leaders to personally exchange best practices.
- Regularly publish case studies documenting how MES programs have specifically improved SME manufacturers' competitiveness.
- Provide MES to all SME manufacturers, but be proactive in identifying aggressive, fast-growing, high-potential SMEs whose success can be a growth catalyst for the broader economy.
- Have the MES program serve as the central hub or channel through which broader government support services are connected to SME manufacturers (even when those services are provided by other agencies).
- Assiduously monitor, learn from, and adopt best MES and manufacturing practices from other nations.
- Leverage the Internet (e.g., through cloud computing) to inexpensively equip SMEs with cutting-edge product (and shop floor) design software tools.

Overview of Manufacturing Extension Services in LAC Economies

Unlike many developed countries that have a single government agency or program devoted specifically to supporting SME manufacturers—such as MEP in the United States or MAS in the United Kingdom—most LAC countries have core agencies that implement a myriad of policies to address the needs of SMEs in general. However, these agencies do not usually specifically or solely target SME manufacturers; rather, they work with all SMEs, including SME manufacturers. These agencies have developed programs to address core functions such as finance, technology transfer, cluster development, and export promotion, and these include an array of services, such as: business and machinery vouchers or credits; information, insurance or loans; tax credits and R&D subsidies; access to public R&D centers; management training; support for new business creation; assistance with technical upgrading; shop floor training; manufacturing and process optimization; and supply chain assistance.⁴¹ While such programs do serve SME manufacturers, they are usually not designed to meet the needs of manufacturers specifically.

Manufacturing Extension Services		ARG	BRA	CHL	CRI	SLV	JAM	MEX	PER
Tech. Acceleration Programs and Practice	Promote Technology Adoption by SMEs	√	√	√	√	√	√	√	√
	Provide Audits of SMEs' Lean Mfg. & Innovation Processes & Skills		√	√				√	
	Business Advisers Work Hands-on with SMEs to Improve Mfg. & Process Techniques	√	√	√				√	
	Support Tech Transfer & Commercialization	√	√			√		√	√
	Promote Tech/Knowledge Diffusion from Universities	√	√					√	√
	Perform R&D in Direct Partnership with SMEs		√	√			√	√	√
	Provide Access to Research Labs/ Prototyping Facilities	√	√					√	√
	Get SMEs into Mfg./ Technology Consortia		√					√	√
Tech. Acceleration Funding Mechanisms	Provide SMEs Direct R&D Funding Grants	√	√	√			√	√	√
	Provide SMEs Loans to Scale/Grow Businesses	√		√		√	√	√	

	Use Innovation Vouchers								√
	Fund Joint Pre-Competitive Research Programs		√						√
	Teach Innovation & New Product Dev. Skills	√	√	√	√	√		√	√
	Provide SMEs Export Assistance and Training	√	√		√	√		√	√
Next Gen. Mfg. Technical Assistance	Promote Energy-Efficient Mfg. Skills			√		√	√		
	Provide Assistance with Standards	√				√	√	√	√
	Teach Role of Design in Mfg.								√
Connect SMEs	Act as Broker to Other SME Support Services	√	√	√	√	√	√	√	√
	Host Best Practice Events	√	√	√	√	√	√	√	√

Table 3: LAC Manufacturing Extension Services Provided by Country

Regardless of the organizational structure used, Table 3 summarizes the specific manufacturing extension services provided by each country surveyed in this report.

Institutional Arrangements

As noted, the countries surveyed in this report use different institutional arrangements in providing their MES support programs, as Table 4 shows. Some programs clearly reside within the formal structure of the central government, operating under the organizational mandate of a specific secretariat, sub-secretary, or ministry. These programs include

Argentina’s Subsecretaria de la Pequena y Mediana Empresa (SEPYME), which is part of the Secretariat of Industry, Commerce, and SME; Costa Rica’s Direccion General de Apoyo a la Pyme (DIGEPYME) under the Ministry of Economy, Industry, & Commerce; and Mexico’s Sub-Secretariat of the Small and Medium Enterprise (SPYME), which reports to Mexico’s Secretary of Economy. The advantage for MES programs that fall within large ministries is that these programs can often leverage high-level government officials to increase program scope and expedite funding. On the other hand, simply being associated with a high-profile government organization does not imply that funds will reach the right MES programs or that programs will have the flexibility and business orientation they need. These programs sometimes face rigid oversight and have limited autonomy or adaptability due to their proximity to long-standing bureaucracies.

Country	Agency	Budget (\$M)	# Employees	Year Established
Argentina	SEPYME	\$88.1	49	1995
Argentina	INTI	\$78.2	895	1997
Brazil	SEBRAE	\$1,600.1	4,500	1972
Brazil	SIBRATEC	\$159.8	669	2007
Chile	SERCOTEC	\$56.2	294	1952
Chile	CORFO	\$1,890.6	524	1939
Costa Rica	DIGEPYME	\$1.7	34	2002
El Salvador	CONAMYPE	\$0.7	41	1996
Jamaica	JAMPRO	NA	NA	1983
Mexico	SPYME	\$633.8	220	2001
Peru	Ministry of Production	\$31.9	NA	2008

Table 4: Summary Overview of Key LAC MES Programs

Other programs fall under government oversight but are decentralized from the overseeing government agency. These programs are still dependent on, and in some capacity supervised by, a particular ministry or secretariat. However, these organizational structures are more removed and have less influence on program functions. Programs in this category include El Salvador’s CONAMYPE, Argentina’s Instituto Nacional de Tecnologia Industrial (INTI), and Peru’s PROMPYE. They each have governing councils that include actors from both the public and private sectors. CONAMYPE’s budget comes mainly from El Salvador’s Ministry of the Economy. Peru’s PROMPYE is responsible to Peru’s Ministry of Employment and Commerce, although its program evaluations, operating budgets, and short- and medium-term planning activities are largely independent of ministry intervention. Due to their semi-autonomous natures, MES programs in these countries can be more responsive to the needs of SMEs in the field. The organizations can shield SMEs to some degree from highly charged political atmospheres. However, they are still

vulnerable to ministerial level changes to budget, staffing, and mandates. Argentina’s INTI, with its 39 centers and a budget of \$78 million, has more freedom than CONAMYPE and PROMPYE.⁴² Its autonomous technology centers offer SMEs support based on industrial clusters. Unlike the other decentralized programs, INTI’s funding model is a combination of public sources, donor contributions, and services fee income. However, recent year-to-year fluctuation in its funding levels may suggest that contributions and service fees are too unstable to consistently enable long-term planning.⁴³

The third category of programs includes those that are independent of any particular ministry or secretariat. Such programs are either independent government agencies or non-governmental organizations. Programs in this category include Chile’s SERCOTEC and Brazil’s SEBRAE. These programs have the highest level of independence from government; they have broad mandates and agenda-setting power. Institutional autonomy allows well-run organizations to create more efficient and flexible programs and to demand greater accountability from intermediary institutions. SEBRAE has a particularly unique institutional structure; it broke from the government in 1990 and was reorganized as a private organization.

Budgets and Employment

Brazil and Mexico allocate the most funds to SME programs as a percentage of overall GDP—0.084 percent and 0.061 percent, respectively—as Figure 4 shows.

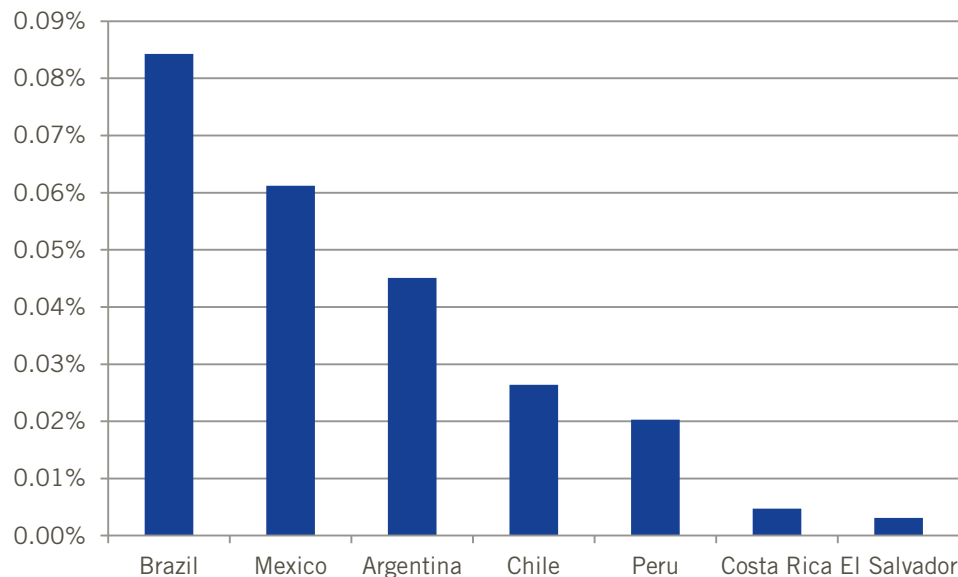


Figure 4: Core LAC MES Investment as a Percent of GDP (Chile’s data only includes SERCOTEC)⁴⁴

CORFO, Chile’s large Economic Development Agency, also supports many manufacturing extension service programs; however, since the vast majority of its budget goes to other development programs, its funding is not calculated into Figure 4. If the specific funding levels of Chile’s CORFO manufacturing extension programs were available, Chile’s funding levels as a percent of GDP would likely be similar to Brazil’s. Argentina, Peru,

Costa Rica, and El Salvador allocate 0.045 percent, 0.020 percent, 0.005 percent, and 0.003 percent of GDP, respectively, to their manufacturing extension services or programs.

As with budgets, the number of employees per program varies considerably. Brazil's SEBRAE has almost 20 times as many employees as Argentina's SEPYME and Chile's SERCOTEC. Costa Rica's DIGEPYME has only 34 full time employees, all located out of the central headquarters in San Juan. CORFO, despite its large budget, has relatively few employees.

But budgetary and employment figures alone do not reflect the full value of LAC MES programs. Across all LAC governments studied in this report, manufacturing and technology extension programs are rising in popularity. However, several programs targeting large SMEs are still better categorized as social policies aimed at alleviating poverty, helping SMEs with short-term and micro-finance challenges, or bringing informal SMEs (largely retail vendors) into the formal economy. Large agencies like Brazil's SEBRAE oversee all SME activities, not just those that support SME manufacturers. While SEBRAE has over 4,500 full time employees and an additional 8,000 external consultants, many of these professionals offer consultancy services to help microenterprises (firms with 10 employees or less) interact with government agencies (e.g., file taxes) or broker support from financial institutions. These services, though important, are not specifically technology extension services.⁴⁵ On the other hand, some technology extension services do work exclusively with SMEs, although in these cases they tend to have much smaller budgets. For example, Argentina's \$78 million budget for INTI is only 5 percent of SEBRAE's budget, but virtually all of INTI's programs focus on providing technology extension services to SME manufacturers. Some of the more targeted MES programs in LAC countries have achieved noteworthy successes. El Salvador's CONAMYPE has a budget of only \$700,000, but ranks above programs in all eight countries short of Brazil and Chile in the Inter-American Development Bank's Institutional Capacity Index—a ranking of SME programs based on organizational capabilities.⁴⁶

Manufacturing in LAC economies can be broken into four categories: traditional manufacturing, natural resource-based sectors, complex products industries, and specialized suppliers.

Core MES Functions in LAC Economies

The first goal of manufacturing extension services is to improve SMEs' productivity. MES programs must address a firm's specific challenges on the shop floor. To that end, MES design and implementation must be based on a tailored assessment of country-specific market failures and individual firm constraints.⁴⁷ Depending on market opportunities and the nature of the manufacturing sector, SMEs in different countries require different policies. Manufacturing in LAC economies can be broken down into four categories: traditional manufacturing, natural resource-based sectors, complex products industries, and specialized suppliers.⁴⁸ (See Table 5) Traditional manufacturing is largely labor-intensive and relies on "proven" technologies in sectors such as textiles, footwear, and furniture. Countries with a strong traditional manufacturing base tend to support MES that improve operational skills and encourage incremental technology adoption. Natural resource-based sectors are obviously driven by direct exploitation of resources. Basic research is an important element of productivity enhancement for these sectors, particularly biotechnology. The primary generators of such research are public laboratories, while the primary users are input suppliers. MES programs in this category focus on export assistance

and public-private research partnerships. Complex products are high-cost and engineering-intensive (e.g., automobiles). In LAC countries, networks of SME manufacturers organize complex products, with one primary market-making firm anchoring the network. These firms are scale-intensive, with SMEs deriving value through geographically close supply chains, technology, and capital goods. Extension programs that target complex products are geared toward fostering relationships between local SMEs and large primary producers. Specialized suppliers are typically client-driven and in LAC countries they are primarily found in the software sector. Barriers to entry are low due to the disintegration of production cycles, low transport, and low physical capital costs. For specialized suppliers, manufacturing extension services focus on bringing together clients and SMEs and facilitating auxiliary upgrades in marketing and design.⁴⁹

Type of SME	Industries	Driver of Innovation & Productivity	Mechanism for Skills & Technology Upgrades	Core Functions of MES
Traditional manufacturing	Textiles and apparel, footwear, furniture, tiles	Mainly supplier-driven	New techniques mostly from chemical and machinery industries. Incremental technology improvements in production methods and design. Most technology transferred internationally through capital goods.	Incremental technology transfer and training programs, commercialization of technology programs.
Natural resource-based	Sugar, tobacco, wine, fruit, milk, mining	Supplier-driven, science-based	New techniques through public research institutions and suppliers (seeds, chemicals, etc.). Knowledge transferred through international quality standards and patents.	Export assistance and training, standards adoption programs, provide access to federal research labs.

Complex Products	Automobile and auto components, aircraft, consumer electronics, biotechnology products.	Scale-intensive firms	New techniques generated by design, complex production systems or products through in-house research. Process and product technologies developed incrementally.	Supply chain integration, support technology consortiums.
Specialized suppliers	Software	Specialized suppliers	New techniques generated through in-house R&D catered toward advanced manufacturing. Adaptive learning through advanced users and user-producer interactions.	Direct R&D funding grants, innovation vouchers.

