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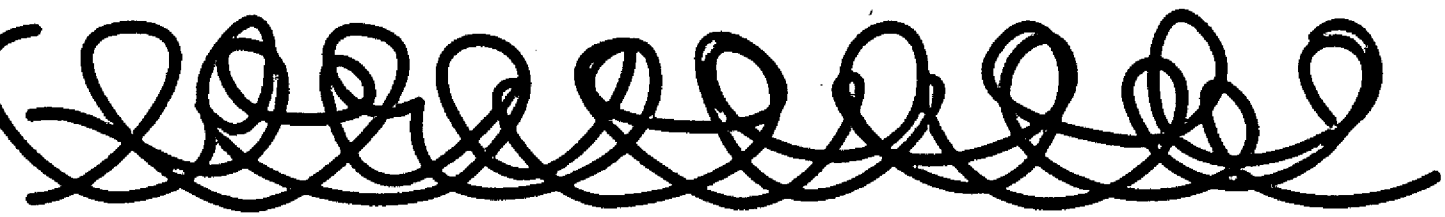
Industrial Development Report 2005
Background Paper Series

Measuring the Demand of Trade-Related Technological Public Goods in Argentina



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Industrial Development Report 2005 Background Paper Series

Measuring the Demand of Trade-Related Technological Public Goods in Argentina

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July 2005

Office of the Director-General

This series includes the background papers commissioned to cover specific aspects addressed in the Industrial Development Report 2005 "Capability building for catching-up – Historical, empirical and policy dimensions". The digital versions are available, together with the full report, on the IDR 2005's website at www.unido.org/idr.

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Executive Summary

This paper inquires into two important aspects related to trade capacity building in Argentina. It first explores manufacturing firms' strategies regarding quality development, management and assurance and trade capacity, and the microeconomic and macroeconomic drivers of their decisions to invest in trade capacity. Second, it addresses the development and application of a metric for the exporters' demand of trade-related technological public goods that can help them comply with standards and technical regulations in mature economies.

The analysis of the first aspect is based on an *ad hoc* survey on the Argentine exporters costs of compliance with foreign STRs and on the qualitative determinants of the decisions to invest in quality and standard compliance. It also relies on secondary information on firm-level and industry-level investments in quality development, assurance, management and certifications.

The main findings in this respect are:

- Total exports appear to lead quality-related investments in all kinds of activities, including non-tradables. Moreover, total exports appear to matter more than manufacturing exports per se in seeking certifications. These investments show no correlation with indicators of activity in the domestic market.

- Large firms have a greater propensity to invest in quality development, management, and assurance than small firms.

- Firms with at least a small participation of foreign capital appear to be significantly more inclined to develop quality systems.

To construct a metric for the exporters' demand of trade-related technological public goods we have adapted a methodology developed by Popper et al (2005) at RAND Institution for the measurement of the trade losses caused by technical barriers to trade. The measurement relies on the calibration of a partial-equilibrium model for exports, which allows the estimation of the producer surplus that exporters have to forgo because of incremental costs of compliance with foreign STRs. This forgone producer surplus is interpreted as the revealed demand for trade-related TPGs. In the paper we discuss the strengths and weaknesses of the proposed methodology, and the methodological insights that are gained.

This methodology is used to measuring the revealed demand for TPGs in Argentina. The assumptions made regarding export market structures bias the estimations upwards, while the characteristics of the firms that report the costs of compliance push the estimations downwards. The net result suggests that there is a large scope for the provision of trade-related TPGs with positive net social benefits, both at an aggregate level and in precisely defined areas.

The main findings of this second part of the analysis are:

- The upper bounds of the demands for TPGs (present discounted value of the trade losses due to STRs) for the 4-digit industries to which the surveyed firms belong range from US$ 0.9 million for leather shoes to US$ 17.4 million for refined fuel, in the case where the standards apply only to current exports to the US and the EU. These demands would rise to the range of US$ 1.7 million (fitness machines) – US$ 129.3 million (refined fuel) in case the standards were extended to all other markets.

- These estimated trade losses (demands for TPGs) represent between 0.9 percent of the value of exports for refined fuels and 5.4 percent for leather shoes.

- If we extrapolated these losses to the total exports to the US and the EU, the aggregate demands for TPGs would reach to up to US$ 209 million. If instead we extrapolated these trade losses to total exports to all destinations, the aggregate demand for trade-related TPGs would reach to up to US$ 1488 million (about 2.4 percent of the present discounted value of total exports).

- The demands for economy-wide and some industry-wide trade-related TPGs exceed the available estimates on the costs of provision for these TPGs.

- The application of this methodology to estimate the net social benefits of specific trade-related TPGs suggests that there is large scope for investing in this type of capabilities. For instance, the estimated lower bound of the benefits of making available laboratories for private tests of EMI standards is six times bigger than the cost.

Introduction

This paper seeks to estimate the revealed demand of Argentine exporters for technological public goods (TPGs) that help them comply with the product and process standards and technical regulations that are required to enter the markets of mature economies like the EU and the US. The ultimate goal is to estimate the social costs and benefits from investing in the provision of such TPGs.

The capability of developing countries to engage in international trade is conditioned by the application of product and process standards and technical regulations in rich countries. As tariff and quota barriers to trade in agricultural, food, and manufactured products continue to decline due to the proliferation of multilateral trade agreements, increasing public debate is taking place regarding the impact of product and process standards and technical regulations. STRs have become a more common, though subtler, form of protection. Standards and technical regulations, be it for products, labor, or the environment, are applied to mitigate health and environmental risks, to prevent deceptive practices, and to reduce transaction costs in business by providing common reference points for notions of 'quality', 'safety', 'authenticity', 'good practice', and 'sustainability' (World Bank). The 1947 GATT accord allowed the use of minimum standards to protect human, animal and plant health, as well as bring order to the market. The World Trade Organization (WTO) established that standards can differ from internationally accepted levels only when there is scientific evidence supporting the decision. Depending upon the particular industry or market circumstances, standards and technical regulations can either raise or lower economic efficiency; promote or block competition; facilitate or constrain international trade; and enable or exclude the participation of the poor in remunerative economic activities.[4]

Leaving aside the fact that in most cases standards and technical regulations are reasonable demands of consumers from rich countries, the fact of the matter is that firms in developing countries may bear relatively larger costs in meeting their requirements than their counterparts in developed nations. This asymmetry arises from differences in technological infrastructure across countries and from the relatively weaker capabilities that developing countries have to prove the equivalence between domestic and rich countries' technical regulations or the international validity of local tests and certifications. Hence the need to invest in the provision of technological public goods, which in turn demands a careful evaluation of their net social benefits.

The World Bank Technical Barriers to Trade Survey (WBTBTS) suggests that the average costs of compliance in developing countries range between 0.26 percent of sales for Photographic and Optical Instruments to 11.21 percent of sales for Fabricated Metals. The average and median costs respectively are 4.44 percent and 3.17 percent. The reported costs include one-time fixed costs (like machine re-tooling, new equipment, etc.), recurrent fixed costs (like the operation of improved quality control systems, periodical certifications, etc.) and variable costs (like using more expensive raw material and inputs, or more expensive labeling and packaging). Higher fixed costs raise the probability that exporters may be unable to enter (or be forced to leave) certain markets, while higher variable costs reduce export shares (and the net price to exporters). Both types of expenditures will cause trade costs in the form of fully forgone producer surplus (when exporters have to leave or cannot enter a given market) or partial losses (when marginal exporters are forced to leave, and infra-marginal exporters endure partial reductions in their producer surpluses).[5]

This paper addresses the costs of compliance for Argentine exporters, and the ensuing trade losses (forgone producer surplus). These are used to assay the exporters' demands for TPGs that

reduced these costs. The costs of providing specific trade-related TPGs are then compared with the ensuing benefits.

Trade-related TPGs relate to the capability to satisfy requirements in the areas of metrology, conformity assessment and public standards. These capabilities require a vast range of technological facilities, programs and institutions, including an adequate endowment of accredited and technologically updated testing and calibration laboratories; an internationally accredited local infrastructure of accreditation and certification; knowledge creation research institutes; training, financial and technical assistance to private firms that seek to comply with standards and technical regulations; standard harmonization; an adequate endowment of technological labor force; prevention/elimination of plagues and diseases; and institutional dynamic capabilities to deal with, and anticipate, the frequent changes in foreign STRs.

A sufficient provision of these TPGs may significantly reduce private firms' costs of STR compliance, thus increasing export competitiveness. It would additionally supply tools for technological upgrading and for improvement of managerial practices and quality control, assurance and management, that further enhance competitiveness. These goods are largely public in nature: their social benefits exceed their costs, and they are non-excludable.[6] It should be mentioned that what matters is not only the "physical" provision of technological infrastructure, but also the management of the existing institutions and programs, which have an important bearing on TPGs-related dynamic capabilities.

The specific questions this paper seeks to shed light on are:

- What are the firms' strategies for quality development, management and assurance and trade capacity-building in a developing country like Argentina?
- What are the microeconomic and macroeconomic drivers of the decisions to invest in trade capacity by private firms?
- What are the costs for Argentine firms of complying with domestic and foreign standards and technical regulations?
- What is the exporters' valuation of TPGs that reduce the trade losses caused by foreign standards and technical regulations?
- How does this valuation compare to the costs of providing these TPGs? Is it there an economic case for the provision of TPGs that enhance trade capacity?

In order to shed light on these issues we conducted a survey of Argentine exporters of different manufactures of agricultural and industrial origins, where we inquire on the costs of complying with basic quality requirements and with the different STRs at home and in the US and the EU. We also ask them for qualitative information regarding the factors that drive, facilitate or obstruct their decisions to invest in quality development and management and in compliance with standards and technical regulations, and on their perceptions regarding the adequacy of the provision of TPGs.[7]

This primary information is complemented with secondary information on quality development, management and certifications from the Normalization Institute (IRAM), the National Institute of Industrial Technology (INTI), and several surveys conducted by the National Institute of Statistics and the Census (INDEC). This information is used to provide answers to the first three questions, both through statistical analysis and through an appraisal of the qualitative responses of the surveyed firms.

Then an adapted methodology developed at the RAND Institution (Popper et al., 2005) for the measurement of the trade losses for Argentine exporters caused by foreign standards is

applied. The measurement relies on the calibration of a partial equilibrium model for exports in a given industry, using as inputs information on one-time and recurring fixed and variable costs of compliance, export prices, volumes and values of exports of that industry to the markets applying the standards. We use as inputs both the primary information on costs of compliance relative to exports as provided by the surveyed firms and secondary information on trade statistics for different export markets, obtained from public sources in Argentina, the US and the EU. The estimated trade losses can then be interpreted as the industry-wide and economy-wide demands (or willingness to pay) for TPGs that bring the costs of compliance with foreign standards to zero. These demands can then be compared to the estimated costs of setting up a trade capacity infrastructure.