Table 5: Types of SME Manufacturers in LAC and Core MES Functions⁵⁰

Figure 5 examines technology extension services by activity in four Latin American countries—Argentina, Chile, Mexico, and Peru. It shows that some countries have more specific needs relating to exports or financial markets. For example, due to their proximity to U.S. markets, Mexico’s export-focused manufacturers drive growth for the country’s manufacturing sector. Thus, policy in Mexico is geared toward export-oriented MES programs.⁵¹ One-quarter of the MES programs in Mexico relate to enhancing SMEs’ export capabilities. In Brazil, Chile, and Peru, SME manufacturers lack sufficient access to credit, producing a major hurdle to upgrading technology and capital equipment. (In Brazil, for example, private short-term interest rates for SMEs surpass 18 percent.)⁵²

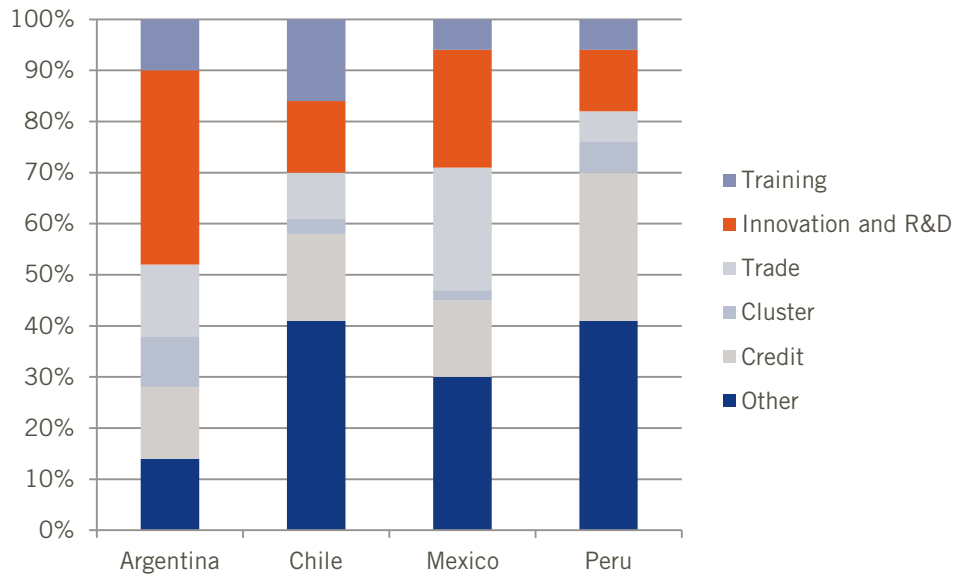


Figure 5: SME Technology Extension Services by Activity, Select Countries, 2009⁵³

All three countries have developed programs to facilitate SMEs’ access to “smart money” and to provide support funds specifically earmarked for training and technical assistance. For example, SERCOTEC’s Seed Capital Program offers Chilean SMEs non-refundable subsidies to support technological “take-off” in the initial stages of growth.⁵⁴ As Figure 5 indicates, 17 percent and 29 percent of MES programs in Chile and Peru, respectively, provide credit for technical assistance, training, or business development. In Argentina, on the other hand, SMEs have greater access to capital and have a strong domestic market to drive profitability. Yet, according to Kristina Thorn of the World Bank, “Comparative data reveal that Argentina underinvests in R&D. Notably, private sector involvement in R&D is very low by international standards. In part, this can be attributed to the prevalence of SME enterprises with few innovative sales.”⁵⁵ To address this problem, Argentina has several MES programs, such as the Technology Fund (FONTAR), that promote R&D by linking SMEs to public R&D labs, offering R&D tax credits, and providing direct subsidies to public R&D projects. Indeed, as Figure 5 shows, Argentina has more activity in innovation and R&D extension services (38 percent) than Chile, Mexico, and Peru.

ADDRESSING SMES’ CORE NEEDS THROUGH LAC MANUFACTURING EXTENSION SERVICES

Countries take different approaches in their manufacturing support strategies in order to be responsive to the particular needs of their SME manufacturers. Nonetheless, in broad terms, successful practices in developed countries clearly indicate that for SMEs to be competitive in the global manufacturing sector, they must successfully address four core challenges: productivity, innovation, exports, and supply-chain integration. LAC SMEs exhibit a high degree of isolation and informality, and can benefit from adopting global best practices based on successful MEP programs in developed countries. While there is no single formula for success, these four variables are essential for any economy—whether developed or developing—seeking to transition SME manufacturers into growth generators. This section examines some of the strongest examples of MES policies and

programs in Latin American and Caribbean countries. Each program seeks to: 1) boost productivity among SME manufacturers; 2) drive innovation (e.g., new product development) by SME manufacturers; 3) help SME manufacturers integrate into global supply chains; and 4) boost exports by SME manufacturers.

Improving SME Manufacturers' Productivity

Programs that seek to improve productivity growth among SME manufacturers come in a variety of forms. Some programs offer financing to encourage businesses to move resources to training employees or managers, while others help SMEs access professional consultants in order to leverage IT-enabled business practices. Finally, some programs offer vouchers for training pertaining to new product development or development of technical skills.

“Smart Money” Financing

As much of the literature indicates, accessing finance is vital but capital alone has a limited impact on the productivity of small firms.⁵⁶ In many LAC countries, access to short-term capital for SMEs constitutes more of a social policy, helping local artisanal firms “just make it.” Fortunately, financing provided by manufacturing extension programs often includes “hooks” to increase productivity. In Chile, SERCOTEC’s Seed Capital Program (SCP) is one of the best examples of a financial subsidy created for small-scale producers to incentivize productivity-enhancing techniques. The program provides financing and obliges managers of SMEs to obtain a certain level of training to access funds. This combination of training, technical, and financial assistance is often referred to as “smart money.”⁵⁷ The subsidy may be used to acquire machines, equipment, or project-related rentals (e.g., raw materials, vehicles, etc.); establish infrastructure; or engage technological consultants. One study finds that most SMEs use SCP funding to hire production-level management.⁵⁸ Firms compete for limited subsidies and are judged by a panel of engineers, entrepreneurs, and previous winners. Consultant teams then develop a training plan for each successful SME, including courses on creating a website, preparing a business plan, accounting, and other productivity-enhancing services. Firms can decide how to proceed with their subsidies, but specific SCP consultants are assigned to each firm to monitor progress. Over the last five years, SCP has allocated \$14 million to SME manufacturers.⁵⁹

Increasing Access to Professional Services

In LAC countries, the consultancy industry is driven by large firms that can justify significant upfront costs through marginal increases in productivity due to sheer output. And because there is a small market for SME consulting, there is little incentive for vendors to develop a particular skill set to assist SMEs and their unique needs. Consequently, SMEs have limited opportunities to learn productive best practices from private-sector consulting firms. To address the need for technical assistance, Argentina created the PRE (Programa de Apoyo a la Reestructuración Empresarial). PRE aims to increase SME productivity by developing the market for professional services for SMEs and promoting access to those services. PRE co-finances up to half of the technical assistance services. From 1999 through 2007, PRE assisted 1,200 SMEs with over \$16 million in financing. Of those SMEs, roughly half the beneficiaries were manufacturing firms.⁶⁰ One of the unique elements of PRE is that it is demand-driven. The preferences of beneficiary firms are a core component of program execution. Firms are asked to develop a business plan that details the particular

For SMEs to be competitive in the global manufacturing sector, they must successfully address four core challenges: productivity, innovation, exports, and supply-chain integration.

form of technical assistance they need. Then, the firms are allowed to choose which consultant or professional service provider they hire. Technical assistance funds can go to a range of activities such as information systems development, quality management, training, new product development, or supply-chain management. According to an impact analysis of PRE by Castillo et al., SMEs that participated in PRE increased employment, real wages, and exports by 14.3 percent, 1.4 percent, and 1.8 percent, respectively.⁶¹

Argentina's SEPYME offers tax credits for small manufacturers to invest in human resource development or training. The Tax Credit System of Training program improves SME productivity by creating an online database for SMEs to collaborate and share best practices and to encourage competition among local firms. After approving consultants and institutions eligible for SEPYME funds, SEPYME provides relevant sector and specialty information on each certified consultant through its online database. SEPYME approves roughly \$9 million in tax credits a year.⁶²

Voucher programs are popular among manufacturing extension services because they are targeted incentives that promote technical and managerial investments often neglected by cash-strapped SMEs.

Providing Vouchers to Boost SMEs' Productivity

Voucher programs are popular among manufacturing extension services in Europe because they are targeted incentives that promote technical and managerial investments often neglected by cash-strapped SMEs. However, to date, only a few LAC countries have created similar voucher programs. Until recently, the largest voucher program in LAC targeting SMEs was Peru's BONOPYME. BONOPYME encouraged technical assistance and training through a system of vouchers. The Ministry of Industry, Tourism, Integration, and International Negotiations (MITINCI) and the Swisscontact Foundation created this program in 1999; however, in 2010, the program was dissolved and recreated under a different name within the Program of Self Employment and Micro Enterprise (PRODAME) and in coordination with the Program of Women's Employment Consolidation (PROFECE). The program organizes vouchers into three categories: diagnostic, training, and technical assistance. Diagnostic vouchers cover the cost of business evaluations to establish needs and identify bottlenecks to growth. Up to six training vouchers are available per firm per year and they can be used for employer or employee training in business management, IT, or other technical courses relevant to firm productivity. Vouchers of \$225 for technical assistance are available twice a year per firm. With these vouchers, firms can hire specialized consultancy services to improve any number of functionalities, including production, sales, operations, or customer service. According to Acevedo and Tan, the training voucher is the most common voucher used by BONOPYME beneficiary firms, which is surprising given that the voucher for technical assistance is larger. This indicates that firms are using BONOPYME funds to address their specific needs, instead of solely as an opportunity to get capital. The authors also found that BONOPYME recipient firms saw an increase in sales and profits by 15 percent and 32 percent, respectively.⁶³

Supporting SME Manufacturers' Innovation Potential

A secondary function of MES programs—after boosting SMEs' productivity—is to increase the technical capabilities and innovation potential of SMEs. Put differently, the first goal is to help SMEs on the efficiency/cost side (e.g., the “top line” of the business), and the second goal is to help SMEs on the growth side (e.g., the “bottom line”). The best

MES programs do both. Innovation-oriented MES programs encourage SME manufacturers to adopt new processes and create new products. Some innovation-supporting policies provide R&D, technology development, and subsidies for modernization. Some support intellectual property development and protection, and others provide awards for innovative business.⁶⁴

All eight countries studied in this report have some programs to promote innovation. The most common innovation policies are those that facilitate technology transfer, which all eight countries have, to differing degrees. Other common programs provide financing for innovation and modernization, or for training and workshops. Some countries, such as Brazil and Chile, have developed programs that promote technical learning through policies designed to support technical clusters of SMEs. Other countries, such as Argentina, have created programs to foster strategic linkages between public and private R&D.

Risk Capital for Innovation

Innovative SMEs are more likely to break into global markets and drive exports, but firms take risks in funding innovation. New or untested technologies, new products or services, or novel business practices demand sufficient capital to “test the water.” Since most LAC SMEs lack access to such funds, some LAC countries provide seed funding and other avenues to assist small innovative firms and foster the evolution of high-value-added SMEs. Brazil’s SEBRAE has created a risk capital program to identify and supply capital to small technology enterprises and manufacturing firms that have export potential. The program is a partnership between SEBRAE, private sector research institutions (both domestic and international), and mutual investment funds. As of 2006, 8 risk capital funds have been established with 22 more expected to come online in the coming years.⁶⁵

In 2009, Brazil’s Funding Unit for Studies and Projects (FINEP), under the Ministry of Science and Technology, created the First Innovative Enterprise (PRIME) program. PRIME provides seed capital to firms that are up to two years old. To qualify, firms must highlight innovative product lines and have at least one economically viable product in production. Recipient firms can obtain subsidies of up to \$70,000 to hire specialists, consulting services, or other forms of technical assistance.⁶⁶ In its first year, PRIME, leveraging a total budget of \$138 million, provided loans to 3,154 companies, supporting 16,000 jobs in the process.⁶⁷ Part of PRIME’s success is the decentralized nature of the program. PRIME has established a network of 18 operators representing different production hubs and regions throughout the country. The government delegates control of the program to these operators, which select and oversee support to SMEs in each region. The decentralized structure increases access to innovation for firms outside of Rio de Janeiro and helps promote diversity among innovative manufacturing sectors. For example, in the region of Espirito Santo, 66 metalworking firms support 60,000 jobs.⁶⁸ PRIME loans have enabled the metalworking cluster to purchase capital for more advanced design capabilities.

Mexico has two programs that facilitate access to funds specifically related to innovation for young and small firms. The “Nuevos Negocios” (New Businesses) program under the National Council on Science and Technology offers financial support for technology proof

of concepts. It also provides financial and technical support for patenting, market penetration, and final stage development of new technology-based manufacturing and services. From 2003 through 2007, the Nuevos Negocios program distributed 140 loans to SMEs, worth a total of \$40 million.⁶⁹ The second program is the Entrepreneurs' Fund, which offers financing for new technologies or product lines in SMEs that cannot access private sector loans. Investments are made in exchange for shares in the firm (no more than 20 percent), which can be recovered at the end of five years. Because many young and small firms do not have access to sufficient capital required as collateral for loans, and because investments in new product lines constitute a greater risk to lenders, the Entrepreneurs' Fund helps bridge the innovation financing gap between SMEs and larger firms. From 2004 through 2011, the program distributed \$10 million worth of loans to 43 firms.⁷⁰

Creating New Advanced Manufacturing Products and Services

Creating new products often entails significant upfront costs. Some manufacturing extension programs help SMEs overcome product development, market testing, and other “valley of death” costs that preclude small firms from successfully bringing new products to market. Chile's National Fund for Technological and Productive Development (FONTEC) supports the adoption of products and new process by Chilean firms. FONTEC's mission is described as:

- (i) to promote R&D, scientific technical services and other activities that contribute to technological development and thereby help enhance the ability of private business to compete and increase their output; (ii) to expand the national technology supply and use of technology either generated or adapted in Chile; and (iii) to promote interaction and cooperation between the country's R&D centers and its businesses and to encourage them to undertake joint projects.⁷¹

According to Maffioli, “The Chilean Science and Technology program (FONTEC) has been an example of a first mover and best practice within the region for the expansion of innovative products and processes.”⁷² Within its first 10 years of operation, FONTEC supported over 1,700 projects worth \$250 million—45 percent of which were projects at SME manufacturers.⁷³ FONTEC identifies firms, particularly small manufacturers, with new production concepts, and subsidizes up to 50 percent of the prototyping, market testing, and other market-entry costs. FONTEC also provides funds to support the larger technological infrastructure associated with new product development, including physical infrastructure, installation, equipment, and training of staff. Capital to support evaluation and pre-investment studies of technological investments are also available (up to \$15,000). Together, these funds represent an effort to assist SMEs throughout the lifecycle of new product development. In a review of 219 firms that received funding through FONTEC, 56 percent indicated that FONTEC represented a “strategic component of their research work program.”⁷⁴

In 2002, Mexico's CONACYT established the Science and Technology Sectoral Fund for Economic Development to support technological innovation in products, materials, and manufacturing processes. From 2002 to 2005, the fund subsidized \$60 million going to

911 SMEs, the majority of which were in the manufacturing sector.⁷⁵ The total value of projects supported was over \$700 million. The fund differs from Mexico's technology transfer programs such as the Technology Modernization Fund (PMT) in its emphasis on new products and not just on new intermediary goods.

Increasing R&D among SMEs

Under most R&D policies in LAC countries, governments allocate funds to public sector institutions but not to SMEs. Public research centers, universities, and national technology institutes perform the majority of R&D, along with some very large, global firms. MES programs tend to neglect R&D since SME manufacturers in LAC countries are predominately competitive in markets driven by natural resources. Most countries have distinct institutions for R&D promotion and SME development, with the two rarely interacting. In the absence of rigorous interagency coordination efforts, SMEs are largely excluded from LAC R&D policy. Yet over the last decade, several LAC countries—most notably Brazil—have created policies linking the public sector R&D backbone to SMEs with close-to-market innovation needs.