This methodology is further used to estimate the social benefits from having access to specific TPGs. For instance, we estimate the trade losses associated to certain specific requirements (like ISO 9001 certifications, or electromagnetic interference (EMI) technical regulations for electric machinery) that would obtain in the cases where the TPGs that facilitate compliance (local infrastructure of certification, laboratories for private tests of EMI standards) are available and where they are not. The difference in the trade losses arising in both scenarios is interpreted as the willingness to pay for that specific TPG. This valuation of the TPGs can then be compared with its cost of provision to assay whether it yields a positive net social benefit or not.

The paper is structured as follows:

Section II provides some background information on the recent performance of Argentine exports of manufactured goods and on their competitiveness, together with a preliminary appraisal of the incidence of the foreign standards and technical regulations on the dynamic performance of exports.

Section IIII presents the findings regarding firms' strategies towards quality and trade capacity-building.

Section IV quantifies the costs of complying with basic quality requirements and with domestic and foreign standards and technical regulations for the surveyed firms.

Section V estimates the exporters' valuations of trade-related TPGs, and compares them to their costs of provision.

Section VI complements these estimations with an appraisal of the possible mismatches between the supply and demand of an specific TPG (testing and calibration laboratories).

Technical requirements to trade and infrastructure for trade capacity

There are three types of technical requirements to trade: public standards, proprietary standards and technical regulations. These requirements cover the areas of product safety, metrology, product and process standardization, conformity assessment and documentation.

Compliance with public standards is not legally compulsory, but it is usually demanded by consumers in order to reduce problems of asymmetric information, credibility and reputation. Typical public standards are the certifications of quality management systems (ISO 9001), of environmental management systems (ISO 14001), of food innocuity (HACCP), of good manufacturing practices, of good agricultural practices, and many other general and product- and process-specific norms.

Public standards eventually become sufficiently widespread and scientifically founded, and are then transformed into technical regulations that are legally compulsory. There are of course many technical regulations that were not previously public standards. Typical examples of technical regulations include the electrical safety regulations set by the CE policy of the EU (these technical regulations were often previously public standards set by the International Electrotechnical Commission), the sulfur content of refined fuels (set by national governments), the ban on the manufacture and use of freon, and most of the sanitary and phitosanitary barriers to food imports, to name but a few.

Proprietary standards on processes and products are set by an specific client in a foreign market, and need not extend to other sales in this foreign market.

The key components of this infrastructure include: a) a metrology system to ensure that the results of tests and measurements are traceable to the International System of Units and are performed correctly; the institutions that make up the metrology system include the Bureau of Legal Metrology and a set of accredited public and private laboratories for tests, calibration and microbiological and clinical analysis, and accredited inspection bureaus, b) an accreditation system to ensure that conformity assessments systems are monitored and meet international requirements, and c) a national documentary standards body to develop or adopt requirements for products, processes and systems that are consistent with those adopted in mature economies; the national documentary standards body includes the national bureau of normalization, and the national system of norms, quality and regulation.

To these three components an internationally accredited local certification infrastructure should be added. We may also include the need for trade-related knowledge-creation institutions that interact with private firms in the generation of know-how for complying with foreign STRs. These knowledge-creation institutions typically include the research agendas and capabilities of the food safety agency, of the national institutes of industrial and agricultural technologies, of the university-enterprise cooperation endeavors, and so on.

A key feature of the trade-related technological infrastructure is its dynamic capability to deal with the fast-changing technical requirements in mature economies. This dynamic capability is conditioned by the budgets, availability of skills, managerial practices and agendas of the institutions that make up the trade capacity infrastructure[8].

Firms' strategies for complying with quality requirements and trade capacity-building

Diffusion of quality management, control and assurance and of certification with general and product-specific norms among Argentine manufacturing firms

The commitment to quality development, assurance and management, together with compliance with general and product-specific norms, appears not to be sufficiently widespread among Argentine manufacturing firms.

The National Survey on Innovation and Technological Behavior of Argentine firms shows that in 2001 fewer than 30 percent of manufacturing firms had certified quality management systems, and fewer than 60 percent had quality control points (see Table 1).

Table 1
Quality Management Systems (1998/2001)

Firms that have or use:	Quantity	Percentage of total panel (1688)
Quality control points	982	58.2
Follow up spreadsheets in each control point	701	41.5
Frequency distributions	*311*	
Cause-effect diagrams	*242*	
Control of variables graph	*414*	
Attributes statistical control	*376*	
Pareto diagrams	*228*	
Certified quality management systems:	495	29.3
General norms	415	24.6
Sector specific norms	174	10.3
Certified products	211	12.5

Source: UNIDO based on Encuesta Nacional de Innovación y conducta tecnológica de las empresas argentinas. 1998/01, INDEC.

These low levels of commitment to quality development and management reinforce the view that a large number of manufacturing firms may be lacking the technological capabilities to export goods that are subject to stringent standards and technical regulations in mature economies.

The role of quality development, control, assurance and management within the organization

Most firms, except for the largest and more established ones, do not appear to assign a distinctive role to quality management and development within their organizational structure, budget and management.

The way firms replied to the survey revealed a great degree of dispersion in their attitudes towards quality development and management. A few firms provided very detailed information, identifying their expenses in quality development and management, and in compliance with public and proprietary foreign standards and technical regulations. Many of the firms limited themselves to providing some aggregate information on the overall expenses in complying with documentary standards, product certifications, quality development and so on. Some firms only provided information on the costs of certifying ISO 9001 and 14001 norms. It was also observed that two comparable firms within a same industry (dairy products) had different views regarding what types of expenditures should be assigned to quality development and management, and to compliance with domestic and foreign standards and technical regulations.

In no case was it possible to obtain an immediate response to the survey. The most frequent explanation for this delay is that detailed information on these costs is not readily available, as firms do not carry separate budgets for their activities in the areas of quality development, quality control and quality management systems. These expenses are usually allocated to separate areas such as human resource management, R&D, purchases of inputs, investment, logistics, marketing (packaging and labeling), and so on.

The microeconomic drivers of trade capacity-building and quality investment

The motivation or advantage of certifying these quality management system norms comes from two sources. First, from the contribution of these certifications to enhance the reputation and the credibility of the certified firms. Second, from their contribution to increased productivity when they are used as a tool to improve production processes.

For the first advantage (enhanced reputation and credibility) to actually occur, the compliance effort (adaptation to the norm) must be proactive and effective. Otherwise, the cost of compliance may end up exceeding the gains (or avoidance of losses) in market share. The effectiveness of compliance costs may differ according to track record and the nature of the compliance efforts. In this regard, it is worth highlighting that, according to inquiries with local consultants, about 70 to 80 percent of all the ISO 9001 developments in Argentina are poor in nature, while 30 to 40 percent of these developments are downright bad. If this perception were right, it would signal that most of these developments obey a marketing strategy rather than to the goal of improving the management of quality systems, with scant results in terms of improving competitiveness via enhanced credibility and reputation.

On the other hand, our survey suggests that successful builders of trade capacity choose to certify these norms when:

- it is required by foreign clients;
- the firm's export-led growth increases the complexity of its operations, and these certifications are used as tools to improve the internal consistency in the firm's operations;
- they are planning to sell in more mature markets, like the EU or the US.

In the cases of the interviewed firms, certification (and the compliance effort) was perceived as a useful tool for improving operational practices, with very positive effects, although a few complained about the short-term opportunity costs of adapting to the requirements of the norm (in terms of diverting time from other productive activities to the required adaptation activities). These firms claim that the investment in improving quality managements systems is a must, regardless of the size of the firms and of the markets they are targeting. A common assertion among the interviewed firms is that the effective application of a quality management system immediately creates a more productive operational environment. In this sense, a traditional cost-benefit analysis of the investment in compliance may lead to wrong conclusions by failing to capture many intangible benefits, both current and future. This of course depends on the effective application of the quality management system. If the firm's effort is restricted to obtaining the certification and then not applying the system, then the compliance effort becomes a purely sunk cost.

It is worth pointing out that many of the surveyed firms had been exporting for quite a while, even to some sophisticated markets, before they decided to certify their quality management systems. In the case of a firm that has been manufacturing high-tech weighing machines for commercial use for 40 years, is one of the leaders in the domestic market, and has been exporting to Latin America for a number of years, the decision to certify compliance with the ISO 9001 and 14001 norms came after they decided to start developing a new model to be marketed in the EU. In the case of a manufacturer of fitness equipments, that has been exporting to several destinations in the EU, the rest of Europe and to the US, the decision came not as a requirement from importers, but rather as a strategy to improve their own managerial procedures.

Moving beyond the case of ISO certifications, the decision to invest in trade capacity is usually a non-linear process. In some cases, firms decide to strategically target a market with stringent public standards and technical regulations, and invest in building the capacity to comply with these requirements beforehand. In other cases, they are to able to engage in some preliminary sales to markets with more stringent requirements without fully complying with these public standards and technical regulations (because their enforcement is currently not too strict), but as they learn about the market and seek to secure the market shares, they try to meet all the regulations and standards. There are other cases where a customer from the EU fully specifies all the public and proprietary standards to be met, many of which go beyond the usual voluntary norms and compulsory regulations set in this market. The firm decides to invest in compliance because it has already secured a contract with this customer and because it anticipates expanded sales to other EU clients, which would allow it to adequately amortize the cost of the investment. It should also be mentioned that the investment was preceded by pilot sales, without having to comply with all the public standards and technical regulations, before the contract was signed.

None of the trade capacity-building efforts reported by the surveyed firms resulted from a government initiative; i.e., we obtained no reports of the demand for trade capacity-building by the firms being a result of the government's effort to promote this demand. The closest that the government comes to promoting this demand is when it enacts domestic technical regulations that are equivalent to foreign ones, but even in those cases the surveyed firms complain that the enforcement is weak.[9] This gives rise to unfair competition, i.e., the firms that do not comply have a cost advantage over the complying ones, which diminishes the latter's incentives to invest in compliance.[10] While enforcement of domestic technical regulations is not per se a requirement to enter foreign markets, it is part of the necessary framework conditions to build trade capacity.

Another hurdle comes from the fact that the government often lacks the installed capacity to test whether the products comply with domestic technical regulations that are equivalent to foreign regulations, and additionally fails to provide accreditation to private laboratories for conducting these tests.[11] This unduly raises the costs of compliance for Argentine manufacturers. On a more positive note, surveyed manufacturers of car parts reported that the tax credits on training expenditures were very helpful. However, these firms also asserted that the programs of support to certifications lacked practicality and were unsuccessful.

Despite the availability of public programs of support to certifications, none of the surveyed firms used them or included them as a factor that favored their certification activities.[12] This would suggest that either the instruments are irrelevant, or that the government lacks efficiency in their implementation, or that private firms are not adequately informed of their existence.

Our survey suggests that successful builders of trade capacity invest in quality development, management, control and assurance, and certify ISO and other norms mostly when it is required by foreign clients and when they are planning to sell in more mature markets. In some cases certification is used as a tool to improve production processes as firms undergo export-led growth. While the interviewed firms take a proactive approach towards certification, which yields them enhanced reputation, credibility and productivity, it appears that this is not the case for most firms in Argentina.

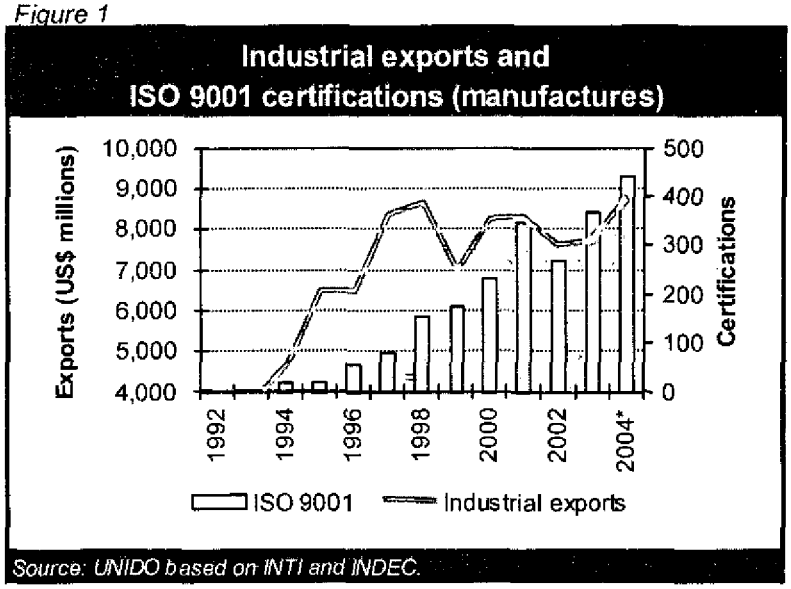
In no case was the investment in quality and compliance with norms and regulations the result of a government initiative. Even when the government promotes this demand by harmonizing regulations, it fails to provide the adequate testing infrastructure and technological assistance. Additionally, weak enforcement of domestic regulations hurts the incentives to invest in quality for complying, as firms intending to do so have to face unfair competition from non-complying firms.

The macroeconomic drivers of trade capacity-building

Moving beyond the qualitative evidence provided by the interviewed firms, it is possible to analyze the statistical relationship between quality development, assurance and management, and a series of macroeconomic variables like GDP, total exports, industrial production and manufacturing exports.

Data on ISO 9001 and 14001 certifications, for both the aggregate economy and manufacturing sectors, are used to proxy the behavior of the investment in quality development over time. The certifications of quality management systems (ISO 9001) and of environmental management systems (ISO 14001) are voluntary norms that exporting firms almost always must comply with in order to export to most markets. It is very revealing to observe that the number of certifications of manufacturing sectors usually closely track the behavior of manufacturing exports (see Figure 1).

Figure 1



Source: UNIDO based on INTI and INDEC.

Indeed, there are relatively large positive contemporaneous correlations between exports and ISO 9001 and 14001 certifications (see Table 2). Somewhat surprisingly, the strongest positive correlation (0.61) is the one observed between total exports (including non-manufacturing activities) and total ISO 9001 certifications (including non-manufacturing activities). This correlation suggests that increases in all types of exports lead to rises in certifications of quality management systems across the board, both in tradable and non-tradable activities. Similarly, increased exports of all types are associated to improvements in quality management practices along the whole value chain. Alternatively, a greater economy-wide certification effort (in manufacturing, service and primary sectors) seems to favor exports of all types of goods and services, by generating a more adequate quality management framework along the whole value chain.

Table 2

	Correlations (quarterly data, 1994:2004)			
	Total exports	Manufacturing exports	Industrial Production	GDP
ISO 9001	0.614	0.060	0.060	-0.098
ISO 9001 (manufactures)	---	0.529	0.129	0.057
ISO 14001	0.376	0.171	---	-0.203
ISO 14001 (manufactures)	---	0.372	0.082	-0.157

Sources UNIDO based on INTI, INDEC.

The second strongest correlation (0.53) is the one observed between manufacturing exports and the ISO 9001 certifications in the manufacturing sector. This suggests once again that there is an important feedback mechanism between exports and certifications, this time at the sectoral level. It is a bit puzzling that this correlation is lower than the one observed between total exports and certifications. This result suggests that compliance with these norms may yield important externalities, as exports appear to benefit from certifications in all sectors, including non-tradable activities.

It is very interesting to notice that the correlations between these certifications and overall economic activity, measured by GDP, are very close to zero. The same holds for the correlation between industrial production and ISO 9001 certifications in the manufacturing sector. This suggests that the certification of these norms is associated more to increased exports than to the expansion of the domestic market.

We conducted a more careful statistical analysis of the time series relationship between the ISO 9001 and 14001 certifications (both economy-wide and industry-specific), total and manufacturing exports and GDP. This is done by performing a Granger Causality analysis of time precedence of pairs of variables, with up to two lags.[13] This analysis does not establish causality in an economic sense, it rather allows to statistically determine whether a change in a given variable precedes in time the change in another variable, at appropriate levels of significance. Our calculations yield the following results:[14]

- ISO 9001 and ISO 14001:
    - Total ISO 9001 certifications precede in time (Granger cause) total ISO 14001 certifications, while the opposite does not hold.
    - Manufacturing ISO 9001 certifications precede in time manufacturing ISO 14001 certifications, while the opposite does not hold.
- ISO 9001 and exports:
    - Total exports precede in time total ISO 9001 certifications, whereas total ISO 9001 certifications do not Granger cause total Exports.
    - Total exports Granger cause manufacturing ISO 9001 certifications, whereas the opposite does not hold.
    - Manufacturing exports and manufacturing ISO 9001 certifications show no significant covariation over time.

- ISO 9001 and economic activity:
    - GDP and ISO 9001 certifications (both total and manufacturing) show no significant covariation over time.
    - Industrial production and ISO 9001 certifications (both total and manufacturing) show no significant covariation over time.

This pattern of temporal causality suggests that greater total exports appear to be the driving force for quality-related investments in all kinds of activities, including non-tradables. What is more, total exports appear to matter more than manufacturing exports for certifications in the manufacturing sector.

This conclusion is further reinforced by the fact that ISO 9001 certifications, both aggregate and manufacturing, show no distinct pattern of temporal association with indicators of domestic economic activity, such as GDP and industrial production.

Finally, investment in quality management system certification (ISO 9001) appears to precede in time the certification of environmental management systems (ISO 14001). Id est, exporting firms seem to resort first to ISO 9001 certifications to capture foreign market shares, and only then move on to certify ISO 14001 norms as a way to secure or increase these shares.

The role of sectoral characteristics in quality development

We now consider how firms' decisions regarding quality development vary by sector. We use three sectoral classifications: industry of activity, size and foreign ownership participation.

The approaches to certifications of quality and environmental management systems, product certification and quality development in general vary significantly across industries. Here we analyze the role played by sectoral variations in export propensities (sectoral exports / sectoral value added), the size distribution of firms within each sector, and the participation of foreign ownership.

We first look at the differences in the intensity of ISO 9001 and 14001 certifications by industry (see Table 3). The share of each industry in total certifications is first compared to its share in GDP. This exercise yields a large correlation between both shares (the correlation between participation in total ISO 9001 certifications and GDP is 0.94; while between ISO 14001 and GDP reaches 0.91), suggesting no intrinsic differences in the certification intensities across industries. However, if we exclude services from the comparison, the correlations drop significantly, to 0.57 and 0.54, respectively, which suggests that inter-industry heterogeneities in manufacturing activities may matter when it comes to investment in quality.

Table 3

Certifications by sector up to May 2003

	ISO 9000 (1)	Share in aggregate certifications (%) (2)	ISO 14000 (3)	Share in aggregate certifications (%) (3)	Sectoral VA share in GDP (%) (4)	Certification intensity (2) - (4)	Sectoral Exports / VA (%)
Vehicle parts	102	2.6	23	4.5	4.8	-2.2	44.0
Paper and paper pulp	67	1.7	2	0.4	3.7	-2.0	23.1
Electronics, Informatics and Telecommunications	220	5.7	19	3.7	1.0	4.7	59.0
Electric energy	50	1.3	51	9.9	3.0	-1.7	
Metalmechanics	465	12.0	18	3.5	4.5	7.5	53.9
Metalurgic	171	4.4	9	1.7	10.1	-5.7	19.6
Rubber products	36	0.9	3	0.6	3.4	-2.4	97.5
Food	268	6.9	19	3.7	28.5	-21.6	62.0
Construction	72	1.9	2	0.4	4.7	-2.8	
Chemicals and petrochemicals	493	12.8	97	18.8	27.1	-14.3	31.6
Services	1595	41.3	235	45.6	62.3	-20.9	3.2
Others	321	8.3	37	7.2			

Source UNIDO based on INTI, Ministerio de Economía and INDEC

To obtain a better understanding of the inter-industry heterogeneity in the decisions to invest in quality management systems, we construct an indicator of sectoral certification-intensity, defined as the absolute difference between an industry's participation in total ISO 9001 certifications and its participation in GDP. We observe that the activities with relatively large certification intensities include Electronics, Informatics and Telecommunications, and Metalmechanics. These activities have export shares that exceed 50 percent.[15] All the activities with export propensities below 50 percent have relatively low certification intensities. There are two interesting outliers, food and rubber products, which have relatively low certification intensities, even though they have very large export shares.[16] The correlations between certification intensities and export propensities are 0.36 for the whole group, but rise to 0.60 when we exclude food, and to 0.84 when we additionally exclude rubber products.

The inter-industry pattern of ISO 9001 certification intensities further strengthens the view that investments in developing and certifying quality management systems are more closely associated to export activities than to the expansion of the domestic market.

If we define sectors by firm size (proxied by total sales), the Technological Activities Survey carried by INDEC in 2001 reveals that large firms have much higher rates of certification, both of general norms and of sector-specific norms. The decision to certify varies positively with size (see Table 4). There are four possible concurrent reasons for this link between size and certification intensity. First, there is the fact that the direct cost of certifying does not increase significantly with size, thus making it relatively cheaper for large firms to certify. Second, adaptation to the requirements to certify can be more burdensome for smaller, less established firms, that have not yet acquired sufficient internal consistency in their operations. Third, large firms are more likely to be targeting (and able to supply) more demanding customers, thus making it more necessary for them to certify quality management systems and products. Fourth, large firms are more likely to be the targets of inspections and auditing by the regulation enforcing authorities (they are also the primary target of control and auditing by the tax authorities). This approach towards certification is consistent with the fact

that the large firms also show higher rates of implementation of quality control points and quality control spreadsheets.