Brazil's National Fund for Scientific and Technology Development (FNDCT) is the best example of a LAC MES program linking SMEs to national R&D institutions.

Brazil's National Fund for Scientific and Technology Development (FNDCT) is the best example of a LAC MES program linking SMEs to national R&D institutions. FNDCT offers matching grants for firms to collaborate on R&D projects with public and university laboratories. In 2010, FNDCT financed €884 million (\$1.1 billion) worth of public-private R&D projects.⁷⁶ Matching grants are a favorite financing option for R&D funds toward SMEs because, unlike credit lines, they do not require collateral. According to Maffioli, "FNDCT is the only technology development fund that directly promotes partnerships between firms and research institutions (i.e., universities and research centers)."⁷⁷ In a study of R&D funds for SMEs in Argentina, Brazil, Chile, Columbia, and Panama, Maffioli found that only FNDCT has a positive multiplier effect on R&D and also increases the number of patents in participating firms.⁷⁸

Argentina's IMPULSAR EBT program takes an "ecosystem approach" to R&D policy—not by directly supplying R&D to firms through public research labs—but by identifying and linking public and private sector actors with similar sectors and product lines. One initiative, EMPRETECNO, coordinates individuals and public and private institutions with proven track records of R&D success to help foster the growth of R&D-intense SMEs. The program offers non-reimbursable grants of up to \$600,000 for a four-year period. In order to maintain linkages between partners, the grant cannot exceed 75 percent of the project's total value. Other parties (public research centers, private firms, or entrepreneurs) are responsible for the remaining investment. One of the most innovative elements of EMPRETECNO is the creation of a deal flow facilitator (Facilitadores de Flujo de Proyectos [FFP]) which oversees program proposals, cost, and intellectual property sharing agreements. FFPs are institutions or consortia of institutions authorized by Argentina's National Agency for Science and Technology (ANPCYT) according to their R&D backgrounds. They are paid a basic compensation of 5 percent once the project successfully attracts external investment. During its first year in operation, the program assisted ten projects, leveraging a combined budget of \$10 million.⁷⁹

Business Incubators to Drive Innovation

LAC countries have used business incubators to increase business development services and productivity within SMEs since the 1980s. Some have streamlined and narrowed the focus of business incubators to specifically address the needs of high-tech, innovative SME manufacturers. Through SEBRAE's Brazilian Basic Industrial Technology (TIB) Program, firms can access technical assistance related to logistics, international regulations, standards, and intellectual property. TIB has advisory officers that help firms improve quality and more competitively price their new products.⁸⁰ Its website is a one-stop-shop for e-services, where manufacturers can navigate all SEBRAE services relating to new product delivery in one location, and chat with experts on specific technical topics. Similarly, the Mexican National Incubator System for New Businesses and Entrepreneurs specifically supports SMEs in innovation and technological development. The Incubator System includes a network of business centers focused on education, innovation, and technological development, mostly situated in universities throughout the nation. Municipalities and business organizations also sponsor and support business incubators and business acceleration sites. The program provides a wide range of services to assist in the formation and strengthening of new businesses, including: seed loans; training and technical assistance with regard to technology, innovation and business management; access to information; and promotional events.⁸¹

Supporting SME Manufacturers' Supply Chain Integration

Complex, global manufacturing depends on intricate supply chains in which value-added is often contributed at multiple stages of the production process. One reason SME manufacturers lack technology, best practices, and access to export markets is that they often have few linkages into advanced supply chains. Supply chain management requires both strategic partnerships with domestic and international firms and the know-how to adopt international standards (e.g., clean energy requirements). In some countries, manufacturing extension programs support horizontal collaboration through cluster development, while in other countries programs seek to increase vertical integration between SMEs and global manufacturers.

Developing Strategic Partnerships

In manufacturing firms, the link between process and organizational innovation and shop floor productivity growth requires "learning by doing," and sometimes more productive firms partner with SMEs to facilitate knowledge transfer. Foreign direct investment is a primary avenue through which SMEs learn best practices.⁸² In 1999, Costa Rica developed the Vertical Integration Project (VIP) after realizing that transnational corporations operating in the country only purchased 5 percent of their inputs from domestic producers.⁸³ Leveraging support from the Inter-American Development Bank (IDB), the program creates partnerships between large firms and Costa Rican SME producers of intermediary goods, with the end goal of integrating SMEs into multinational firms' supply chains. Large, global firms often find it easier to coordinate with other global firms because organizational practices and competencies are already established. VIP overcomes these coordination problems by helping large firms assess the quality of products and services produced by SME manufacturers. The program also facilitates sector organizations between

similar manufacturers to place SMEs in a better bargaining position with international firms.⁸⁴

The Supplier Development Program (PDP) under Chile's CORFOR seeks to promote vertical integration between SME manufacturers and larger firms by offering large firms incentives to provide training on technology, design, and quality standards so SMEs can become reliable suppliers.⁸⁵ The program's ultimate goal is to promote mutually beneficial, long-term commercial relations between large buying firms—potential exporters—and their SME domestic suppliers.⁸⁶ A project subsidized by the program must be sponsored by a large firm and include a minimum number of 30 SMEs operating in the firm's supply chain.⁸⁷ Within its first year of operation, 82 projects were funded with a total of \$2.5 million. Since then, 2,853 SMEs have participated in the program.⁸⁸ PDP is successful in part because it combines traditional MES training programs with new supply chain incentives that target training schemes to the needs of large firms. One current fault of the program is that a minimum of 30 SMEs are required to form a partnership, but 20 must come from agriculture or forestry sectors, and only ten can come from manufacturing sectors.⁸⁹ Since manufacturing (including food processing)—not farming—drives productivity, this requirement should be eliminated. Nonetheless, Chile's PDP is certainly an example of a strong practice and currently serves as a model for other supplier development programs in Colombia, El Salvador, Mexico, and Uruguay.

Horizontal Collaboration and Cluster Development

Organizing complementary SMEs increases the speed of knowledge transfer and technology spillovers. Manufacturing extension programs that support clusters help SMEs overcome scale barriers, increase firm bargaining power, and promote industry-wide technology transfer. Mexico's Fund to Promote the Integration of Productive Chains (FIDECAP) sought to develop linkages between SMEs within complementary markets. FIDECAP offered subsidies for projects and industrial infrastructure that supported market collaboration between SMEs. The program also funded Business Linking Centers that served as regional hubs for specific sectors of SME manufacturers. Between 2001 and 2006, FIDECAP supported 2,207 projects that benefited over 597,000 firms, with a total investment of \$387 million.⁹⁰ In 2004, FIDECAP was rolled into a larger organization to support SMEs—Fondo PYME—but the program continues to serve a similar function.

Chile's Group Development Projects (PROFO) is a program designed to support groups of SMEs rather than individual firms. PROFO coordinates firms horizontally in similar regions and sectors for up to three years. The program helps firms collectively overcome scale-based barriers, improve access to internal and external markets, transfer technology, modernize management, and expand exports. PROFO hires a manager for each cluster to help the firms acquire and manage additional public and private sector funding. The program serves as an intermediary MES that coordinates participants in the formulation of common associative clusters and promotes access to wider MES in Chile. Many PROFO clusters receive further funding from the Fund of Technical Assistance (FAT), SERCOTEC, or from the Association of Manufacturing Exporters.⁹¹ Since its creation,

over 33,000 enterprises have participated in the program.⁹² According to a study by Benavente and Crespi, companies that participate in PROFO increased their annual sales by 12.9 percent.⁹³

Peru has developed sector-specific Technology Innovation Centres (CITE) that connect SMEs with other private and public sector agents from a manufacturing or agriculture sector's value chain (including producers, suppliers, regulators, and laboratories). CITEs can be public or privately run and must be financially self-sustaining based on participating SMEs' sales. CITEs help actors throughout a supply chain collaborate, creating and disseminating standards for sectors that lag behind in technology adoption.⁹⁴ One such example is CITEccal, the CITE for eather goods, footwear and associated industries. According to a 2011 IDB analysis of SME best practices:

CITEccal was the catalyst for the introduction, adoption and dissemination of standards among numerous shoe companies, which had long been working in isolation without any form of coordination, compatibility or specialization in their production activities. The introduction of standards has made it easier to modernize the industry, with new groups specializing in areas that were previously neglected, such as design and the management of suppliers to improve leather supplies. This has boosted productivity and innovation, creating the conditions for the introduction of technologically advanced machinery, whose use was previously rare or non-existent.⁹⁵

Supporting SME Manufacturers' Export Promotion

Manufacturing SMEs face a number of challenges when exporting, including incomplete information on foreign markets, minimum scale needed to overcome logistical costs, and a lack of coordination to meet large-scale foreign demand. As such, most SMEs fail to export. In Brazil, for example, only 2 percent of SMEs export.⁹⁶ Manufacturing extension programs related to exports provide information on foreign markets, including products, demand, regulations, and business cultures. They offer training and support to help businesses understand and comply with foreign standards. Some programs provide strategic linkages and partnerships with public institutions and firms abroad. Others offer financial support for manufacturers to participate in trade shows and other commercial activities.

Information Services for Export Promotion

Gathering information on foreign markets often represents a fixed cost that SMEs are not able to absorb. Several manufacturing extension services promote exports by providing market information to SMEs. Argentina's Fundación ExportAR supports export promotion primarily through information sharing but also by funding market feasibility studies (e.g., likelihood of success in foreign export markets). Fundación ExportAR is an autonomous agency with roughly 85 employees and an annual budget of \$4.5 million (as of 2008).⁹⁷ Specific assistance includes: providing training in the export process; providing market intelligence, including relevant background information and information on specific commercial opportunities abroad; organizing and co-financing the participation of Argentinean firms in international marketing events such as trade fairs, exhibitions, and missions; arranging meetings with potential foreign buyers; and supporting the association of small companies to operate more effectively in external markets. Fundación ExportAR

The economic evidence that is available clearly indicates that MES have increased productivity and innovation outcomes within SMEs in a handful of developed economies.

deviates from most export promotion programs in that it supports the creation of export consortia (“Grupos de Exportadores”) with a manager responsible for facilitating technical assistance and coordinating activities for two years. These consortia help SMEs exchange best practices and coordinate to access foreign markets. According to one impact evaluation of ExportAR, the authors found that, “ExportAR is well targeted in the sense that significant effects are only registered for SME companies. More specifically, support from Fundación ExportAR seems to have resulted in increased exports from firms within micro, small and medium size categories.”⁹⁸

Chile’s National Agency for Export Promotion (PROCHILE) seeks to increase SMEs’ access to foreign markets and diversify SME exports, shifting focus away from traditional natural resource industries and toward high-tech sectors and advanced manufacturing. Like Fundación ExportAR, PROCHILE supports SME exporters through financing, assistance in the design and execution of marketing and promotion campaigns, market research studies, and participation in international affairs. PROCHILE coordinates exporters by forming export committees comprised of four or more enterprises within similar traded-sectors.⁹⁹ It currently runs 56 trade offices in 43 countries, covering 90 percent of the destination markets for Chilean exports.¹⁰⁰ According to a 2010 impact evaluation of PROCHILE, participating firms experienced technological gains in products, productive processes, and organization. PROCHILE firms also acquired more strategic alliances, improved access to commercial information, and increased training and export promotion activities.¹⁰¹

Standards Adoption and Training

Brazil’s SEBRAE manages a Bonus Metrologia program that assists SMEs in complying with international standards. Given Brazil’s large number of food processing manufacturers, international quality standards are a significant barrier to entry for SMEs. Bonus Metrologia operates a network of laboratories located in geographic regions based on export industry clusters. It provides specific training and technical assistance according to type of product and manufacturing sector.¹⁰² The program offers product testing to ensure quality and equipment calibration for in-house standards evaluation, among other services. Similarly, Argentina’s INTI helps Argentinean SME manufacturers understand international standards specifications so they can design their products accordingly.

Costa Rica’s Regional Centers for the Support of Small and Medium Sized Companies (CREAPYME) are located in five regions and are joint initiatives between PROCOMER, the Ministry of Foreign Trade, and the Ministry of the Economy, Industry, and Commerce. The offices provide export training programs, counseling on inscription and formal export procedures, and basic assistance services to firms. They also map and identify companies that have the potential to become exporters. Working with PROCOMER foreign offices, CREAPYME helps SMEs gather direct market information on local demand patterns, understand relevant trade regulations, and establish domestic contacts.¹⁰³

ECONOMIC IMPACT OF LAC MANUFACTURING EXTENSION SERVICES

The economic literature identifies several methodological difficulties in evaluating the economic impact of MES programs. First, not all SMEs that participate in MES have the

greatest growth potential. Some are firms looking to government support programs to overcome cash flow or other temporary problems. In these cases, MES will seem to produce less value.¹⁰⁴ On the other hand, some research suggests that only the most advanced firms are even aware of MES and therefore impact evaluations overestimate the value of MES programs. To address these concerns, numerous studies have employed quasi-experimental econometric techniques such as “difference-in-differences” (DID) to evaluate the impact of MES. Even these techniques, however, do not present a complete causal analysis. Second, assessing the impact of MES on the macroeconomic level is difficult because there are so many other variables clouding the picture. Nonetheless, there are numerous impact studies on specific MES in Latin America and the Caribbean.

Leading developed countries have done a much better job of comprehensively evaluating their MES programs than LAC countries. The economic evidence that is available clearly indicates that MES have increased productivity and innovation outcomes within SMEs in a handful of developed economies. The evidence also suggests that these programs more than pay for themselves through the mid- and long-term growth of SMEs. For instance, a 2012 study of the U.S. Manufacturing Extension Partnership found that every \$1 of federal investment in MEP generates \$30 of return in economic growth (see Figure 6), translating into \$3.6 billion in total new sales annually for U.S. SME manufacturers.¹⁰⁵ Moreover, client surveys indicate that MEP centers create or retain one manufacturing job for every \$2,067 of federal investment, one of the highest job growth returns out of all federal funds.¹⁰⁶

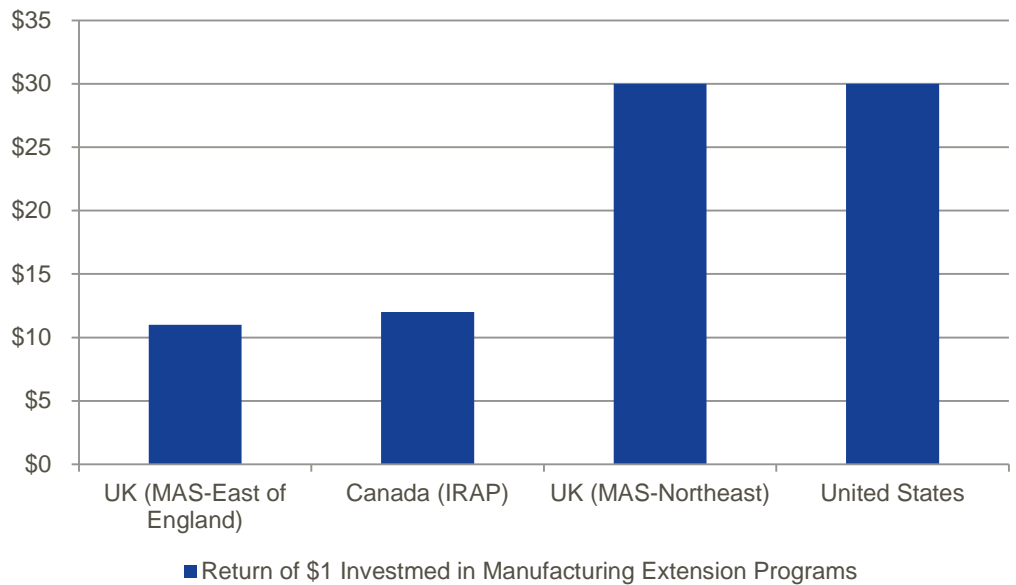


Figure 6: Return of \$1 investment in Manufacturing Extension Programs, U.S., UK, and Canada¹⁰⁷

Similarly, an extensive 2010 review of the United Kingdom’s Manufacturing Advisory Service found that between 2002 and 2009, the service generated \$6.2 in additional value-added for every \$1 of public investment.¹⁰⁸ Within MAS, several regional offices reported even higher paybacks: MAS East of England achieved a rate of return of \$11 and MAS Northeast generates \$30 for every \$1 of public funds. An internal evaluation of Canada’s

IRAP program found that the R&D capacity and capabilities of NRC IRAP clients grew over the evaluation period (2002 to 2007) and that NRC IRAP clients have on average greater capabilities and capacity than non-client SMEs. The evaluation found that between 2002 and 2007, IRAP increased output from manufacturers in the range of \$2.4 billion to \$6.7 billion.¹⁰⁹ A follow-on 2010 IRAP review found that every \$1 of public investment in IRAP programs induced \$12 of economic activity. The study also concluded that firms that participated in IRAP programs saw an 11 percent increase in firm sales, 14 percent increase in employment, 13 percent increase in R&D spending, and 12 percent increase in productivity.¹¹⁰

There is a general consensus within the academic literature that MES programs in developed countries have positively impacted SME outcomes. Table 6 summarizes impact evaluations of manufacturing extension services in developed economies.

Jarmin found the United States' MEP increased value-added per worker by between 2 percent and 6 percent. Using a different methodology, Jarmin found labor productivity grew between 3 percent and 16 percent for SME manufacturers involved in MEP programs. On the other hand, some studies have not found impacts on labor productivity, despite robust impacts to employment. Criscuolo et al. found that Regional Selective Assistance programs in the United Kingdom increased employment by 16 percent to 30 percent, yet the authors found no statistically significant impact on total factor productivity (TFP) or labor productivity.¹¹¹ These findings clearly indicate that all countries must focus on MES that enhance productivity first and foremost, not just employment. Nevertheless, the majority of both the academic and program evaluation literature indicates that the best extension service programs both promote intermediary goals (e.g., R&D, training, technology transfer) and increase productivity and employment.

Study	Program Evaluated	Methodology	Findings
Jarmin, 1998	USA - (MEP) manufacturing extension services	Fixed effects	2%-6% gains in value-added per worker
Jarmin, 1999	USA - (MEP) manufacturing extension services	Selectivity correction with Difference in Differences (DID)	Increase labor productivity by 3%-16%
Wren and Storey, 2002	UK - (Enterprise Initiatives programs) marketing, consulting, BDS	Survival models, DID with selectivity correction	4% gains in medium firms survival; 3%-7% and 2%-3% gains in sales and employment
Motohasi, 2002	Japan - (Promotion of Creative Businesses) tech transfer and assistance	Fixed effects	1%-3% improvement in sales

Criscuolo et al., 2007	UK - (Regional Selective Assistance) plant expansion or modernization, regional R&D	Fixed effects, IV, matching, DID	Employment increases by 16% and 30% impact on investments; no impact on labor productivity or TFP
Morris and Stevens, 2009	New Zealand - (Growth Services Range) grants and advisory services for high performance SMEs	DID, matching with DID and dynamic panel models	8%-20% impact on sales; mixed results on labor productivity
National Research Council Canada, 2010	Canada - (Industrial Research Assistance Program) SMEs innovation capacity	Qualitative surveys, regression and cost-benefit analysis	Increased firm sales, employment, R&D, and productivity by 11%, 14%, 13%, and 12%
U.S. National Institute of Standards and Technology, 2012	USA - (MEP) manufacturing extension services	Qualitative surveys	Rate of Return (RoR) equal to \$30 for every dollar invested; one job created or retained for every \$2,067 invested
DTZ Consulting, 2011	UK - (Manufacturing Advisory Service) Manufacturing extension services and BDS	Qualitative interviews and surveys, trend and indicator analysis	RoR equal to \$6.2 for every dollar invested; one job created or retained for every \$9,100 invested

Table 6: MES Impact Evaluations from Developed Economies

Yet leading countries could also stand to improve their evaluation methods. For example, in most countries, agencies in charge of MES are also responsible for publishing evaluations. A better mechanism would be to have other agencies or auditors conduct independent evaluations.

LAC governments have in general not undertaken empirical evaluations on their MES programs. Instead, academic studies through the Inter-American Development Bank supply most of the relevant work. Alvarez and Crespi studied the impact of Chile's SME export promotion program, ProChile, across 365 enterprises. The authors found a positive effect on innovation and technology adoption among traded products, but they found no conclusive results that the program increased exports in general.¹¹² Benavente and Crespi analyzed Chilean firms that participated in Chile's Associated Development Project (PROFO), which creates manufacturing clusters by promoting strategic linkages among SMEs. They found that the program has a statistically positive impact on management strategies such as planning, marketing, and training, and on total factor productivity.¹¹³ Chudnovsky et al. studied the impact of Argentina's Technological Fund Program (FONTAR) on a sample of 414 firms. The fund supports projects with such aims as modernizing products and processes, integrating personnel with doctorate degrees, and adopting IT technologies. The authors found that the program increased the amount of innovation within recipient companies. They did not find a significant impact on worker productivity, however.¹¹⁴ Similarly, Tan and Lopez-Acevedo studied Mexico's Centre for International Mobility (CIMO) and found the program significantly impacts training and technology adoption but it has no impact on labor productivity.¹¹⁵ Hall and Maffioli

studied the impact of technology development funds (TDFs) on R&D among SMEs in Argentina and Brazil and found that, contrary to the misperception of some economists, TDFs have a positive impact on R&D intensity and do not crowd out private R&D investment.¹¹⁶

Finally, Lopez-Acevedo and Tan carried out perhaps the most extensive economic impact analysis of SME programs in LAC countries in their 2010 World Bank study, *Impact Evaluation of SME Programs in Latin America and the Caribbean*. The authors found Chile's Production Development Corporation (CORFO) induces greater adoption of technology and worker training, but only when financing is coupled with firm linkages or technical assistance—programs providing financial assistance alone proved ineffective. They found more robust results in Mexico, with MES improving SME value added, sales, exports, and employment. Finally, the authors show that two MES programs have had a particularly strong impact in Peru: PROMPYME and BONOPYME's voucher program for technology transfer both increased sales and earnings by workers by 15 to 20 percent.¹¹⁷

The literature indicates that extension services are better at accomplishing intermediary goals, such as R&D partnerships and technology transfer, than at absolutely increasing sales, exports, or productivity. In part this is likely the case because MES programs in LAC are new and studies have not yet been able to capture the impact on output. However, the econometric work does seem to validate the recommendation that LAC governments determine what drives productivity in SMEs and create programs that specifically address those needs. Table 7 summarizes impact evaluations of manufacturing extension services in LAC economies.

The majority of both the academic and program evaluation literature indicates that the best extension service programs both promote intermediary goals (e.g., R&D, training, technology transfer) and increase productivity and employment.

Study	Program Evaluated	Methodology	Findings
Alvarez and Crespi, 2000	Chile - (ProChile) export promotion program	Fixed effects	Gains in intermediary goals (training, technology use) no gains on export sales
Benavente and Crespi, 2003	Chile - (PROFO) strategic linkages between SMEs	DID and matching	Depending on methodology, 11%-15% increase in TFP
De Negri et al., 2006	Brazil - (ADTEN) R&D incentive programs	Propensity score matching, selection models, and DID	Increased R&D expenditures by 28%-39%; no impacts on sales, employment, or labor productivity
Chudnosky et al., 2006	Argentina - (FONTAR) technology transfer and funding	Matching and DID	50%-80% increase in R&D (as a percent of sales); no impact on labor productivity
Tan and Acevedo, 2007	Mexico - (CIMO) supply chain and export promotion Mexico	Production functions and matching and DID	Improved training and technology adoption of 9%-14%; no impact on sales or productivity
Benavente et al., 2007	Chile - (FONTEC) R&D incentives and technology transfer	Matching and DID	Sales increase by 40%, export intensity by 3%; no impact on labor productivity

Hall and Maffioli, 2008	Argentina, Brazil, and Chile - (Technology Development Funds)	Mixed method-propensity scores, matching, DID, fixed effects and IV estimations	Increased total R&D intensity by 0.74%, 18%, and 0.66% in Chile, Argentina, and Brazil; increased employment by 10.8%, 1.5%, 7.9%, respectively; each program produced negative impacts on productivity, but only statistically significant in Chile (-3%)
Acevedo and Tan, 2010	Chile, Columbia, Mexico and Peru - Numerous programs	DID	(Broken down by country below).
Acevedo and Tan, 2010	Chile - technology assistance, cluster formation, and credit programs	DID	Overall impact of SME programs on wages and sales: 7%-9%; TA program impact on sales: 20%; cluster formation program impact on sales and output: 7%-8%; credit program: no impact on any variables
Acevedo and Tan, 2010	Mexico - (Programs in Ministries of Labor, Economy and Science and Technology) training, BDS, export promotion, R&D	DID	Overall impact of SME programs on sales, output, and employment: 5-6%; no impact on exports or wages; Science & Technology Ministry impact on sales, output and exports: 8%, 10%, 25%; Labor Ministry impact on sales, output, and exports: -3%,-5%, -25%
Acevedo and Tan, 2010	Peru - (BONOPYME, PROMPYME, and CITE-Calzado) BDS, public procurement, Technology transfer	DID	Total impact on profits and sales: 21%-26%; impact on profits and sales by program: BONOPYME: 15%-32%; PROMPYME: 19%-20%; CITE-Calzado: no impact
Bonilla et al., 2011	Chile - (SERCOTEC) seed funding	Nearest neighbor matching method	Impact on employment: 22%; no impact on sales
De Negri et al., 2011	Brazil - (BNDES and FINEP) public credit programs	Fixed effects, industry year interactions	Impact on employment and exports: 24% and 39%; no impact on labor productivity
Alvarez et al., 2012	Chile - (FONTEC and FONDEF) innovation and R&D promotion	Propensity score matching and DID	FONTEC impact on wages, employment, and productivity: 6.4%, 4.6%, and 7%; FONDEF impact on sales, employment, labor productivity: -8%, 10%, and no impact on TFP and wages

Table 7: MES Impact Evaluations from LAC Programs

POLICY RECOMMENDATIONS

Observations of current LAC MES programs, along with perspectives on global best practices, yield the following nine summary policy recommendations to improve the overall impact of LAC MES:

- 1) The primary goal of manufacturing extension services is to increase productivity. In LAC countries, SME policies have a wide range of goals. Many SME policies

are better described as social rather than economic policies. Social policies, while important, play a different role from MES in supporting the prosperity of SMEs. MES are driven by the overarching goal of productivity enhancement. Governments should be explicit in distinguishing programs aimed at increasing the growth of SME manufacturers from programs aimed at other social priorities. This distinction is particularly important in LAC countries, where there are different agencies providing extension services, guided by different mandates. For example, the Program of Women's Employment Consolidation (PROFECE) operates Peru's technology transfer voucher program, while JAMPRO, an export promotion agency, operates Jamaica's.

- 2) Create independent agencies specifically for manufacturing extension services. To date, most LAC countries roll SME manufacturing extension services into one of two types of programs: programs that support SMEs in general (e.g., SEBRAE, DIGEPYME, or CONAMYPE) and those that support private sector R&D and innovation (e.g., FNDCT, FINEP). While the latter predominantly address the needs of large firms in sectors such as pharmaceuticals and ICT, the former often invest heavily in micro firms in the retail and service sector. SME manufacturers are exposed to unique market failures relating to innovation *and* basic business development services. Thus, both types of services are needed. Currently, manufacturing extension services in LAC countries operate in institutional silos with little coordination. Governments should create independent agencies to explicitly address manufacturing extension services. Programs such as the Manufacturing Extension Partnership in the United States and the Manufacturing Advisory Service in the United Kingdom are agencies with the sole mission of developing and promoting manufacturing extension services for SMEs. In addition, LAC MES agencies should be more independent from government structures. Agencies that have agenda-setting and budgetary discretion are better able to avoid short-term political pressures and excessive bureaucratic oversight. This is indeed the case with Brazil's SEBRAE, Argentina's INTI, and Chile's SERCOTEC—decentralized and autonomous programs that have some of the most success providing manufacturing extension services to their countries' SME manufacturers.
- 3) Support “Smart Money,” not simply access to credit. Manufacturing extension services are different from programs that solely seek to reduce credit restraints among SMEs in that extension programs address knowledge and technical deficiencies. Traditional credit support is neutral while extension services are targeted.¹¹⁸ To that end, financial support should be tailored to incentivizing training, technology transfer, and innovative practices. Supervision of financing initiatives should be provided by a wide range of engineers, successful entrepreneurs, and experts in manufacturing—not just by government bureaucrats. Benchmarks for recipient SMEs should also go beyond loan repayment to include training, new product design, and export targets.
- 4) Policies should be demand-driven, reflecting the actual needs of SMEs. Legacy programs in LAC are mainly supply-driven; they rely on the assumption that a critical mass of researchers, labs, and funding opportunities will translate into codified knowledge in the productive sector, with little consideration for

technology demand.¹¹⁹ However, SMEs will only participate in programs that accurately and efficiently address their needs. Effective manufacturing extension services should be customized to the “down to earth” needs of the company and not to some high-level, aggregate innovation or R&D target. Programs should represent a pragmatic approach to technology extension in a timeframe that makes sense to firms. These policies should primarily offer process improvement, innovation and management guidance, and related assistance, with the national system offering standardized programs in training, quality, and lean areas.