Table 4

Quality systems

Proportion of firms over the total according to size

	With control points	With quality control spreadsheets	With certified quality management systems	
			General norms	Specific to sector
LARGE	89%	77%	91%	54%
MEDIUM	34%	27%	59%	26%
SMALL	3%	2%	22%	9%

Source: UNIDO based on Encuesta Nacional de Innovación y conducta tecnológica de las empresas argentinas. 1998/01, INDEC.

This finding suggests that SMEs would be the major beneficiaries of having access to trade-related TPGs that facilitate quality development and certification, although the promotion of their demands for TPGs also has to be pursued. However, large firms would receive an immediate benefit in terms of a reduction in the compliance costs they are currently undertaking.

Next we define sector by the participation of foreign capital in ownership, and inquire into the inter-sectoral differences in quality development, assurance and management. Fully domestically owned firms have much lower rates of quality system management certifications, control points and "quality spreadsheets" than firms that have even a minimal share of foreign ownership (see Table 5). There appears to be a discontinuity. There is a high jump in the rates of quality system development and certification among firms with no foreign ownership shares and firms with even a minimal share of foreign ownership. However, once the minimum threshold of foreign ownership is crossed, there is no noticeable increase in the attitude toward quality system development when the participation of foreign capital goes up.

Table 5

Quality systems

Proportion of firms over the total according to foreign ownership

Foreign capital (%)	With control points	With quality control spreadsheets	With certified quality management systems
0	51%	34%	22%
1 _ 49	79%	56%	57%
50 _ 59	81%	65%	55%
100	85%	73%	60%

Source: UNIDO based on Encuesta Nacional de Innovación y conducta tecnológica de las empresas argentinas. 1998/01, INDEC.

There thus appears to be a segmentation between fully domestically owned firms and firms with at least some participation of foreign capital in their approaches toward quality systems development and management. The latter maybe more inclined to develop quality management systems as a result of demands, and transfers of managerial and manufacturing practices, from their headquarters. An implication of this finding is that fully domestically

owned firms should, in principle, be the major beneficiaries of having access to trade-related TPGs, although the promotion of their demand for TPGs also has to be pursued. However, foreign-owned firms would receive an immediate benefit in terms of a reduction in the compliance costs they are currently undertaking.

Certifications in the food industry

The food industry displays a plethora of norms, metrology requirements, food safety standards, sanitary and phitosanitary requirements (as established in the Codex and in importing countries laws and regulations) and other regulations that have to be complied with, either in the domestic or foreign markets, or in both. Compliance with all these requirements involves, among other things, the certification of the following norms: Good Agricultural Practices (GAP), Good Manufacturing Practices (GMP), Hazard Analysis of Critical Control Points (HACCP), and foreign norms like EUREP-GAP (required by retail chains in central Europe), British Retail Consortium standards (BRC, required in Great Britain), and International Food Standards (IFS, developed by German retailers).

While ISO certifications are usually not required, according to food industry experts we consulted on the subject, the opinion of quality management consultants we interviewed was that the HACCP and ISO 9001 certifications are complements and not substitutes. These consultants aver that quality development and management in the food industry are quite poor on average, which is reflected on the relatively low intensity of ISO certifications we analyzed in the previous section.

We now turn our attention to the evolution over time of certifications of all types in the food industry.

Data from the Argentine Normalization Institute (IRAM) show that certifications in the food industry have been significantly growing over the past few years (see Figure 2). This would suggest that, despite the apparently low initial levels of certified quality development and management in this sector, there is a growing trend towards complying with different STRs. We have no benchmark to assess whether the number of certifications is satisfactory in absolute levels.

We can further analyze the composition of certifications in the food industry, both cumulative and in the most recent year (see Table 6). The greatest participation corresponds to PFI (Integrated Fruit Production) certifications, required for exporting fruit to Europe. We observe that HACCP, GAP, and GMP had a relatively small participation (7.5 percent) in the cumulative certifications (fifth column in table). However, these certifications had a significantly larger participation (18.3 percent) in the certifications of the most recent year. This would suggest that the investing in quality development and in compliance with standards is progressively spreading to non-fruit food production.

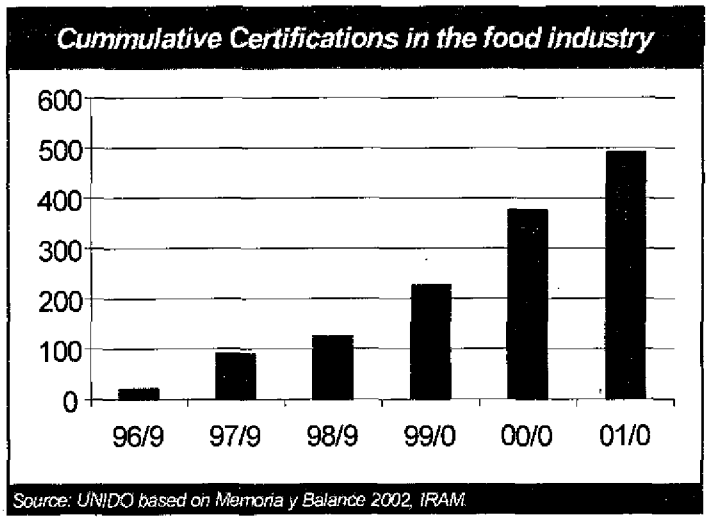
Table 6

Certifications in the food industry

Program	Cerifications given		Share in total	
	2001/02	Cummulative	2001/02	Cummulative
EU-GAP	2	2	2.8	0.4
GMP-IRAM 14102	3	16	4.2	3.2
GMP-IRAM 14101	3	3	4.2	0.6
GMP- Yerba Mate	1	6	1.4	1.2
GMP- Té Negro		1	0.0	0.2
PFI - Alto Valle	1	234	1.4	47.3
PFI - Uruguay		131	0.0	26.5
PFI - Concordia	4	4	5.6	0.8
PHI - Uruguay	51	78	71.8	15.8
PHI - H.Ascasubi	2	3	2.8	0.6
HACCP	4	9	5.6	1.8
Product stamp		6	0.0	1.2
Organic stamp		2	0.0	0.4
Total	71	495	100.0	100.0

Source: UNIDO based on Memoria y Balance 2002, IRAM.

Figure 2



Exports of food represent 26 percent of all Argentine exports. It is crucial for the food industry to invest in quality development, management and assurance, given the stringent and rapidly evolving food safety and sanitary and phitosanitary norms and regulations introduced in foreign markets. In this sense, the fast rate of growth of certifications with industry-specific norms is a positive development (although it could be reflecting the rapid pace of introduction of more severe standards abroad). However, the low participation of the food industry in ISO 9001 certifications, together with the opinion of consultants and the relatively deficient testing and calibration infrastructure, suggest that quality management is still under-developed in this industry and that it would greatly profit from a better provision of TPGs and of a promotion for their demand by private firms. The analysis done in Gargiulo (2005) regarding the capabilities of the Food Safety Agency (SENASA) further strengthens this view.

Costs of complying with basic quality requirements, foreign standards and domestic and foreign technical regulations

Costs of complying with basic quality requirements and domestic technical regulations

There exists a series of costs that firms should incur in order to comply with basic quality requirements (quality development, assurance and control), product and process certifications, and domestic technical regulations, regardless of whether they export or not. These costs include expenditures such as implementation of Good Manufacturing Practices, controls of processes, raw materials and inputs, personnel training, occupational safety, development of suppliers, packaging, maintenance of equipments (food industry); operation of in-house laboratories for mechanical, chemical, metallographic and corrosion tests, certification of API and TÜV norms (steel industry); metrology, quality auditing, quality assurance, and laboratories (valves for internal combustion engines); tracing weights for calibration tests, compliance with electric security regulations, testing and product certification (weighing machines), to give but a few examples.

Our survey provided information on the costs of complying with basic quality requirements and technical regulations that the interviewed firms face. To simplify notation, we bundle all these costs under the generic name of "basic quality costs," by which we denote all those quality-related costs that the interviewed firms aver have to be incurred, regardless of whether the firm exports or not. These costs, expressed as a percentage of sales and grouped by industry affiliation of the interviewed firms, are presented in Table 7.

Table 7

Activity area	Incidence of expenditure in quality on sale's price
Chemicals (granular enzymes)	
Metals (aluminum and steel)	0.058 - 0.27%
Vehicle parts (shock absorbers and engine valves)	0.92 - 3.19%
Electric machinery (digital weighing machines and fitness equipment)	0.93%
Beef	1.50%
Dairy products (cheese, powder milk)	0.66 - 9.5%
Footwear (leather shoes)	2.50%
Processed food (fruit juice and canned tomato)	0.2 - 2%
Oil seed products (peanut and peanut butter)	0.33%
Refined fuels	0.04%

Source: UNIDO Survey

There is a significant dispersion, across industries and even across firms within a same industry, in the costs of complying with basic quality requirements and domestic technical regulations. This dispersion arises from differences in size, stage of growth of the firm and of its capacity-building endeavor, inter-industry technical and standards heterogeneity, and in what expenditures firms consider to be related to complying with basic quality requirements.[17]

It should also be remarked that most of the surveyed firms included the certifications of ISO 9001 and 14001 norms as part of the quality-related expenditures that must be incurred regardless of whether they export or not, although in practice they usually certify these norms mostly when they are exporting (or planning to do so).

The monetary costs of certifying ISO 9001 and 14001 norms (including the adaptations required by the norm) and product specific norms and regulations are usually relatively low, and make up a very small share of the overall costs of complying with basic quality requirements. Table 8 presents a summary of these costs, as reported by the surveyed firms.

Table 8

Certification	Cost relative to total sales*
ISO 9000	0.0004 - 0.35%
ISO 14000	0.02 - 0.18%
HACCP	0.001 - 0.006%
IRAM 92/98 (electrical safety)	0.025 - 0.075%
API (steel)	0.0013%
TÜV (steel)	0.0001%

** Includes certification and adaptation to norm requirements*

Source: UNIDO Survey

Making all the previous adaptations required by the norm, that usually embrace both internal and external training, significant cultural changes and possibly large opportunity costs, is much more costly than the certifications per se. These adaptation costs, which can be substantial, are hard to quantify and are relatively larger for smaller firms and for firms that are initially poorly organized. In the case of small firms, large opportunity costs may arise from having to allocate the time of managers (which frequently are involved in production, quality development and research activities) to dealing with all the heavy paperwork that these certifications involve. We should recall, however, that according to the interviewed firms an effective compliance effort of quality management certifications is beneficial, as it immediately creates a more productive operational environment.

These compliance costs tend to be larger than for firms in developed countries as a result of the relatively higher systemic certification need (because of problems of credibility and reputation) in countries that are standard takers (i.e., they need to accommodate STRs that differ among industrial countries that are trade partners) and, in addition, cannot draw so intensively as do standard setters on mutual recognition agreements. In any case, the quantifiable costs of adaptation, installation and certification of these norms is usually very low, even for small firms.