- 5) Identify and promote “next practices” in knowledge-intensive sectors. In order to be globally competitive, SMEs will need to stay ahead of the learning curve in energy-efficient practices, international standards and certificates, cutting-edge design principles, and other “next practices.” Within leading manufacturing programs in Europe, Asia, and the United States, there is an emerging tier of high-value, targeted extension services focused on explicit support for R&D and innovation. These services help SMEs engage in collaborative research consortia, merge into clean energy supply chains, or export to new markets. LAC governments should adopt and localize international leading next practices.
- 6) Develop sophisticated and frequent program evaluations. The majority of LAC manufacturing extension programs lack the budget or the institutional capacity to monitor and evaluate their programs. Without frequent and reliable impact evaluations, agencies cannot fully address program and administrative deficiencies, nor scale best practices. A 2010 European Commission review of Peruvian SME policies offers an applicable anecdote: “The impact of FOMYPE on employment and economic growth cannot be measured, due to the lack of monitoring tools and baselines.”¹²⁰ Countries should formalize the often ad hoc evaluations by establishing clear benchmarks, outside auditors, and monitoring systems that enable learning and the proliferation of best practices.¹²¹ LAC countries should look to the examples set by countries such as the United States, Canada, and the United Kingdom to benchmark the effectiveness of manufacturing extension services and programs.¹²²
- 7) Create education programs for ICT-based tools. MES programs need to educate SME manufacturers about emerging ICT-based tools that can be used for more effective product design or supply chain management (e.g., cloud-based computer animated drafting/design [CAD] software). All MES programs in LAC countries should establish training programs to teach SME manufacturers how to use web-based IT tools that facilitate computer-assisted product design or that help optimize manufacturing process design. These types of ICT learning programs exist outside of LAC countries: Canada’s Digital Technology Adoption Program (DTAP) is one example. However, beyond Web 2.0 initiatives, few LAC countries take advantage of digital training for manufacturers.
- 8) Manufacturing policy should reflect the modern production process. A core lesson from successful export and supply chain manufacturing extension programs is that advanced manufacturing is a global sector. The existence of international manufacturing supply chains means products move across several countries during the production process, with key components added at various steps in the process

MES programs need to educate SME manufacturers about emerging ICT-based tools that can be used for more effective product design or supply chain management.

before final assembly occurs. Policy should support the ability of a country's manufacturers (whether large or small) to engage in these global supply chains. Unfortunately, some countries continue to try to support domestic manufacturers through tariffs on foreign parts and products. But raising barriers to entry for some products, such as ICT products, only inhibits the ability of a country's firms to engage in global supply chains. At the same time, tariffs raise costs on productivity-enhancing technologies, damaging the competitiveness of all other firms and industries in an economy. For example, the Argentinean government has required some manufacturers to match every dollar worth of products they import to the country (such as component parts) with a dollar of exports—an approach called export equalization.¹²³ However, such policies miss the vital importance of advanced capital goods (many of which cannot be produced domestically) to SME manufacturers trying to move up the value chain to manufacture more sophisticated products.

- 9) Recognize that not every SME is a growth driver. The stark reality in LAC countries is that most firms are SMEs—in the manufacturing sector and throughout the economy. The majority of these establishments are micro and informal, exist in artisan sectors, and fulfill local demand. These SMEs and their proprietors are often highly undercapitalized and would benefit substantially from a number of government services. To that end, most SME programs in LAC countries do not target industries or types of SMEs. Yet successful manufacturing extension services target program resources toward the specific needs of firms that meet a necessary baseline of skills and technology to grow and drive economic prosperity. Broader SME policies and manufacturing extension services are not mutually exclusive, and both should be part of a country's economic policy. However, some small yet high-growth-potential manufacturers offer unique growth opportunities for LAC economies and thus should have specific policies designed to meet their needs.

REVIEW OF MANUFACTURING EXTENSION SERVICES BY LAC COUNTRY

Argentina

Argentina's \$69.4 billion manufacturing sector accounts for 20 percent of the country's GDP.¹²⁴ Manufacturing SMEs represent 15.9 percent of total enterprises in the sector. The main government entity in charge of SME support services is the Ministry of the Industry through its Secretary of Small and Medium Enterprises and Regional Development (SEPYME) and the Secretary of the Industry. The Ministry of the Industry is part of the Presidential Cabinet. Specific manufacturing extension services are provided by INTI, the National Institute of Industrial Technology.

SEPYME has an annual budget of \$88 million.¹²⁵ The services SEPYME provides seek to increase productivity and innovation, create business clusters, and favor local development. The most important programs of SEPYME include: provision of assistance and information to facilitate access to export markets; diagnostics of SMEs' operational processes and economic support to implement improvement recommendations; subsidies for expenditures related to improving competitiveness; product and process innovation and

quality certifications; seed capital for the creation of new companies; refunds on investment expenditures made in human resources training; technical and economic assistance to groups of SMEs to implement, develop, and strengthen productive projects; creation of business clusters; financial assistance to reduce the cost of credit and loans to build industrial parks; provision of infrastructure to connect industrial parks; and credit for purchases of working capital.¹²⁶

Specific manufacturing extension services are provided through the National Institute of Industrial Technology, a decentralized agency under the supervision of the Secretary of the Industry. INTI provides a wide range of services and programs specializing in technology transfer, innovation, and R&D. INTI provides these services through technological centers in several regions of Argentina that specialize in the following sectors or themes: food and beverages; textiles, fabrics, and leather products; aeronautics and space; quality, design, and development of products; construction, materials, and processes; electronics and metrology; chemistry; and natural resources and the environment. INTI's centers offer services such as: access to laboratories for analysis and tests of products; certification assistance; technical assistance for technology transfer; audits to improve processes; R&D; capacitation of human resources to improve the quality of products; and machinery calibration. In addition to these services, INTI also provides technical assistance on agricultural machinery through diagnosis and implementation of improvements in processes and innovation and assistance for the adoption of sustainable energies; studies of the technological and economic feasibility of projects; and optimization of bioprocesses. INTI's annual budget of \$78 million supports operations at 39 centers in various regions across the country.¹²⁷

Another agency that plays a role in promoting innovation and productivity in Argentina's SME sector is the Ministry of Science, Technology, and Innovation. Created in 2007 to increase R&D investment and help bolster innovation, the Ministry creates synergies between enterprises, universities, and research centers to increase the adoption of technology in Argentina's economy. The main program under the Ministry is the Technological Fund (FONTAR), which has an annual budget of \$4 million.¹²⁸ The fund provides financing for projects focused on technological modernization of products or processes, integration of personnel with doctoral degrees, or adoption of IT technologies.

Regarding manufactured exports, Argentina's extension services focus on increasing the value-added of the products rather than on providing in-depth assistance. This may be explained by the fact that the majority of manufactured exports from Argentina are products with low- and medium-use of technology in their production, such as paper products, food and beverages, wood products, fabric and textiles, furniture, plastic, metals, and oil or oil products. In the period from 1995 to 2005, such products accounted for 77 percent of the exports from Argentina's manufacturing sector.¹²⁹ The manufacturing products with high-tech usage—office, accounting, and computing machinery; electronic and communications equipment; pharmaceutical, medical and optical equipment; and aircraft—represented just 3 percent of Argentinean exports over that period.¹³⁰ Argentina's government is directing its extension services to increase the participation of high-tech industries in both exports and in the overall economy. With its new programs, the

government hopes to increase both technology transfer and R&D expenditures, which currently equal just 0.7 percent of Argentina's GDP.

Brazil

Brazil's \$280.6 billion manufacturing sector represents 15.7 percent of the country's GDP.¹³¹ The vast majority, 99.6 percent, of Brazilian enterprises are SMEs. Likewise, SME manufacturers account for over 99 percent of Brazilian manufacturers.¹³² Despite the fact that the contribution of Brazil's manufacturing sector to GDP has declined from 30 percent in 1980 to 13.4 percent today, it remains a vibrant component of the country's economy. Brazil's manufacturing sector is a key producer of high-value-added products, exports, and jobs.

SME manufacturers account for over 99 percent of Brazilian manufacturers.

The main entity in charge of extension services for SMEs is the Brazilian Service of Support to Micro and Small Enterprises (SEBRAE), a private nonprofit organization. SEBRAE was originally created in 1972 by the government of Brazil, but it became independent in 1990. Despite being a private institution, SEBRAE develops its activities in collaboration with the public and private sector through its National Deliberative Council, which includes government institutions, business organizations, and research institutions.¹³³ Delegates from the government and the private sector comprise SEBRAE's National Board. SEBRAE is funded with a social contribution that companies pay each month through the National Institute of Social Security (INSS). SEBRAE has centers in each of Brazil's 26 states and in the federal district of Brasilia. It has 750 points of service across the country. With an annual budget of \$1.6 billion, SEBRAE has 4,900 employees and 8,000 external consultants.¹³⁴ The activities of SEBRAE are divided into three main economic sectors that represent the core "pillars" of Brazil's economy: agriculture, industry, and services/trade. According to SEBRAE, 63,000 enterprises benefit from its programs each year.¹³⁵ Some of the many manufacturing sectors SEBRAE works with include: textiles and clothing, wood and furniture, food and beverages, biotechnology, cosmetics, leather and shoes, electronics, gems and jewelry, printing, metal-mechanic, pottery, plastics, chemicals, IT, medical equipment, and pharmaceuticals.

The services SEBRAE offers include: assistance and training in financial planning, entrepreneurship, and adoption of new technologies; seed capital for business incubators; business cluster development; consulting services to single enterprises or to clusters of SMEs on management, human resources, market access, entrepreneurship, and access to technology; innovation support; access to financial services and access to credit; and promotion and market access through business fairs.¹³⁶

In addition to SEBRAE, Brazil's Ministry of Science, Technology, and Innovation is an important source of support to manufacturers. Through the Secretary of Technological Development and Innovation, the Ministry proposes, coordinates, and monitors training programs for Brazilian enterprises. The programs help manufacturers adopt new technologies, promote R&D, attract productive investment, foster innovation, and empower human resources. The objectives of the Secretary, though not aimed exclusively at manufacturing, are still relevant to the manufacturing sector. The Ministry oversees the Brazilian Technology System (SIBRATEC), an organization that supports R&D activities

through access to laboratories. SIBRATEC supports innovation in products and processes, promotes the adoption of advanced technologies, and increases foreign trade opportunities for Brazilian SMEs. It is organized into three types of networks, called components: innovation centers, technological services, and technological outreach. From 2007 to 2009, SIBRATEC implemented eight state-level technology extension networks, six thematic innovation centers, and 18 technology services networks, involving 54 institutions and 527 laboratories.¹³⁷ Brazil's Ministry of Science, Technology, and Innovation further promotes extension services through the Projects and Studies Company (FINEP), a public enterprise that fosters science, technology, and innovation in companies, universities, technological institutes, and other public and private institutions. FINEP has 669 employees and an annual budget of \$160 million.¹³⁸

Costa Rica

Costa Rica's \$5.7 billion manufacturing sector accounts for 17.3 percent of the country's GDP.¹³⁹ SMEs represent 98 percent of all enterprises the country.¹⁴⁰ Costa Rica's Ministry of Economy, Industry, and Commerce is the agency responsible for providing extension services to SMEs through the Directorate for the Support of the Small and Medium Enterprises (DIGEPYME). The Directorate has 34 full time employees and 5 regional offices. Its main purpose is to implement plans, programs, projects, and actions to strengthen strategic areas of development for SMEs. It focuses on training and technical assistance, sustainable development, marketing, funding, technological innovation, and international cooperation. The Ministry has an annual budget of \$12.7 million, of which \$1.7 million is assigned to DIGEPYME.¹⁴¹

The Ministry of Science and Technology (MICIT) is another relevant source of manufacturing extension services for Costa Rican SMEs. One of its most important programs is the Fund of Research and Technological Development (PROPYME). The fund provides non-refundable resources to SMEs intended to help firms develop new products, improve processes, train human resources, access laboratories and specialized facilities to test products, and adopt new technologies. PROPYME coordinates with DIGEPYME to allocate funding among the various eligible SME projects. The Ministry of Science and Technology also promotes R&D activities through the National Council for Scientific and Technological Research (CONICIT). CONICIT provides funding for human resource training, research project implementation, and technological development carried out by research centers and private companies. It prioritizes research on aeronautics, biotechnology, nanotechnology, health sciences, energy, and IT technologies. CONICIT's main initiative is the Program of Projects Associated with the Productive Sector, which tries to address the scientific and technological needs of SMEs by supporting research and technological development projects that spring from collaborations with companies and universities or other research institutions. Non-reimbursable funding is awarded to companies with the stipulation that the company must use the funds to procure research services from the university or research institute.

Another relevant source of support for SMEs is the National Institute of Learning (INA), a decentralized educational institution that provides workforce training in coordination with the private sector. A fixed percentage is taken from the payrolls of public and private

enterprises to finance INA, and members of the labor sector, industry, and government manage the program. Its main program of support is the Virtual Platform of Support for SMEs, which disseminates knowledge regarding information technology. Its web page provides information on courses for building business networks and managerial skills.

Finally, government agencies in Costa Rica offer financial securities to facilitate SMEs' access to credit. The Popular and Community Development Bank administers the Special Fund for the Development of Micro, Small, and Medium Enterprises (FODEMIPYME), which provides guarantees and securities to facilitate SMEs' access to loans. The National Bank of Costa Rica offers the same kind of service through the National Trust for Development (FINADE), which provides guarantees and securities to facilitate SMEs' and startups' access to credit.

Chile

Chile's \$26.6 billion manufacturing sector represents 11.5 percent of the country's GDP.¹⁴² Chilean SMEs account for 99 percent of the country's enterprises, and 97.2 percent of its manufacturing enterprises.¹⁴³ As large firms have increased in dominance, SMEs' sales have fallen. Microenterprise and SME sales fell from 27 percent of total sales in 1994 to just over 23 percent in 2000.¹⁴⁴

The Ministry of Economy, Development, and Tourism is the agency in charge of extension services for Chilean SMEs. The Ministry has an annual budget of \$2.5 billion and provides different services through decentralized agencies. Through the Technical Cooperation Service (SERCOTEC), a decentralized agency that functions as a corporation of the Ministry with offices in all regions of Chile, policymakers promote initiatives for improving the competitiveness of micro and small enterprises and for strengthening the management capabilities of Chilean entrepreneurs. SERCOTEC implements and designs its own programs and offers the following services: provision of seed capital to start new business; finance for clusters of SMEs to develop projects to gain access to new markets or to develop new products or services; technical assistance provided by expert consultants to improve production processes; creation of business networks; promotion of SMEs' products at the regional, national, and international level; and the creation of public-private ventures to develop projects of high added value. SERCOTEC has 294 employees and an annual budget of \$56 million.¹⁴⁵

The Ministry also promotes innovation, technology transfer, and R&D through the Production Development Corporation (CORFO), which has an annual budget of \$1.9 billion (part of the overall budget of the Ministry). CORFO provides services with an emphasis on innovation, business clusters, and management skills. It chooses priority areas on the premise that the market is not capable of providing the right conditions for the development of SMEs.¹⁴⁶ Its programs are not necessarily directed toward the manufacturing sector, but given its vast resources and the fact that it has a presence in all regions of the country, CORFO constitutes a key player in the provision of services to SME manufacturers. To deliver its services, CORFO outsources to public agencies, regional governments, public and private institutes, and industry associations.¹⁴⁷ The main services CORFO offers include: funding for companies to hire specialized consultants in

SME support services provided by the Chilean government have shown positive effects on the adoption of new technology and have helped deliver increases in sales and labor productivity.

business innovation; funding for the creation and consolidation of businesses clusters; funding for firms to expand R&D; tax incentives to develop R&D activities; credit and access to finance for adoption of technology; facilitating SMEs' access to financial instruments and credit; funding for the development of products with intense use of technology; funding for investment in new technology and capital goods; credit guarantees for SMEs; funding for the adoption of energy-efficient manufacturing skills; and funding to support business startups. Finally, the Ministry plays a brokering role to make SMEs aware of the services that other ministries provide. It encourages SMEs to create business clusters.

Other government agencies in Chile offer additional programs to support the development of SMEs. The Ministry of Foreign Affairs promotes international trade and exports by Chilean SMEs through PROCHILE, a decentralized agency. The National Commission for Scientific and Technological Research (CONICYT), a decentralized agency of the Ministry of Education, promotes initiatives to support R&D activities and the transfer of technology and knowledge to Chilean enterprises. However, the extent of coordination between these ministries and the Ministry of Economy, Development, and Tourism with CORFO and SERCOTEC is unclear, thus making some of the actions of these programs potentially redundant. SME support services provided by the Chilean government have shown positive effects on the adoption of new technology and have helped deliver increases in sales and labor productivity.¹⁴⁸ A more unified system of innovation with closer cooperation between agencies could further enhance the impact and effect of Chile's manufacturing extension services.

El Salvador

Twenty-two percent of El Salvador's GDP derives from manufacturing, the majority of which is in *maquila* products (manufactured products assembled for re-export) and food processing. As in Costa Rica and Jamaica, small domestic markets mean that manufacturers must export to achieve scale and remain competitive. *Maquila* products account for almost half of all exports. Traditionally, *maquila* assembly has encompassed low-value-added products that are generally not technologically intensive.¹⁴⁹ Yet, as competition across the low-value components of the global manufacturing supply chain increases, El Salvador's manufacturing and traded sectors face pressure to adopt advanced technologies and improve productivity.¹⁵⁰

CONAMYPE (the National Commission for Micro and Small Businesses) is the primary institution charged with promoting, facilitating, and coordinating technology extension services for SMEs. Founded in 1996, CONAMYPE was originally created to assist micro businesses with micro credit and provide basic business development services. But the advent of global competition in El Salvador's primary export markets, along with the low productivity of SME producers, promoted a shift in the program toward technology extension services. CONAMYPE supports innovation among modern, competitive SMEs by facilitating access to technology and finance. It provides training and technical assistance and hosts best practice events for SMEs. CONAMYPE is part of the Ministry of the Economy but is an autonomous body with agenda-setting power and an independent board and budget. The budget of the commission for 2011 is \$700,000.¹⁵¹ Beyond

CONAMYPE, programs exist to assist SMEs under the Vice Ministry of Trade and Industry, including the Directorate of Quality and Productivity, the Directorate of Innovation, and the Directorate of Productive Export Development (FOEX).

The primary MES programs under CONAMYPE are the Technology Assistance Fund (FAT), BOMOMYPE, and the Business Procedures Center. FAT offers subsidies of up to 80 percent for the purchase of technical assistance. FAT also tries to facilitate domestic supply chains by incentivizing technical capital goods procurement locally. Given the importance of productivity growth in traded sectors like manufacturing, the “FAT Exporter” program provides: technical assistance for potential export activities; development of export plans; improvement of product quality; packing; laboratory testing; research on specific markets; and business consolidation.¹⁵² BONOMYPE provides aid to SMEs that request assistance for training within the eastern regions (La Paz, La Union, Morazan, San Miguel, San Vicente, and Usulután) of El Salvador. At present, up to 4,500 microenterprises are receiving training through 36,000 linkages. Finally, the Business Procedures Center supports increased productivity of SMEs by providing business development services, primarily through e-services.

As in Jamaica, a number of El Salvador’s MES programs are carried out as development funds jointly administered by the European Union. The Project to Strengthen Competitiveness of Micro and Small Enterprises in El Salvador (FOMYPE) is a technical assistance contract funded by the European Union and run by CONAMYPE. It has hired an international technical assistance staff to improve SMEs’ technical capabilities, develop consultancy services, and provide graduates of several national technical institutes with technical advisory services and training.

Conspicuously lacking from El Salvador’s MES policy toolbox are policies to promote and assist R&D within SMEs. The National Council for Science and Technology (CONACYT) directs science and technology policy and public sector R&D, but has few programs directed toward SMEs. SMEs in El Salvador currently perform little R&D and are not competitive for funds under CONACYT. In fact, there are few institutional linkages between CONACYT and CONAMYPE.¹⁵³ CONAMYPE focuses on productivity among SMEs while CONACYT directs innovation and R&D. Yet SMEs in tradable manufacturing sectors, even in low-value assembly manufacturing, need R&D to improve productivity and achieve global competitiveness. El Salvador should incorporate R&D and science programs into its manufacturing extension services for SMEs.

Jamaica

Comprising 8 percent of GDP (down from 13.4 percent in 1990), Jamaica’s manufacturing sector is smaller than Brazil’s, Argentina’s, and Chile’s. However, in this heavily service-oriented economy, the manufacturing sector remains the largest contributor to GDP out of all the goods-producing sectors, employing 72,000 Jamaicans.¹⁵⁴ Manufacturing in Jamaica is dominated by natural resources, with food processing, beverage, and tobacco manufacturing contributing over half of manufacturing value added.¹⁵⁵ Unlike Brazil or Argentina, Jamaica cannot rely on large domestic markets to drive manufacturing competition. Instead, the industry is largely export-oriented. MES

programs in Jamaica focus on close-to-market tech transfer, skills training, and increasing access to export markets.

Currently, there is no comprehensive government entity for either SME policy or technology extension services in Jamaica. Various state and quasi-state agencies provide MES to SMEs instead. Because foreign direct investment (FDI) and exports drive manufacturing in Jamaica, Jamaica Trade and Invest (JAMPRO) plays a leading role in MES. Under its mandate of encouraging private investment and export promotion, JAMPRO has created several programs that promote SME financing for technology and training. One such example is the Jamaican Business Development Center (JBDC), which runs technical training programs and offers technical support through its national network of institutions. JBDC has sponsored training sessions with over 2,000 new SMEs each year since 2005.¹⁵⁶

JAMPRO's two other MES programs are the Modernization of Industry Program (MOI) and the Private Sector Development Program (PSDP). MOI "orients manufacturing industries toward adoption of techniques which exploit internal economies and reliable information systems designed to make them more competitive in the domestic and overseas market."¹⁵⁷ It offers tax incentives to help firms that qualify for plant modernization to purchase machinery and other technologies.¹⁵⁸ In order to qualify for certification under the MOI, SMEs must either participate in the export trade or provide support services or raw materials to export manufacturers.¹⁵⁹ PSDP is jointly funded by the government of Jamaica and the European Union, and is run by JAMPRO. PSDP coordinates SME support programs across 18 private and public sector agencies to improve SMEs' access to export markets and establish regional manufacturing clusters.¹⁶⁰

A number of other public agencies direct MES policies in Jamaica, including the Ministry of Finance and Public Service; the Jamaica Agro Processors Association; the Ministry of Industry, Investment, and Commerce; and the Business Development Corporation. As with programs under JAMPRO, most of these MES are tightly oriented toward export markets. For example, the Quality Jamaica Project, managed by the Bureau of Standards, trains SME manufacturers on how to navigate international food and beverage standards, such as the International Organization for Standardization's ISO 9000/14000.¹⁶¹

MES in Jamaica are characterized by policies that acknowledge Jamaican manufacturers' current strengths—food and beverage exports. Jamaica's manufacturing extension services need to go further to promote advanced manufacturing through R&D incentives and programs that support next-generation technologies outside of traditional export markets. One potential reason for the lack of diversity in policy is that without an autonomous, umbrella organization for MES, policies are adopted based on the core competencies and agenda of the particular funding agency. This is certainly the case with JAMPRO's MES programs. According to the *2009 Policy Report for the Jamaican MSME Sector*, "The development of expertise through specialization suggests that the centralization of SME services would be beneficial. The Government of Jamaica should therefore create a centralized agency and empower it to conduct (or have conducted) local, regional and international market research on behalf of the SME policies and best practices."¹⁶²

Mexico

Mexico's \$179.1 billion manufacturing sector accounts for 18 percent of the country's GDP.¹⁶³ SMEs represent 99.3 percent of all manufacturing enterprises in Mexico.¹⁶⁴

The government agency in charge of services for SMEs is the Sub-Secretariat of the Small and Medium Enterprise (SPYME). Working under the Secretariat of Economy, SPYME is responsible for advancing MES programs to bolster levels of innovation and competitiveness, encourage adoption of new technologies, and increase SMEs' access to credit. SPYME is also charged with supporting the creation of new enterprises. It offers a variety of financial support programs, including funding for startups, financial collateral guarantees to facilitate SMEs' access to financial services of commercial banks, and loans to expand or develop businesses or help create new enterprises. SPYME has an annual budget of \$633 million and operates in all of Mexico's states.

SPYME offers a wide variety of services through entrepreneurship centers called *Centros Mexico Emprende*, which have a presence throughout the country. There are 71 centers and 140 offices in the network, with 100 facilitators and 1,100 business consultants serving SMEs. The centers offer joint services with private and academic institutions in key areas such as: audits of SMEs' processes and skills; links to other government programs and the private sector; agency services to facilitate SMEs' access to credit from banks; and training in business development. The centers have provided services to 47,380 entrepreneurs and 45,903 enterprises and perform 2,490 diagnostics to companies every year.¹⁶⁵

SPYME offers additional support to SMEs through other agencies and programs. The National Committee for Productivity and Technological Innovation (COMPITE) is a decentralized organization operating under the supervision of SEPYME that provides training on re-engineering processes, operations, logistics management, and marketing, and courses on the ISO 9000 quality management system. Through the Entrepreneurship Fund, SPYME has provided \$243 million to guarantee SMEs' access to credit.¹⁶⁶ SPYME promotes linkages between companies, the creation of business clusters, and the integration of production chains through the Mexican Business Information System (SIEM), which integrates and maintains a broad business register. As a complement to this type of support, SPYME offers assistance in exports, provides economic incentives to foster the creation of industrial parks for SMEs, and stimulates the creation of networks between SMEs and large companies to develop high-value supply chains.

SPYME also offers a series of programs and initiatives targeted at high-value-added SMEs in areas such as nanotechnology, biotechnology, biomedical devices, engineering, chemicals, electronics and telecommunications, information, mechanical engineering, and advanced manufacturing technologies. Mexico's National Innovation and Technology Fund, a joint initiative with the National Council of Science and Technology, supports initiatives of SMEs and research centers, especially those at universities. The fund promotes R&D of new products and processes or improvements with a significant innovation content; consolidation of engineering centers; design, research and technological development; integration of highly qualified individuals with SMEs; and the development

Mexico's National Innovation and Technology Fund, a joint initiative with the National Council of Science and Technology, supports initiatives of SMEs and research centers, especially those at universities.

of technological and scientific projects into startup enterprises. In 2010, the fund supported 231 projects with a total budget of \$64 million.¹⁶⁷

In addition to SPYME, other agencies offer extension services to SME manufacturers, including the Secretariat of Social Development, the Secretariat of Agriculture, Livestock, Rural Development, Fisheries and Food, and the Secretariat of Labor and Social Welfare. However, Mexico does not have a clear mechanism to coordinate the efforts of these different agencies, which sometimes leads to redundancy and waste of resources.

Peru

Peru's \$23 billion manufacturing sector accounts for 16.5 percent of the country's GDP.¹⁶⁸ There are 78,246 formal enterprises in the manufacturing sector, which account for 8.3 percent of all enterprises in Peru. The main activities of these enterprises are: clothing and textile manufacturing (22 percent), food and beverages (21 percent), and metal products, excluding machinery and equipment (15 percent). SMEs account for 99.6 percent of all Peruvian manufacturers.¹⁶⁹ In the manufacturing sector, Peruvian SMEs tend to be very small. Enterprises that develop products with high value-added requiring heavy investment in R&D, such as medical equipment and electronics, represent less than 1 percent of total SMEs in Peru's manufacturing sector.¹⁷⁰ Peru's national investment in R&D is low, with a national R&D intensity of approximately 0.1 percent of GDP (\$158 million in total between the public and private sectors), whereas R&D intensity on average represents 0.62 percent of GDP across Latin America.¹⁷¹

MES in Peru are coordinated predominantly through the Ministry of Production (MP) which has an annual budget of \$31.9 million.¹⁷² The MP provides its services to SMEs through the Directorate of Micro and Small Enterprises and Cooperatives (DGMYPE-C). DGMYPE-C supports SMEs largely through basic training in productivity, productive processes, product design, and management. It distributes publications on relevant topics for SMEs and helps small firms adopt quality standards. It also facilitates the creation of business clusters to promote collaboration between the public and private sectors and increase the productivity of SMEs.

The Ministry of Production facilitates tech transfer through the Centers of Technological Innovation, with 14 centers in seven regions (Pira, Lima, Arequipa, Iquitos, Pucallpa, and Tacna) throughout Peru. The Centers assist SMEs in adopting new technologies. They support the development of R&D by providing access to technological labs and funding joint public-private R&D expenditures on the development of products and processes. The Centers also create SME networks, connecting SMEs with researchers and academic institutions to foster technological development and technology adoption by SMEs.

Another service available to SMEs is the Research and Development for Competitiveness Fund (FIDECOM), a decentralized organization within the Ministry of Production. FIDECOM supports the R&D efforts of both individual SMEs and groups of SMEs in innovation and productive processes, as well as efforts to transform technological and scientific research into new products or businesses. It has an annual budget of \$73 million.

Drawing on the success of manufacturing extension services in other parts of the world, LAC countries have increasingly adopted policies that support the competitiveness, productivity, and innovation potential of their SME manufacturers.

In addition to the efforts of the MP, the Science and Technology Program promotes the adoption of new technologies in SMEs for product development. A decentralized commission that articulates the efforts of the various government agencies in charge of economic and technological development, the Program fosters public-private partnerships between the government, research institutions, universities, and SMEs. It provides non-refundable funds that support collaborative R&D efforts between companies and private institutions, universities, or research centers. The Inter-American Development Bank and the Peruvian government fund the Program. An initial grant of \$36 million supported the Program from 2007 to 2011, and another \$100 million will fund the Program in its second phase.¹⁷³

Despite these laudable efforts, a 2011 report by the Commission of Science, Technology, and Innovation indicates that MES in Peru still have opportunity for improvement. The main conclusion of the report is that the role of innovation, R&D, and technology transfer to Peru's SMEs remains meager. The report found that Peru's SME policy remains fragmented, with insufficient coordination among universities, SMEs, and government agencies charged with innovation policy.¹⁷⁴ Peru must take additional steps to better support the productivity and innovation potential of its SME manufacturers.