The most significant costs of complying with basic quality requirements, as reported by the interviewed firms, are usually associated with quality assurance, laboratories, and metrology. Table 9 shows these costs, as reported by the interviewed firms:

Table 9

	Cost relative to sales
Quality assurance	0.031 - 4.600%
Laboratories	0.001 - 1.500%
Metrology	0.100 - 3.150%
Norm and product certifications	0.002 - 0.630%

Source: UNIDO Survey

All these costs should be incurred regardless of whether the goods are exported or not. However, exporting requires complying with both the most basic quality requirements and the foreign standards and technical regulations. Consequently, any deficiency in the provision of technological public goods that increases the costs of complying with basic quality requirements will end up hurting trade capacity and international competitiveness. Similarly, the capability to comply with basic quality requirements and domestic technical regulations is part of the necessary framework conditions to build trade capacity. The interviewed firms reported several examples of how an inadequate provision of technological public goods increases their costs.[18]

The costs of complying with basic quality requirements and domestic technical regulations are far from negligible, and are necessarily a first step towards trade capacity-building. The costs associated to quality assurance, testing and metrology are significantly higher than those related to quality management system certifications. However, the latter involve significant adaptation activities that have large opportunity costs, especially for small firms. These relatively large costs raise the incentives for small firms not to comply with local norms and standards which, together with poor enforcement, ends up raising the costs of compliance for larger, more formal firms. This raises again the convenience of having access to TPGs and promoting their demand (both through fiscal incentives and better enforcement), especially by smaller firms.

Costs of complying with foreign standards and technical regulations

Exporting to markets like the US or the EU involves complying with product and process standards, both public and proprietary, and with technical regulations that demand a variety of investments and extra expenditures ranging from product and process certification to product and process redesigns, and which may generate other extra costs such as duplication of inspections, delays of shipments and so on.

Compliance with these requirements may involve one-time costs (R&D to adapt products or processes; investing in new equipment), recurrent fixed costs (a minimum administrative and laboratory staff devoted to standard compliance activities; maintenance of equipment and laboratories; validation of product and process certifications; costlier quality control process), or higher variable costs (more expensive inputs and raw material). Fixed costs of compliance may negatively affect the firm's decision to enter, or remain in, a given market with restrictive standards. Variable costs of compliance will reduce exports and the exporter's net price.

Table 10 presents the total costs of compliance (as a percentage of the value of sales) with standards in the EU and the US, as reported by the surveyed firms, grouped by industry.

Table 10

Activity area	Incidence of expenditure in quality on sale's price	Incidence of incremental costs on sale's price
Chemicals (granular enzymes)	**0.29%**	**0%**
Metals (aluminum and steel)	**0.058 - 0.27%**	**0 - 4.20%**
Vehicle parts (shock absorbers and engine valves)	**0.92 - 3.19%**	**0 - 4.66%**
Electric machinery (digital weighing machines and fitness equipment)	**0.93%**	**4.30 - 8.33%**
Beef	**1.50%**	**S/d**
Dairy products (cheese, powder milk)	**0.66 - 9.5%**	**1.77 - 3.19%**
Footwear (leather shoes)	**2.50%**	**10.73%**
Processed food (fruit juice and canned tomato)	**0.2 - 2%**	**2.44%**
Oil seed products (peanut and peanut butter)	**0.33%**	**2.04%**
Refined fuels	**0.04%**	**2.50%**

Source: UNIDO Survey

In many activities, the incremental cost of compliance with foreign standards and technical regulations is nil, either because the STRs are universally shared by all countries (the case of shock absorbers, for instance) or because the firm is part of a global production network and already works with an integrated total quality system, without distinguishing between domestic and foreign STRs.

In those industries where compliance with foreign STRs involve non-negligible incremental costs, these extra outlays can reach 11 percent (in the case of leather shoes) of total sales, and an even larger figure in terms of exports.

These incremental costs differ by industry, and include investments such as: product redesigns related to Good Manufacturing Practices, re-tooling, improvements in raw materials, personnel training, improvements in quality control, certification of market-specific product standards and norms, duplication of inspections, labeling and packaging. Additionally, there are other non-quantifiable costs, such as the opportunity cost (losses of sales and diversion of managerial time from other activities) involved in adapting with foreign norms, dealing with the required paperwork, and so on.

Some of these incremental costs are linked to compliance with public standards (like certifying BRC norms for exporting food to the United Kingdom), others to the compliance with proprietary standards (like the requirement of installing faucets with automatic sensors for an exporter of canned vegetables to the EU), and yet others to compliance with technical regulations (like the labeling requirements in the US for the leather shoe industry).

The greatest costs of compliance are usually those related to machine re-tooling, which are one-time fixed costs that are in some cases related to proprietary standards (like machines for assuring the size of canned tomatoes) and in others to technical regulations (like in the case of refined oil products that must meet new requirements in terms of sulfur content).

Costs of compliance related to public standards (like certifications) are usually low in monetary terms, although they can have large, unquantified, opportunity costs in terms of the time required to deal with paperwork (like in the case of certifying UL norms for exporting electric machinery to the US).

The quality-related incremental costs required to export to the US and the EU can be as big as, or even bigger than, the basic costs of quality development, management and assurance.

The incidence of these incremental costs appears to be greater in activities with high certification intensity, such as electric machinery and vehicle engine parts, and in labor-intensive industries with smaller economies of scales (like leather shoes).

Additionally, firms in the electric machinery industry and in the dairy products sector (which also has relatively high compliance costs) report important deficiencies in the provision of industry-specific TPGs.

This suggests that the activities that appear to be the biggest demanders of TPGs (the ones with bigger certification intensities) are the ones who would benefit more from having access to trade-related TPGs.

The sizable costs of complying with both basic quality requirements and foreign STRs observed in several activities raise the concern that the firms' decisions to invest in quality development, management and assurance and in trade-capacity-building may be significantly discouraged if: a) domestic technical regulations are not properly enforced, b) the adequate

TPGs are not provided, c) the overall policy and institutional environment is not geared towards promoting exports.

These incremental costs for Argentine industries can also be compared to those obtained by the World Bank Technical Barriers to Trade Survey (WBTBTS) for the average developing country and the average Latin American country, which we show in Table 11.

Table 11

Industry	Incidence of incremental costs on sale's price		
	Argentina (IERAL-UNIDO)	Average LDC (WBTBTS)	Average LatAm (WBTBTS)
Chemicals (granular enzymes)	0.000%	3.170%	1.830%
Metals (aluminum and steel)	0 - 4.20%	11.210%	6.460%
Vehicle parts (shock absorbers and engine valves)	0 - 4.66%	4.180%	2.410%
Electric machinery (digital weighing machines and fitness equipment)	4.30 - 8.33%	2.400%	1.380%
Beef	S/s	3.430%	1.980%
Dairy products (cheese, powder milk)	1.77 - 3.19%	4.610%	2.660%
Footwear (leather shoes)	10.730%	2.730%	1.570%
Processed food (fruit juice and canned tomato)	0.2 - 2%	4.610%	2.660%
Refined fuels	0.035%	9.830%	5.670%

Source: UNIDO based on World Bank and UNIDO Survey

Bearing in mind that the interviewed firms may be considering different items as being part of the incremental costs in both surveys and that the firms included in each industrial classification may differ across surveys, it is possible to observe that the costs of compliance in Argentina are relatively higher in the electrical machinery and dairy products industries (highly intensive in certifications), and in the footwear sector (labor intensive, low economies of scale). On the other hand, costs of compliance appear as relatively lower in Argentina in industries such as basic metals and refined fuel (industries with low certification intensities where production is highly concentrated and done at large scale, and where there is evidence of significant provision of industry-specific TPGs by industrial associations[19]) and in processed food (that has a low certification intensity).

It should be noted that the level of compliance costs can be the result of a combination of the following factors:

- An inadequate provision of TPGs by the government or private associations. For instance, insufficient public testing capacities, lack of international accreditation of local inspections and of capabilities for local certification of products, among others.
- Lack of harmonization with foreign standards and technical regulations, and insufficient capability to demonstrate their equivalences when settling disputes.
- High costs of importing and adapting equipment required to meet more stringent foreign STRs.
- Low scale of production due either to domestic market structure, poor export performance, and unfair competition from "technically informal" local firms that benefit from poor enforcement of local regulations.
- Stage of development of the firm.

From this brief summary, it emerges that the size of the costs of compliance depends only in part on the provision of what we usually associate with TPGs, i.e., the first item in the previous list.

However, the government could in principle help alleviate all these private costs of compliance through measures such as direct provision of TPGs, subsidizing, certification tax breaks, coordination of investments in industry-specific TPGs by the private sector, and so on. The case for subsidizing activities that could be profitable for the private sector, such as certification, could be justified on the grounds that these activities may have positive externalities (thick labor market externalities, for instance), with social benefits that exceed the private ones.

Quantifying the revealed demand for trade-related technological public goods

We will estimate the revealed demand for trade-related TPGs as the producer surplus that exporters have to forgo when complying with foreign STRs. [20] This forgone producer surplus represents the exporters' willingness to pay for TPGs that alleviate the costs of compliance. In order to make these estimates, we adapt a model developed by Popper et al (2004) at RAND for the National Institute of Standards and Technology in the US to measure the economic costs caused to U.S. exporters by the technical barriers to trade implemented by other countries.

Variable costs of compliance with foreign STRs would reduce the net price that exporters receive (vis-à-vis the pre-standard situation). This would force marginal exporters to leave the market, obliterating their producer surplus, and would also reduce the producer surplus obtained by the infra-marginal exporters that stay. Fixed costs of compliance must additionally be subtracted from the producer surplus of infra-marginal exporters. If the fixed costs of compliance exceed the value of the market (the pre-standard producer surplus), all exporting firms are forced to leave (or cannot enter) the standard adopting market, experiencing a full loss of the value of the market.

This methodology requires that we compare the losses from compliance (forgone surplus caused by variable incremental costs of compliance plus the fixed costs of compliance) with the value of the market (producer surplus that exporters would obtain if there were no costs of compliance). If the latter is greater, firms comply with foreign STRs, and the resulting trade losses represent the demand for TPGs.

It should be remarked that these trade losses measure the benefit to exporters from having access to trade-related TPGs that alleviate these losses, but not the benefits to society as a whole. Assuming that the variable costs of compliance are paid to local agents (i.e., they are a transfer from exporters to local certifiers, laboratories, etc.), the social welfare gains from compliance-cost reduction would be limited to the producer surplus attached to the increasing marginal exports.[21] [22] However, if the costs of compliance were in part or fully paid to foreign agents (like in the case of duplication of inspections), then both the firms' and society's valuation of trade-related TPGs would tend to converge.

These trade losses can be estimated by calibrating a partial equilibrium model for the exports to a country that adopts STRs the compliance of which causes incremental costs to exporters. This calibration allows us to estimate the forgone producer surplus caused by compliance. The model features the export supply schedule to a given market, the net price that exporters receive after complying with product standards, the fixed costs of compliance, and the associated producer surplus variations.

The calculation of these trade losses only requires information on prices, quantities, and compliance costs and some approximation to the price elasticity of the export supply. Given that

the fixed compliance costs can be amortized over the timespan of the projected export project, the losses are measured in present discounted value terms.

A more detailed description of the methodology and of the assumptions we make, and their implications, is presented in Annex III. Here it will suffice to say that the assumptions we make regarding the market structure for exports bias our estimations towards an upper bound of the demand for trade-related TPGs, whereas the characteristics of the interviewed firms (whose reported costs of compliance are used to extrapolate the industry-wide costs of compliance) bias our estimates towards a lower bound. These opposing biases lead us to believe that our estimates are within a realistic range.

Assessing industry-wide demands for TPGs in Argentina

We present next our estimates of the revealed industry-wide demands for TPGs, based on the methodology discussed above. We estimate a range of these demands, based on assumptions on three alternative price elasticities of exports, two time horizons for amortizing the one-time costs of compliance, and three discount rates.

Before presenting our estimates we should mention that what is public and what is strictly private in trade capacity-building investments remains an open discussion. For instance, investing in the certification of quality management systems would appear to be a private responsibility. However, to the extent that there may be externalities arising from certifications (thick labor markets of trained managers, for instance), the scope for public intervention immediately emerges. The role of public goods is more obvious in the case of incremental costs of compliance arising from the duplication of inspections due to the lack of international recognition of local inspections. There are other required spendings, like machine re-tooling, that would seem to be obviously private. But then again there may exist positive externalities from such investments (like knowledge spillovers) that justify some public intervention. In our estimates it is hard to separate clearly what is public and what is private in trade capacity-building. We thus estimate the revealed demand for TPGs as the trade losses arising from compliance with public and proprietary standards and technical regulations all together.

We first illustrate the use of this methodology by applying it to estimate the costs of compliance for exporters of leather shoes to the US. The relevant information for this calculation, obtained from the survey and from the National Institute of Statistics and the Census (INDEC), is presented in Table 12.

Table 12

Value of exports (2003) USD	2,363,000
Unit price	14
Volume exports	168,786
One-time costs	
Product re-design	23,157
Re-tooling	57,657
Training	14,414
Total	95,229
Recurrent fixed costs	
Certify specific standards	8,743
Total	8,743
Aggregate variable costs	
Improve quality control	5,671
Duplication inspections	17,250
Labeling & packaging	48,914
Total	71,835

Source UNIDO based on UNIDO Survey

We next apply this information regarding values, volumes, prices and costs to the formula for estimating the total costs of compliance borne by Argentine exporters (see Annex III). The resulting estimates are presented in Table 13.

Table 13

Compliance cost absorption by Argentine shoe exporters (in USD)

3 year time horizon			
Discount rate	Price elasticity of exports		
	1	5	10
10%	318,825	330,842	345,863
20%	301,833	312,937	326,818
30%	288,189	298,560	311,524
5 year time horizon			
Discount rate	Price elasticity of exports		
	1	5	10
10%	436,133	454,451	477,348
20%	388,605	404,369	424,075
30%	354,051	367,959	385,345

Source UNIDO based on UNIDO Survey

These costs can be interpreted as the estimated revealed demand of Argentine leather shoe exporters for TPGs that bring their incremental compliance costs to zero. The cost absorption by exporters if they choose to stay in the market must be compared to the estimated value of the market that exporters would lose if they chose to leave, which we present in Table 14:

Table 14

Present discounted value of the market

Discount rate	3-year horizon	5-year horizon
10%	3,232,037	4,926,696
20%	2,986,569	4,240,090
30%	2,789,459	3,740,913

Source: UNIDO based on INDEC

In all cases the value of the market exceeds the costs of compliance, so that Argentine exporters (save for the marginal ones) will choose to stay in the market. Given that our assumptions for the estimation leads to an overestimation of the true value of the market (see Annex III), another way of interpreting this result is by positing that it would be worth for exporters to incur with the costs of compliance if the value of the market represented at least 5.58 percent of total exports.[23]

This exercise illustrates that any TPG that reduces these compliance costs and which costs less than the total reduction in costs would be beneficial from the point of view of trade capacity-building. For instance, a TPG that eliminated the costs associated to the duplication of inspections (like the international accreditation of local inspections) and cost less than US$ 54,964 – 100,820 (the costs borne by Argentine exporters), would have a net social benefit from the point of view of trade capacity-building. Besides, such a public good would probably be of use for other export activities (like non-leather shoes), thus generating a bigger social benefit.

We now present the estimates of the aggregate incremental costs of compliance in the other industries included in the survey. We present two sets of estimates. The first one is based on the assumption that the costs of compliance apply only to sales to the US and the EU. The estimates of the revealed demand for TPGs are thus based on current exports made to these destinations. These calculations can significantly under-estimate the actual demand for TPGs, as they may fail to take into account potentially larger exports that may accrue in the future. This is particularly relevant for the weighing machines industry, for instance, which is currently exporting very little to the EU but where the firm we surveyed is actually developing models to be sold in this market, that will significantly increase current sales to this destination. With this concern in mind, we present a second set of estimates where the costs of compliance are assumed to hold for all destinations of sales. In these calculations we are using current total exports as a crude proxy for potential exports to the EU and the US. These estimations can also be interpreted as reflecting the costs that Argentine exporters would face if the current American and European standards were adopted in all countries. We now show the estimates of the demand for TPGs based on current exports to the EU and the US, both in nominal values (Table 15a) and relative to the value of the market (Table 15b).

Table 15a

Estimated trade losses USD thousands **UE + USA**				
	3 year horizon		5 year horizon	
Elasticity	1	10	1	10
Discount rates	30%	10%	30%	10%
Canned tomatoes	896.6	927.3	955.4	1,033.7
Footwear (leather shoes)	538.6	646.4	661.7	892.1
Oil seed products	4,628.4	5,751.3	6,138.2	8,661.0
Metals (steel tubes)	2,731.4	2,767.6	2,806.2	2,901.4
Fitness equipment	148.3	171.8	198.9	261.9
Weighing machines	1.8	2.2	2.4	3.3
Dairy produce	901.8	920.6	940.0	989.1
Refined fuel	17,303.9	17,323.9	17,346.7	17,400.2

Source: UNIDO based on UNIDO Survey and INDEC

Table 15b

Estimated trade losses Percentage of value of the market **UE + USA**				
USD thousands	3 year horizon		5 year horizon	
Elasticity	1	10	1	10
Discount rates	30%	10%	30%	10%
Canned tomatoes	6.03	7.22	4.21	6.01
Footwear (leather shoes)	8.92	12.40	7.19	12.76
Oil seed products	3.35	4.82	2.91	5.42
Metals (steel tubes)	3.22	3.77	2.17	2.95
Fitness equipment	5.52	7.42	4.86	8.43
Weighing machines	3.62	5.13	3.15	5.76
Dairy produce	2.51	2.97	1.72	2.38
Refined fuel	1.84	2.13	1.21	1.59

Source: UNIDO based on UNIDO Survey and INDEC

The revealed willingness to pay for TPGs is usually large, ranging from US$ 538,600 – 892,120 for the leather shoe industry to US$ 17.3-17.4 million for the gasoline industry. There are two outliers, the precision weighing machines and the fitness equipment industries, which have very low valuations as a result of their currently low levels of exports to these destinations.

As shown in Table 15b, the estimated trade losses are significantly smaller than the value of the market, so that firms will prefer to comply with the foreign STRs. Put differently, the minimum required value of the market (or producer surplus), relative to exports, would be 6.38 percent.[24] Any value of the market above this figure would justify compliance with foreign standards and technical regulations.[25]

Table 16 shows the estimations of the demands for TPGs that would accrue if the US and the EU STRs were adopted in all markets, or if all Argentine exporters decided to redirect all their external sales towards the US and the EU.

If we assume that the exports to all destinations represent the potential exports to the US and the EU, then the potential willingness to pay for trade-related TPGs rises significantly. It would now range from US$ 954,050 – 1,685,030 for the fitness equipment industry to US$ 128.6 – 129.3 million for the gasoline industry. These estimates can also be interpreted as the willingness to pay for TPGs in the case where the STRs are adopted by all markets.[26]

These estimated trade costs represent between 1.8 percent of the value of the market for refined fuels and 10.7 percent for leather shoes. Put differently, a sufficient condition for making it profitable to comply would be that the value of the market represented at least 5.4 percent of total exports.

Table 16

Estimated trade losses
USD thousands
Total

	3 year horizon		5 year horizon	
Elasticity	1	10	1	10
Discount rates	30%	10%	30%	10%
Canned tomatoes	30,079.7	31,109.1	32,051.4	34,679.8
Footwear (leather shoes)	2,156.7	2,588.3	2,649.6	3,572.3
Oil seed products	91,307.9	113,461.0	121,092.9	170,862.6
Metals (steel tubes)	22,490.0	22,787.4	23,105.3	23,889.2
Fitness equipment	954.0	1,105.4	1,279.5	1,685.0
Weighing machines	31,777.1	38,808.5	42,178.4	58,484.4
Dairy produce	14,870.5	15,180.2	15,499.1	16,308.8
Refined fuel	128,558.3	128,706.6	128,876.3	129,273.2

Source: UNIDO based on UNIDO Survey and INDEC

Measuring the economy-wide demand for trade-related TPGs

We next extrapolate the estimated industry-wide trade losses to the trade losses associated to total exports to the US and the EU. The extrapolation procedure and its implications for the results are presented and discussed in Annex III. Here it suffices to mention that the characteristics of the interviewed firms and the certification intensities of their industries of activity bias our estimations towards a lower bound of the actual aggregate demand for TPGs related to exports to the US and the EU.

The extrapolation analysis suggests that the lower bound of the aggregate trade losses from compliance with standards and technical regulations in the US and in the EU could reach to up to US$ 209 million (and a minimum of US$140 million).[27]

We next extrapolate these trade losses to the trade losses associated to total exports to all destinations. This gives us a measure of the estimated demand for TPGs that would arise if all the exports were re-directed towards the US and the EU or the standards and technical regulations observed in these regions were extended to all markets. Again, the certification intensities of the surveyed industries, along with the characteristics of the interviewed firms and the expected capabilities of the firms that are exporting to destinations that are technically less demanding than the US and the EU, suggest that this extrapolation is biased towards a lower bound of the true demand for trade related TPGs.