CONCLUSION

Drawing on the success of manufacturing extension services in other parts of the world, LAC countries have increasingly adopted policies that support the competitiveness, productivity, and innovation potential of their SME manufacturers. Within LAC countries, manufacturing extension services represent a sharp contrast from policies of the past. Previous attempts to support manufacturing involved import substitution industrialization policies and supply-side efforts such as funding public R&D. Today, LAC countries operate manufacturing extension initiatives through decentralized agencies and horizontally organized programs based on the production demands of firms. These programs play an effective role in driving exports and SME integration into global supply chains, incentivizing training and technology transfer, and expanding technology-intense, manufacturing capital goods markets. According to the available empirical data, these programs increase worker productivity, boost exports, and “nudge” SMEs toward training, technology transfer, and R&D. The next step for LAC governments is to create more autonomous and targeted agencies to spearhead manufacturing extension services and policies, particularly for SMEs in high-tech sectors. Governments should not lose sight of the productivity potential of low- and medium-value producers, however. The appropriate policy mix acknowledges existing skills and production capacity while supporting the transition of SMEs to more advanced manufacturing. Leading countries address policy from a multifaceted perspective. They not only enhance operations “on the shop floor” through business development services, they seek additional opportunities for SMEs to grow through the adoption of cutting-edge technologies, innovation, and the commercialization of new products.

ENDNOTES

1. Gilberto Libanio, "Manufacturing Industry and Economic Growth in Latin America: A Kaldorian Approach" (mimeo, CEDEPLAR / Federal University of Minas Gerais, Brazil), http://www.policyinnovations.org/ideas/policy_library/data/01384/_res/id=sa_File1/Libanio_manufacturing.pdf.
2. Nilton Naretto, "Government Support for Small and Medium-Size Enterprise's Clusters in Brazil" (research paper, Institute of Brazilian Issues Minerva Program, The George Washington University School of Business and Public Management, December 2002), <http://www.gwu.edu/~ibi/minerva/Fall2002/Nilton.Naretto.pdf>.
3. Wilson Peres and Giovanni Stumpo, "Small and Medium-Sized Manufacturing Enterprises in Latin America and the Caribbean Under the New Economic Model," *World Development* 28, no. 9 (2000), <http://www.sciencedirect.com/science/article/pii/S0305750X00000462>.
4. Ibid.
5. Dani Rodrik, "Industrial Policy for the Twenty-First Century" (research paper, John F. Kennedy School of Government, September 2004), <http://www.hks.harvard.edu/fs/drodrik/Research%20papers/UNIDOSep.pdf>.
6. Sebastian Faudez, Nanno Mulder, and Nicole Carpentier, "Productivity Growth in Latin American Manufacturing: What role for international trade intensities" (MPRA Working Paper No. 36507, 2011).
7. Ibid.
8. DTZ Consulting, "Review of the Manufacturing Advisory Service and Research to Support the Business Case for Continuing and Developing the Manufacturing Advisory Service: Final Report," December 2010, 35.
9. The European Commission, "A Study of Business Support Services and Market Failure" (report, Foundation for SME Development, University of Durham, July 2002), 6, http://ec.europa.eu/enterprise/newsroom/cf/_getdocument.cfm?doc_id=4160.
10. DTZ Consulting, "Review of the Manufacturing Advisory Service."
11. Christian Martincus, Jeronimo Carballo, and Pablo Garcia, "Firm Size and the Impact of Export Promotion Programs" (Washington, DC: Inter-American Development Bank, 2010), http://www.international.gc.ca/economist-economiste/assets/pdfs/research/TPR_2010/Chapter6-eng.pdf.
12. Michael Gort and Steven Klepper, "Time Paths in the Diffusion of Product Innovations" *The Economic Journal* 92, no. 376 (1982): 630-653.
13. Charles Jones and John Williams, "Measuring the Social Return to R&D," *Quarterly Journal of Economics* 113, no. 4 (1998): 1119-1135; Edwin Mansfield, "Social Returns from R&D: Findings, Methods, and Limitations," *Research Technology Management* 34, no. 6 (1991): 24-27; Eric Brynjolfsson, Lauren Hitt, and Shinkyu Yang, "Intangible Assets: How the Interaction of Information Technology and Organizational Structure Affects Stock Market Valuations," *Brookings Papers on Economic Activity* 33 (January 2000): 137-199.
14. Robert D. Atkinson, "Effective Corporate Tax Reform in the Global Innovation Economy" (Washington, DC: ITIF, July 2009), http://www.itif.org/files/090723_CorpTax.pdf.
15. The Manufacturing Extension Partnership, "Delivering Measurable Results to Its Clients: Fiscal Year 2008 Results," National Institute of Standards and Technology, January 2010, 2, <http://www.nist.gov/mep/loader.cfm?csModule=security/getfile&pageid=1290761&bypasswarning=1>.
16. DTZ Consulting, "Review of the Manufacturing Advisory Service," 14.
17. Eric Oldsman, "Evaluating SME Programs: Learning from the NIST Manufacturing Extension Partnership" (presentation, Nexus Associates, Inc., Mexico City, September 23, 2004), 8, <http://info.worldbank.org/etools/docs/library/128766/OldsmanNISTMEPPProgram.pdf>.
18. The Manufacturing Extension Partnership, "Delivering Measurable Results," 2.
19. M. Piore and C.F. Sabel, *The Second Industrial Divide: New Possibilities for Prosperity* (New York: Basic Books, 1984).
20. Daniel Lederman and William F. Maloney, "R&D and Development" (World Bank Policy Research Working Paper No. 3024, April 2003), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=402480.

21. Bronwyn Hall, "Government Policy for Innovation in Latin America" (technical report, Regional Studies Program of the Office of the Chief Economist for Latin America, The World Bank, May 25, 2005), http://elsa.berkeley.edu/~bhhall/papers/BHH05_LAC_innov.pdf.
22. Philip Shapira, Jan Youtie, and Luciano Kay, "Building Capabilities for Innovation in SMEs: A Cross-Country Comparison of Technology Extension Policies and Programs," *International Journal of Innovation and Regional Development* 3-4 (2011): 254-272.
23. Ibid.
24. Stephen Ezell and Robert D. Atkinson, *International Benchmarking of Countries' Policies and Programs Supporting SME Manufacturers* (Washington, DC: ITIF, September 2011), <http://www.itif.org/files/2011-sme-manufacturing-tech-programss-new.pdf>.
25. Mauricio Moreira, "Fear of China: Is There a Future for Manufacturing in Latin America?" (LAEBA Working Paper No. 33, Inter-American Development Bank / Asian Development Bank, presented at the LAEBA Annual Conference, Beijing, December 2004), <http://www.iadb.org/intal/intalcdi/PE/2007/00493.pdf>.
26. Martin Abeles and Diego Rivas, "Growth versus development: different patterns of industrial growth in Latin America during the 'boom' years" (report, Commission Economica para America Latina, 2011), <http://www.cepal.org/publicaciones/xml/2/45182/DocW57fin.pdf>.
27. Robert Atkinson, Luke Stewart, Scott Andes and Stephen Ezell, *Worse than the Great Depression: What the Experts are Missing About American Manufacturing Decline* (Washington, DC: ITIF, March 2012), <http://itif.org/publications/worse-great-depression-what-experts-are-missing-about-american-manufacturing-decline>.
28. Juan Llisterri, *HGSMEs in Latin American Emerging Economies*.
29. Abeles and Rivas, "Growth versus development."
30. Shapira, Youtie, and Kay, "Building Capabilities for innovation in SMEs."
31. Interview with Petar Stojic, Former Head of Business Support Policy at UK Department for Business, Innovation, and Skills, May 27, 2011.
32. The European Commission, "A Study of Business Support Services and Market Failure," 7.
33. Phone interview with Dr. Rainer Jäkel, June 7, 2011.
34. Ibid.
35. USA National Innovation Marketplace, "How the National Innovation Marketplace Works" (video, uploaded May 13, 2012), http://www.youtube.com/watch?v=QnM2HCKL_aw&feature=youtube_gdata_player.
36. The Manufacturing Extension Partnership, "USA National Innovation Market Place," website (accessed May 10, 2011), <http://innovationsupplychain.com/>.
37. DTZ Consulting, "Review of the Manufacturing Advisory Service," 35.
38. Jason Charron, "Industrial Research Assistance Program (IRAP): Achieving SME growth through innovation and technology" (presentation, ITIF, September 14, 2011), 14, <http://www.itif.org/files/2011-sme-manufacturing-charron.pdf>.
39. Elisa Giuliani and Carlo Pietrobelli, "Upgrading in Global Value Chains: Lessons from Latin American Clusters," *World Development* 33, no. 4 (2005): 547-573.
40. Ibid.
41. Ibid.
42. Ministerio de Economía y Finanzas Públicas, "Presupuesto Nacional 2012," (Buenos Aires: Ministerio de Economía y Finanzas Públicas, 2012), 22, <http://www.mecon.gov.ar/onp/html/presupresumen/resum12.pdf>.
43. Shapira, Youtie, and Kay, "Building Capabilities for innovation in SMEs."
44. Authors' calculations based on World Bank GDP data and countries' investment in MES programs as compiled for this report.
45. Sebrae, "Serviço Brasileiro de Apoio às Micro e Pequenas Empresas," website (accessed June 10, 2012), <http://www.sebrae.com.br/customizado/sebrae/institucional/quem-somos/estrutura-de-atendimento>.
46. Pablo Angelelli, Rebecca Moudry, and Juan José Llisterri, "Institutional Capacities for Small Business Policy Development in Latin America" (Sustainable Development Department Technical paper series, Inter-American Development Bank, Washington, DC, December 2006), <http://www.iadb.org/intal/intalcdi/PE/2010/07027.pdf>.

47. Bronwyn Hall, "Government Policy for Innovation in Latin America."
48. Giuliani and Pietrobelli, "Upgrading in Global Value Chains."
49. Ibid.
50. Ibid.
51. Pablo Ibararan, Alessandro Maffioli, and Rodolfo Stucchi, "SME Policy and Firms' Productivity in Latin America" (IZA Discussion Paper No. 4886, Bonn, Germany, October 2009), <http://ftp.iza.org/dp4486.pdf>.
52. Ibid.
53. Ibararan, Maffioli, and Stucchi, "SME Policy and Firms' Productivity in Latin America."
54. Claudio Bonilla, Christian Cancino, and Marcos Vergara, "Productivity Development or Social Policy? The Impact of the Seed Capital Program of SERCOTEC in Chile" (Washington, DC: Inter-American Development Bank, 2011).
55. Kristian Thorn, "Science, Technology and Innovation in Argentina" (working paper, World Bank Latin American and Caribbean Region Department for Human Development, September 2005), <http://siteresources.worldbank.org/INTARGENTINA/Resources/ScienceTechnologyandInnovationInArgentina.pdf>.
56. Jose Benavente and Gustavo Crespi, "The Impact of an Associative Strategy (the PROFO Program) on Small and Medium Enterprises in Chile" (SPRU Electronic Working Paper No. 88, SPRU—Science and Technology Policy Research, University of Sussex, June 2003), <http://ideas.repec.org/p/sru/ssewps/88.html>.
57. Manuel Agosin, Christian Larrain, and Nicolas Grau, "Industrial Policy in Chile" (IDB Working Paper Series No. 170, 2010).
58. Ibid.
59. Ibid.
60. Victoria Cassillo et al., "Can SME Policies Improve Firm Performance? Evidence from an Impact Evaluation in Argentina" (IDB OVE Working Paper No. 6, December 2010), http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1848984.
61. Ibid.
62. Angelelli, Moudry and Llisterri, "Institutional Capacities for Small Business Policy Development."
63. Gladys Acevedo and Hong Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean* (Washington, DC: World Bank, April 2010), <http://www.iadb.org/intal/intalcdi/PE/2010/05674.pdf>.
64. Angelelli, Moudry and Llisterri, "Institutional Capacities for Small Business Policy Development."
65. Ibid.
66. Hugo D. Kantis and Juan S. Federico, "Entrepreneurial Ecosystems in Latin America: the role of policies" (report, Entrepreneurial Development Programme—Institute of Industry, Universidad Nacional de General Sarmiento, 2012), http://www.kauffman.org/uploadedfiles/irpr_2012_kantis.pdf.
67. Ibid.
68. Angelelli, Moudry and Llisterri, "Institutional Capacities for Small Business Policy Development."
69. Kantis and Federico, "Entrepreneurial Ecosystems in Latin America."
70. Ibid.
71. Jose Miguel Benavente and Alessandro Maffioli, "Public Support to Firm's Innovation: The Chilean FONTEC Experience" (report, Sixth Conference on Micro Evidence on Innovation in Developing Economies, March 2007), http://www.merit.unu.edu/MEIDE/papers/2007/BENEVENTE_MAFFIOLI_Public%20support%20to%20firm's%20innvation_the%20Chilean%20FONTEC%20experience.pdf.
72. Bronwyn H. Hall and Alessandro Maffioli, "Evaluating the Impact of Technology Development Funds in Emerging Economies: Evidence from Latin-America" (NBER Working Paper No. 13835, Cambridge, MA, March 2008), http://www.nber.org/papers/w13835.pdf?new_window=1.
73. SMEs make up 85 percent, and one half of those were in the manufacturing sector. See: Benavente and Maffioli, "Public Support to Firm's Innovation."
74. Benavente and Maffioli, "Public Support to Firm's Innovation."
75. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
76. Elizabeth Balbachevsky and Antonio Botelho, "Science and Innovation policies in Brazil: a framework for analysis of change and continuity" (paper presented to the IPSA-ECPR Joint Conference: Whatever

-
- Happened to North-South?, University of Sao Paulo, February 2011), http://www.fllch.usp.br/dcp/assets/docs/ElizabethB/IPSA2011__Balbachevsky_and_Botelho.pdf.
77. Hall and Maffioli, "Evaluating the Impact of Technology Development Funds in Emerging Economies."
 78. Ibid.
 79. Kantis and Federico, "Entrepreneurial Ecosystems in Latin America."
 80. Angelelli, Moudry and Llisterri, "Institutional Capacities for Small Business Policy Development."
 81. Ibid.
 82. Ibid.
 83. Jacint Jordana, Christian Martincus, and Andres Gallo, *Export Promotion Organizations in Latin America and the Caribbean: An Institutional Portrait* (Washington, DC: Inter-American Development Bank, August 2010), <http://idbdocs.iadb.org/wsdocs/getdocument.aspx?docnum=35340242>.
 84. Ibid.
 85. Ibid.
 86. Irani Arraiz, Rodolfo Stucchi, and Francisca Henriquez, "Impact of the Chilean Supplier Development Program on the performance of SME and their large firm customers" (Washington, DC: Inter-American Development Bank, May 1, 2011).
 87. Ibid.
 88. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 89. Arraiz, Stucchi, and Henriquez, "Impact of the Chilean Supplier Development Program."
 90. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 91. Benavente and Crespi, "The Impact of an Associative Strategy (the PROFO Program)."
 92. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 93. Benavente and Crespi, "The Impact of an Associative Strategy (the PROFO Program)."
 94. United Nations, "Innovation Gaining Market Share and Fostering Social Inclusion: Success Stories in SME Development" (Washington, DC: The Inter-American Development Bank, 2011).
 95. Ibid.
 96. Peres and Stumpo, "Small and Medium-Sized Manufacturing Enterprises."
 97. Martincus, Carballo, and Garcia, "Firm Size and the Impact of Export Promotion Programs."
 98. Ibid.
 99. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 100. PROCHILE, "Chile's National Agency for Export Promotion," website (accessed June 10, 2012), www.prochile.cl.
 101. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 102. Angelelli, Moudry and Llisterri, "Institutional Capacities for Small Business Policy Development."
 103. Martincus, Carballo, Pablo Garcia, "Firm Size and the Impact of Export Promotion Programs."
 104. Bonilla, Cancino, and Vergara, "Productivity Development or Social Policy?"
 105. National Institute of Standards and Technology, "Manufacturing Extension Partnership: Making an Impact on U.S. Manufacturing" (Washington, DC: National Institute of Standards and Technology, January 2012), <http://www.nist.gov/mep/upload/MEP-PARTNERING-IMPACTS-2011-v2.pdf>.
 106. Ibid.
 107. Ezell and Atkinson, *International Benchmarking of Countries' Policies and Programs*.
 108. Ibid.
 109. Ibid.
 110. Bill Dobson, "NRC Industrial Research Assistance Program (NRC-IRAP) Overview" (presentation, Industrial Research Assistance Program, Toronto, June 1, 2011), <http://www.slideshare.net/webgoddesscathy/industrial-research-assistance-program-nrcirap-innovation-information-forum>.
 111. Chiara Criscuolo, Ralf Martin, Henry Overman, and John Van Reenen "The Effects of Industrial Policy on Corporate Performance: Evidence from Panel Data" (London: Center for Economic Performance, London School of Economics, 2007).
 112. R. Alvarez and G. Crespi, "Exporter Performance and Promotion Instruments: Chilean Empirical Evidence," *Estudios de Economía* 27, no. 2 (2000): 225–241.
 113. Benavente and Crespi, "The Impact of an Associative Strategy (the PROFO Program)."

-
114. D. Chudnovsky, A. Lopez, M. Rossi, and D. Ubfal, "Evaluating a Program of Public Funding of Private Innovation Activities. An Econometric Study of FONTAR in Argentina." (IDB OVE Working Paper No. 16, December 2006).
 115. H. Tan and G. Lopez-Acevedo, "How Well Do Small and Medium Enterprise Programs Work? Evaluating Mexico's SME Programs Using Panel Firm Data" (Washington, DC: World Bank, 2007).
 116. Bonilla, Cancino, and Vergara, "Productivity Development or Social Policy?"
 117. Acevedo and Tan, *Impact Evaluation of SME Programs in Latin American and Caribbean*.
 118. Hall and Maffioli, "Evaluating the Impact of Technology Development Funds in Emerging Economies."
 119. Ibid.
 120. European Commission, "Mid Term Review of the Country Strategy of 2007-2012 and National Indicative Programme 2011-2013: El Salvador," 2012.
 121. According to Angelelli et al. in particular, the evaluation design should clearly identify: "(i) a detailed assessment of the rationale behind the particular policy tool adopted, including a description of the country's specific market failures that the instrument would be addressing, and the rationale of the specific selection mechanism adopted (i.e., the targeting of the instrument); (ii) the identification of the short, medium and long run expected outcomes; (iii) the periodic collection of primary data on the programs' beneficiaries and on a group of comparable non-beneficiaries; (iv) the repetition of the impact evaluation on the same sample of beneficiaries and non-beneficiaries so that long run impacts can be clearly identified; and (v) the periodic repetition of the impact evaluation on new samples of beneficiaries and non-beneficiaries in order to identify potential needs of re-targeting of policy tools." See: Angelelli, Moudry and Llisterra, "Institutional Capacities for Small Business Policy Development."
 122. For examples, see reports such as: National Institute of Standards and Technology, "Manufacturing Extension Partnership: Making an Impact on U.S. Manufacturing"; DTZ Consulting, "Review of the Manufacturing Advisory Service," 35.
 123. Matt Moffett, "Taxes Put Chill on Electronics," *Wall Street Journal*, February 27, 2012, <http://online.wsj.com/article/SB10001424052970204778604577239361549940608.html?KEYWORD S=Argentina#printMode>.
 124. World Bank, GDP for 2010 in current US dollars (country indicators: Argentina; accessed June 20, 2012), <http://data.worldbank.org/country/argentina>.
 125. Ministerio de Economía y Finanzas, "Presupuesto del Ministerio de Industria para el año 2012," (Buenos Aires: Ministerio de Economía y Finanzas, 2012), 10, <http://www.mecon.gov.ar/onp/html/presutexto/ley2012/jurent/pdf/D12E608.pdf>.
 126. Secretaría de la Pequeña y Mediana Empresa, "Motor de la Industria y el Empleo" (Buenos Aires: Ministerio de Industria), <http://www.sepyme.gob.ar/#>.
 127. Ministerio de Economía y Finanzas, "Presupuesto del Instituto Nacional de Tecnología Industrial para el año 2012," (Buenos Aires: Ministerio de Economía y Finanzas, 2012), <http://www.mecon.gov.ar/onp/html/presutexto/ley2012/jurent/pdf/D12E608.pdf>.
 128. Ministerio de Economía y Finanzas, "Presupuesto del Ministerio de Ciencia, Tecnología e Innovación Productiva para el año 2012," (Buenos Aires: Ministerio de Economía y Finanzas, 2012), <http://www.mecon.gov.ar/onp/html/presutexto/ley2012/jurent/pdf/D12J71.pdf>.
 129. The definition of low use of technology is adopted from the OECD from its 2001 International Industrial Standard Classification. Secretaría de Ciencia, Tecnología e Innovación Productiva, *Industria Manufacturera: Análisis del Comercio Exterior según su Intensidad Tecnológica* (Buenos Aires: Ministerio de Educación, Ciencia y Tecnología, 2007), 5.
 130. Ibid.
 131. World Bank, GDP for 2010 in current US dollars (country indicators: Brazil; accessed June 20, 2012), <http://data.worldbank.org/country/brazil>.
 132. Instituto Brasileiro de Geografia e Estatística, "Estatísticas do Cadastro Central de Empresas 2009," (Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística, 2011), 62.
 133. It is worth mentioning that several relevant federal agencies are involved in their activities such as the Ministry of Development, Industry and Trade; Funding Agency for Studies and Projects (FINEP), Economic and Social Development National Bank (BNDES), etc. See "Serviço Brasileiro de Apoio às

-
- Micro e Pequenas Empresas,” accessed June 20, 2012,
<http://www.sebrae.com.br/customizado/sebrae/institucional/quem-somos/conselho-deliberativo-nacional>.
134. SEBRAE 2011 Budget. Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, Composição Das Receitas Do Sistema Sebrae – 2012, Serviço Brasileiro de Apoio às Micro e Pequenas Empresas, <http://www.sebrae.com.br/customizado/orcamento-do-sistema-sebrae/1-2012%20Composicao%20da%20Receita.pdf>.
 135. This number corresponds to the “industry” division of SEBRAE. “Serviço Brasileiro de Apoio às Micro e Pequenas Empresas,” accessed June 20, 2012,
<http://www.sebrae.com.br/customizado/sebrae/institucional/grandes-setores-de-atuacao/industria>.
 136. SEBRAE has an Academy of Entrepreneurs which works as an open school and offers entrepreneurship education. See “Serviço Brasileiro de Apoio às Micro e Pequenas Empresas,” accessed June 20, 2012,
<http://www.sebrae.com.br/customizado/sebrae/institucional/como-trabalhamos/produtos-e-servicos>.
 137. Elizabeth Balbachevsky and Antonio Botelho, “Science and Innovation policies in Brazil.”
 138. Ministério do Planejamento, “Orçamento e Gestão, Orçamento Anual De 2012, Volume IV,” (Brasília: Ministério do Planejamento, Orçamento e Gestão, 2012) , 93, ,
http://www.planejamento.gov.br/secretarias/upload/Arquivos/sof/orcamento_12/L12595_12_Volume_IV.pdf.
 139. World Bank, GDP for 2010 in current US dollars (country indicators: Costa Rica; accessed June 20, 2012), <http://data.worldbank.org/country/costa-rica>.
 140. Ministerio de Economía, Industria y Comercio, “Estudio Oferta de Crédito para la Pyme en Costa Rica en 2011” (San Jose: Dirección General de Apoyo a la Pequeña y Mediana Empresa, 2012), 3,
http://pymes.elfinancierocr.com/sites/default/files/estudio_credito_pymes.pdf.
 141. Ministerio de Economía, “Industria y Comercio, Presupuesto 2012,”(San Jose: Ministerio de Economía, Industria y Comercio, 2012),
http://www.meic.go.cr/index.php?option=com_content&view=article&id=515&Itemid=254.
 142. World Bank, GDP for 2010 in current US dollars (country indicators: Chile; accessed June 20, 2012), <http://data.worldbank.org/country/chile>.
 143. Mike Goldberg and Eric Palladini, “A Strategy to Promote Innovative Small and Medium Enterprises” (World Bank Policy Research Working Paper No. 4518, 2008), 9.
 144. Ibid., 10.
 145. Dirección de Presupuestos, “Ley de Presupuestos del Sector Público años 2012,” (Santiago: Ministerio de Hacienda, 2012), 235.
 146. Goldberg and Palladini, “A Strategy to Promote Innovative Small and Medium Enterprises,” 9.
 147. Acevedo and Tan, *Impact Evaluation of SMEs Programs in Latin America and Caribbean*, 35.
 148. Ibid.
 149. Joint USG-GOES technical team, “Partnership for Growth: El Salvador Constraints Analysis” (report, U.S. Embassy of the United States, July 2011),
http://photos.state.gov/libraries/elsalvador/92891/PFG/ES%20Constraints_Analysis.pdf.
 150. Ibid.
 151. United Nations Conference on Trade and Development, *Science, Technology and Innovation Policy Review: El Salvador* (Geneva: United Nations, 2011).
 152. Merlin Lopez, *Information and Communication Technology (ICT) for development of small and medium-sized exporters in Latin America: El Salvador* (Santiago: United Nations, December 2005),
<http://www.cepal.org/publicaciones/xml/5/26935/SW-50-ElSalvador.pdf>.
 153. Ibid.
 154. Manufacturing Task Force, “Vision 2030 Jamaica: Manufacturing Sector Plan 2009-2030” (report, Planning Institute of Jamaica, 2009).
 155. Ibid.
 156. Ibid.
 157. “Manufacturing Sector at a Glance,” Jamaica Promotions Corporation (JAMPRO) webpage (2007),
<http://www.jamaicatradeandinvest.org/index.php?action=investment&cid=1&oppage=1&optyp=mm>.
 158. Ibid.
-

-
159. "Incentive Programs: Export Industry Encouragement Act," Jamaica Business Development Corporation webpage (2011),
http://www.jbdc.net/index.php?option=com_content&view=article&id=66&Itemid=76.
 160. David Tennant, "Policy Report for the Jamaican MSME Sector: Policy Suggestions for Improved Financing and Enhanced Human Resource Development for Jamaican Micro, Small, and Medium Enterprise Sector," *Private Sector Development Programme*, 2008.
 161. Ibid.
 162. Ibid.
 163. World Bank, GDP for 2010 in current US dollars (country indicators: Mexico; accessed June 20, 2012),
<http://data.worldbank.org/country/mexico>.
 164. The composition is 95.7 percent for micro enterprises, 3.5 percent small, 0.6 percent medium, and 0.2 percent large. "Instituto Nacional de Estadística y Geografía," Censo Económico website (accessed June 20, 2012),
<http://www.inegi.org.mx/est/contenidos/espanol/proyectos/censos/ce2009/saic/default.asp?s=est&c=17166>.
 165. Secretaría de Hacienda y Crédito Público, "Informe de la Cuenta Pública 2011," (México City, Secretaría de Hacienda y Crédito Público, DF, 2012), 316.
 166. Ibid.
 167. Secretaría de Economía, "Quinto Informe de Labores 2011," (Mexico City: Secretaría de Economía, México DF, 2011), 40.
 168. National Institute of Statistics and Informatics of Peru, GDP per sector 2010; World Bank, GDP for 2010 in current US dollars (country indicators: Peru; accessed June 20, 2012),
<http://data.worldbank.org/country/peru>.
 169. Instituto Nacional de Estadística e Informática, "IV Censo Económico de Perú, 2008," (Lima: Instituto Nacional de Estadística e Informática, 2010)
<http://desa.inei.gob.pe/cenec2008/redatam/?id=ResultadosCensales#>.
 170. Comisión Consultiva para la Ciencia, Tecnología e Innovación, *Nueva política e institucionalidad para dinamizar la CTI peruana* (Lima: Comisión Consultiva para la Ciencia, Tecnología e Innovación, 2012), 12.
 171. Ibid.
 172. In 2011, the law in Peru determined that the ministry of Labor and Employment Promotion will no longer be in charge of SME programs.
 173. Fondo de Innovación, "Ciencia y Tecnología," (program cost and financing; accessed June 20, 2012)
<http://www.fincyt.gob.pe/web/costoyfinanciamiento.html>.
 174. Ibid., 11.

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ABOUT THE AUTHORS

Scott Andes was a Research Analyst at The Information Technology and Innovation Foundation with research areas including emerging markets, competitiveness metrics, technology development, and manufacturing. Mr. Andes is now a Senior Policy Analyst at the Brookings Metropolitan Policy Program, where his work focuses on advanced industries, innovation and technology, and economic development. Mr. Andes received a BSc from the London School of Economics and is currently completing graduate studies at Carnegie Mellon University.

Stephen Ezell is a Senior Analyst at the Information Technology and Innovation Foundation, with a focus on international information technology competitiveness and national innovation policies. Mr. Ezell holds a B.S. from the School of Foreign Service at Georgetown University, with an Honors Certificate from Georgetown's Landegger International Business Diplomacy program. He is the co-author with ITIF President Dr. Robert Atkinson of *Innovation Economics: The Race for Global Advantage* (Yale University Press, September 2012).

Jesus Leal is an independent consultant. His research areas include social and economic development, antipoverty policy, and national security. Mr. Leal received a BSc in Political Science and International Relations from the Center for Research and Teaching in Economics (CIDE) in Mexico City and is currently completing graduate studies at Carnegie Mellon University.

ABOUT ITIF

The Information Technology and Innovation Foundation (ITIF) is a Washington, D.C.-based think tank at the cutting edge of designing innovation strategies and technology policies to create economic opportunities and improve quality of life in the United States and around the world. Founded in 2006, ITIF is a 501(c) 3 nonprofit, non-partisan organization that documents the beneficial role technology plays in our lives and provides pragmatic ideas for improving technology-driven productivity, boosting competitiveness, and meeting today's global challenges through innovation.

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