This extrapolation suggests that the lower bound for the revealed potential aggregate demand for TPGs (in the case where all exports were re-directed towards the US and the EU or the standards and technical regulations observed in these regions were extended to all markets) could reach up to US$ 1,488 million (about 2.4 percent of the present discounted value of total exports). The minimum estimated loss would be US$ 1,120 million.

Aggregate costs and benefits of providing trade-related TPGs

The estimated aggregate demand for trade-related TPGs dwarfs the estimated investments that are required to build trade capacity in the areas of normalization, technical regulations, conformity assessment (accreditation, certification and testing and calibration), and basic industrial metrology.

According to the estimations made in IRAM (2005), the annual required investments to build trade capacity infrastructure total approximately US$ 44.3 M, and the present discounted value could reach US$ 184.7 million considering a 5-year period and a 10 percent discount rate (and a minimum of US$ 104 million in a three year horizon and a discount rate of 30 percent). These figures must be compared to the aggregate demand for TPGs, which ranges from US$ 140 million (in the case where it applies only to exports to the US and the EU) to US$ 1,488 million (in the case where it applies to all destinations). Hence it appears that the potential benefits of building extra trade capacity would far outweigh the costs.

Focusing on trade capacity in the food industry, we estimate that the trade losses associated to compliance with foreign standards in three narrowly-defined sectors (oilseed products, dairy products and canned tomatoes) can reach up to US$ 222 million. If these costs were extrapolated to the entire food industry, the trade costs would be US$ 799.3 million. A large share of these costs arises from deficiencies in the functioning of the Food Safety Agency (SENASA).[28] Gargiulo (2005) has estimated the costs for bringing SENASA's capabilities up to date, and to improve its dynamic capabilities to be in the range of US$ 53.4 million (reactive capabilities) to US$ 133.6 million (proactive capabilities). These costs are significantly smaller than our estimates for the overall losses for food exporters, suggesting that the social benefits of upgrading SENASA's capabilities exceed its costs.

Demand for specific TPGs in Argentina

We now compare the trade losses associated to specific standards and technical regulations with the costs of providing the specific TPGs that increase the ability to comply with these STRs. The estimated trade losses associated to specific STRs in narrowly-defined industries would be a lower bound of the actual demand for these TPGs, as it is often the case that the demand for a same trade-related TPG is shared by several other industries (for instance, the TPGs required to comply with some STRs in the leather shoe industry are likely to facilitate compliance for the non-leather shoe industry). In order to make this type of analysis it would thus be better to group the activities by type of TPG demanded, and to make a cost-benefit analysis for each TPG separately.

Demand for ISO 9001 certification capacity in Argentina

We now illustrate this type of cost-benefit analysis for an specific TPG: the local infrastructure of certification of ISO 9001 norms. Since a local infrastructure of certification already exists in Argentina, in this section we conduct a counterfactual analysis that estimates the trade losses that Argentine exporters would accrue in the case such an infrastructure was not available.

Setting up the national certification organization involves spending on buildings, equipment, accreditations, international mutual recognition networks, human resources, training, and the participation in national and international meetings. All these measurable costs can be compared to the benefits that Argentine exporters obtain from being able to certify these norms at home.

We start by estimating the costs that Argentine exporters would have to bear if they had to certify the ISO 9001 norms abroad instead of being able to do it in Argentina. Certifying an ISO 9001 norm (including the costs of adaptation and training) in Argentina costs between US$ 9,000 and US$ 17,000, while doing so in an average developing country costs between US$ 15,500 and US$ 42,750, according to data provided by the IPT Department at UNIDO; i.e., about 2.24 times more on average.

Additionally, our survey reveals that the average incidence of the costs of ISO 9001 certifications on exports is around 0.05 percent, which yields a total cost of US$ 14.28 million on aggregate. If the Argentine exporters were to face the average LDC certifying costs, it would cost them 0.11 percent of the value of their exports, or US$ 31.41 million on aggregate.

Taking these certifications as one-time costs (in practice they must be validated, albeit at a low cost, after two years in most cases), the benefit for Argentine exporters of manufactured goods (including processed food) from having access to local certification would amount to US$ 5.1 million, should these certifications were a specific requirement to sell to the US and the EU, and to US$ 17.13 million, should they be for exporting to all markets.

If we assume instead that the ISO 9001 norms are specific only to the exports of non-food manufactured goods (as suggested by the available evidence and the opinion of consulted food industry experts), then the benefits for Argentine exporters would be US$ 1.33 million if the certifications were required only for the US and the EU, and US$ 5.90 million if they were necessary to sell to all markets.

We can compare these benefits to some of the costs required to set up the local certification infrastructure. Here we focus on the costs of setting up and operating a national certification organization (IRAM). While this organization carries out only 27 percent of all the certifications, its existence and operation as a non-profit organization that additionally operates

as the normalization institute (and is a member of a large number of technical committees at the ISO) significantly contributes to lowering the local costs of certification.[29]

IRAM reports that the annual costs required to have a national certification organization amount to US$ 3.6 million, which falls between the upper and lower bounds of the estimated benefits for Argentine exporters.[30] However, this budget is the one required to build certification capacities for a large variety of norms and regulations that widely exceeds the certification of ISO 9001 norms alone.[31] Hence the benefits arising from having access to this TPG exceed those arising from being able to certify ISO 9001 norms at home. Alternatively, if the budget of the national certification organization corresponding to ISO 9001 certifications alone were one third or less of its total budget, then the net social benefits of this certification capability would be positive.[32]

The benefits to Argentine exporters from having access to a local infrastructure of ISO 9001 certifications range from US$ 1.33 million to US$ 17.13 million. These estimates represent a lower bound for these benefits, as this local infrastructure also helps reduce the costs of certifying other required ISO norms. The annual costs required to have a national certification organization amount to US$ 3.6 million, which falls between the upper and lower bounds of the estimated benefits for Argentine exporters. But this TPG also facilitates the compliance with other technical regulations.

There remains the issue of whether this infrastructure should be funded by the government or by the firms that benefit from the existence of a non-profit certification organization and its distinctive services (membership in international networks of mutual recognition, participation in international technical committees and scientific meetings, certification personnel training, etc.) that are not funded through service fees. There already are firms that contribute to the financing of these activities in exchange to having access to club goods provided by IRAM, such as exclusive technical information, early warning of forthcoming changes in foreign standards, and so on. However, there are vast ranks of firms that free-ride on this TPG, thus giving scope for the government to correct its apparent under-provision through the coordination of private actions, probably via the use of instruments such as tax deductions on the memberships to the certification organization.

Demand for an industry-specific well defined TPG

The analysis of the capability that Argentine manufacturers of electrical machinery have in order to meet the EU technical regulations regarding electromagnetic and radio frequency interference standards (EMI/RFI) provides another instance of precisely defined missing TPGs for trade-capacity-building.

In order to make sure that a machine meets the electromagnetic interference standards (EMI), the manufacturer has to inject by air a range of electromagnetic frequencies to the machine. This test requires a sophisticated laboratory and a Faraday cage. There currently are no private or public laboratories of this nature that offer the possibility for private firms to test their machines previous to attempting certification of the model. The cost of this facility amounts to about US$ 1 million, certainly unaffordable by most, if not all, manufacturers of electrical machinery in Argentina.

The problem is made worse by the fact that these testing facilities can be rendered obsolete quite fast due to changes in EMI standards, as recently occurred with the adoption of new EMI standards associated to cellular phones. This would explain why private laboratories may not invest in this testing capacity, making an even stronger case for the provision of a TPG.

The National Institute of Industrial Technology (INTI) has a laboratory of this kind, which is used only for standard-approval testing activities and not for technical assistance and pre-approval tests.[33]

Under these circumstances, individual firms base their developments on theoretical parameters and rely on home tests that are quite indirect and incomplete. For instance, a surveyed manufacturer of fitness machines undertakes voltaic tests that require special filters and have a good degree of inaccuracy. They are thus quite uncertain about whether their machines actually meet the EMI parameters established in the EU technical regulations.

Manufacturers then take the models to INTI, where they are tested for approval. These tests are quite costly (US$ 1,400 per test) and there is a high likelihood that firms may have to test their models at least three times before they are approved. This carries an additional opportunity cost in terms of forgone sales until the model is finally approved.[34]

The CE policy of the EU admits different degrees of conformity with the norm, which range from the firm declaring that it meets the technical regulation to the case where an international accredited organization certifies its compliance. Given the large costs of compliance caused by the lack of specific TPGs, Argentine firms frequently opt to declare conformity based on their own inaccurate tests. But they run risks of litigation if some accident occurs due to EMI. It should also be added that while this strategy is possible for goods such as treadmills, it is not possible for other electrically powered medical instruments such as mechanical ventilators.

Based on our survey, for a firm that wants to export four different models of machines to the EU, that fails to pass INTI's tests twice before getting the EMI parameters right, and that has to forgo one month of sales of the model until the models is approved, we estimate the incidence of the compliance costs at 13.2 percent of its exports to the EU. These expenditures include the costs of home tests, of the tests at INTI and the forgone sales. These are one-time costs of compliance with foreign technical regulations that are associated both to metrology and to conformity assessment.

We alternatively estimate the costs that would obtain in case a suitable laboratory with a Faraday cage offered assistance and the possibility of pre-testing the model at the same cost of testing at INTI. We assume that in this hypothetical case firms perform only one pre-certification "private" test, one test for approval at INTI, and do not have to forgo sales. In this case the cost of compliance would represent only 3.2 percent of the value of exports to the EU. The gain associated with having access to this TPG would thus represent 10 percent of the value of exports to the EU.

Having access to facilities that allow firms to perform private pre-certification tests for compliance with EMI technical regulations in the EU would save 10 percent of the value of exports of electrical machinery to the EU and other mature markets.

We apply these estimates of the incidence of the compliance costs to the values of total exports of electrical machinery to the EU, to the EU and the US together, and to all destinations, to obtain measures of the aggregate benefits for Argentine exporters of having access to this TPG. We include the case where the technical regulation applies to all destinations in anticipation of a possible extension of this regulation to other markets. This case can also be interpreted as having the exports to all destinations represent the potential exports to the US and the EU, thus allowing to estimate the potential (rather than the actual) willingness to pay for this for trade-related TPG.

Table 17 presents the valuation of the TPG for the exporters of electrical machinery, both in the case where this testing facility is useful only for one year and when it is useful for testing during 3 years (in the latter case we estimate the present discounted value for exporters).

Table 17

Value of EMI testing facilities to Argentine exporters of electrical machinery				
Destination where	Life length of testing facilities			
		3 years		
		Discount rates		
norms applies	1 year	10%	15%	20%
EU only	2,902,148	7,217,213	6,626,258	6,113,321
EU and US	5,592,461	13,907,622	12,768,847	11,780,415
All markets	27,858,504	69,279,977	63,607,237	58,683,424

Source UNIDO based on UNIDO's survey and INDEC Trade Statistics

Our estimates suggest that the benefits to exporters of electrical machinery arising from the provision of facilities for private testing of compliance with EMI technical regulations largely exceed its cost, especially when it can be used for more than one year and when the technical regulation holds in other markets as well. This is thus another instance where there is scope for the provision of a trade-related TPG that has positive net social benefits.

When dealing with physical infrastructure, the problem has an additional geographic dimension, as the production of electrical machinery can be spread over different locations. Nevertheless, our estimations suggest that there is scope for installing multiple testing facilities at different locations without obliterating the social benefits of doing so.

It should be noted that not all the trade-related TPGs necessarily have to be provided by the public sector. Indeed, many of them are industry-specific public goods that may not be provided because of coordination failures. For instance, in the case of the testing facilities required for EMI, the government could coordinate the collective action of private manufacturers of electrical machinery to set up this testing facility. As shown above, the benefit of doing so largely exceeds its cost, but firms may fail to cooperate because either lack of leadership or free-riding problems giving scope for a relatively costless coordination action by the government. Another potentially costless (or less costly) public intervention would be offer guaranteed ex-post subsidies to private laboratories that set up these facilities, that are triggered only in case these facilities become obsolete (because of a change in EMI technical regulations) before the investment has been amortized.

Firms' appraisal of the supply of trade-related TPGs

More insights on the demand for trade-related TPGs can be obtained by analyzing the perception that surveyed firms have regarding the adequacy of the provision of these public goods, both in terms of its "physical" provision and in terms of the management of existing facilities and programs.

We present next a summary of the firms' views on these matters, which help to qualify the costs of compliance, and the underlying willingness to pay for TPGs that we analyzed in previous sections.

TPG	*Firms' perception*
International accreditation of local tests, inspections and certifications	Lack of harmonization between local and foreign technical regulations in several sectors (dairy products, beef) or the lack of physical capacity for testing different technical requirements (electrical machinery, motor valves) unduly raise the costs of compliance for local firms. Lack of mutual recognition agreements increase the costs of testing and inspections and the probability of rejection of shipments (wine sales to Germany). Lack of local certifiers for several norms (SA 8000, for instance) raise the costs of certification.
Knowledge creation	The National Institute of Industrial Technology appears to be biased towards testing activities and away from quality-related research and technical assistance.
Availability of testing laboratories and metrology services	Personnel in public research institutions are not sufficiently trained and updated to perform certain tests. Adequate material resources (machinery and equipment) are frequently not available. Firms in several activities are forced to perform many tests abroad, at a high cost. These deficiencies prevent the realization of joint R&D on new products between the public and private sectors. The public sector does not offer all the calibration services that are required to test compliance with different norms and technical regulations in several industries.
Response time	Large delay in the response of public institutions to demands of technical assistance, the approval of new models, and in testing activities. Delays in accreditation of private laboratories have led to bottlenecks for the approval of compliance with new technical regulations in the electrical machinery industry.
Institutional dynamic capabilities	Cellular phones have changed EMI technical regulations in the EU, and manufacturers of electrical machinery fear that new facilities for testing and certifying compliance with these regulations may not be installed in time.
Enforcement of local technical regulations	Poor enforcement (weighing machines, dairy products) leads to unfair competition that deters complying firms from passing to prices the costs of quality development and compliance with regulations.
Facilitation or obstruction of coordination	The National Institute of Industrial Technology (INTI) did not allow manufacturers of weighing machines (70 percent of which are located in the city of Rosario) to fund the installation of testing facilities for the approval of new models and the tracing of scales and masses in the city of Rosario. As a result, these tests have to be undertaken at the Miguelete technological park in the province of Buenos Aires, more than 300km away from the location of production.
Access problems	Many surveyed firms report a geographical mismatch between the location and production and the location of laboratories and other testing and trade-creating facilities.
Education of firms, workers and customers	The government does not play an active enough role in activities of training and assistance that lead to a cultural change regarding investing in, and demanding, quality. When new technical regulations have been introduced, like in the case of having firms develop auditable quality systems in the weighing machines industry, the government has offered no assistance of any sort, leading to sizable costs of compliance.

TPG	*Firms' perception*
Assistance to certification programs	Programs of support to certifications lack practicality for their implementation.
Financial assistance to quality development	Fiscal incentives to quality-related training programs have proved useful. The financing of the one-time investments required to meet foreign product standards and technical regulations, which often represent a large initial disbursement, is not readily available. While the FONTAR program offers financing for new machinery and equipment, there is a mismatch between the response time demanded by foreign customers and the speed of access to credit. This is particularly critical for SMEs.[35]
Inter-institutional coordination	Lack of agreement between INTI and Metrología Legal regarding the tests required for the approval of new models of weighing machines has prevented the approval of new models since September 2003.
Collective action	In many industries, inter-firm heterogeneity regarding size, productivity, technological development, attitude towards quality, and conformity to regulations prevents collective action leading to privately-funded provision of industry-specific TPGs.

The perceptions of the interviewed firms regarding the supply of trade-related TPGs reveal that the large costs of compliance with foreign standards and technical regulations often emerge not from a "physical" lack of technological infrastructure, but rather from an inadequate management of TPGs.

A good example is given by the contrast between the strategies pursued by Argentina and Brazil when introducing the requirement that manufacturers of weighing machines implement an auditable quality system. Brazil proceeded with a 5-year implementation plan. During the first year the public sector provided technical assistance to firms. During the second year there was a campaign for educating consumers and users. During the third year manufacturers received financial assistance from the government. The fourth year was used as a test period. And only in the fifth year was the technical regulation enforced. By then firms had both the technical and financial capability to comply with this regulation, and the large rate of compliance allowed them to share with consumers the costs of compliance.

In Argentina, instead, the introduction of this technical regulation was not preceded by any transition or adaptation period, firms did not receive any kind of public support and customers were not educated. As a result, one of the largest firms had to afford at once costs of implementation that represented 8.33 percent of their total annual sales. These costs included the re-adaptation of metrology control rooms, the accreditation of weights and masses, the re-training of workers and managers, certificates of calibration, and three audits by INTI. Additionally, the introduction of the new regulation was unanticipated, causing a large opportunity cost to this firm, which had to divert sizable resources from previously planned activities, such as the development of new models to be exported to OECD countries. These costs are exacerbated by the lack of education to customers, which do not value the compliance with this regulation, and by the poor enforcement of the regulation (only 10 percent of all manufacturers comply with it), which prevents complying firms from passing through to prices the costs the compliance.

A review of the list of TPG-related public institutions and programs, and their declared activities, would suggest that the most basic capacities for metrology, assessment and standardization are available.[36] Nevertheless, the perceptions of the surveyed firms regarding the suitability of the TPGs provided and the magnitudes of their costs of compliance with foreign standards and technical regulations suggest that important TPGs are missing, both in terms of "physical infrastructure" (like the facilities for testing EMI parameters) and in terms of management (like in the case of the introduction of the requirement of auditable quality in the weighing machines industry).[37]

Matching the supply and demand of TPGs: the case of laboratories

The qualitative information provided by firms suggests that many of the costs of compliance with foreign standards and technical regulations could be large because of deficiencies both in the physical supply and in the management of TPGs. The deficiencies in the physical supply appeared to be related to mismatches between geographical locations of production and of laboratories and other trade-related technological facilities, and to mismatches between industrial specialization of production and the specialization of laboratories.

While this is not a study on the supply of TPGs, we can nevertheless inspect if these mismatches exist at the aggregate level. To this end we will compare the endowment of laboratories, both in terms of location and testing specialization, with the location and composition of production. This is an exercise of limited scope, as we are considering only the physical existence of laboratories at a rather aggregate level of specialization, without having access to indicators of performance and without inquiring neither into the range of experiments they can perform nor into how updated they are with respect to the ability to test foreign product standards and technical regulations. Nevertheless, any obvious mismatches that could result from this analysis would be indicative of more worrisome mismatches at a deeper level.

There are eight accredited public testing laboratories and two public calibration laboratories. Additionally, there exist twenty nine private testing laboratories, nine private calibration laboratories and two private clinical analysis laboratories that are accredited by the Argentine Office of Accreditation. Their capacities regarding the number of experiments that can be performed vary with the industrial area of activity being covered by the laboratory.

Industry match between the supply and demand of accredited laboratories

We now turn to an exploratory comparison of the relative availability of specialized laboratories by industry with the participations of each of these industries in GDP and in total exports. The objective is to roughly appraise whether some activities may face an under-provision of accredited laboratories. Table 18 presents this comparison.

The comparison allows to distinguish three groups of industries. The first group includes those areas of activity where the participation of specialized laboratories in the total number of laboratories exceeds the industry's participation in GDP and exports. These industries include textiles, non-metallic minerals, electric machinery and electronics, gas, toys and precision measurement instruments. Some of these activities, like electrical machinery and electronics, have large ISO certification intensities. Additionally, sectors like electronics and textiles tend to have relatively large costs of quality development, suggesting that this "over-provision" may result from an intrinsic testing intensity of these industries. This over-provision, however, does not guarantee that all the compliance-related experiments can be performed, as suggested by our analysis of the costs of not having access to testing facilities for EU EMI technical regulations in the electrical machinery industry.

The second group is made of industries that have greater participations in laboratories than in GDP, but smaller participations in laboratories than exports: fabricated metals and metal mechanics, petroleum and its products, tobacco, and motor vehicles and transportation equipment. These activities appear to be adequately equipped relative to the domestic market, but insufficiently equipped relative to their participation in international trade. However, this "under-provision" relative to export shares is relatively small and does not appear to raise much concern. The last group includes those activities that appear to face an "under-provision" of testing and calibration facilities vis-à-vis their participations in GDP and in international trade: chemicals, agricultural goods, and food. The apparent under-provision raises special concern in agricultural goods and the food industry, that represent a large share of total exports, and which have relatively high costs of compliance with foreign standards and technical regulations.

Table 18

Sector	Laboratories		Sectoral share in GDP	Share of sectoral exports on total exports
	Quantity	Share (%)		
Textiles	2	3.92	0.54%	0.91%
Non ferrous minerals	3	5.88	0.59%	0.36%
Fabricated metal and mechanics	2	3.92	3.68%	6.14%
Chemicals	1	1.96	3.80%	5.25%
Audio and video equipment and electrical machinery	10	19.6	0.35%	3.58%
Water	10	19.6	0.24%	
Petroleum and its products	6	11.7	2.53%	15.77%
Agricultural goods	3	5.88	11.04%	25.90%
Tobacco	2	3.92	0.85%	5.25%
Motor vehicles and transportation equipment	1	1.96	1.10%	6.91%
Gas	3	5.88	0.32%	2.27%
Toys	1	1.96	0.29%	1.40%
Food and Beverages	2	3.92	6.37%	25.90%
Precision instruments	3	5.88	0.07%	0.36%
Health	2	3.92	3.04%	

Source: UNIDO based on IRAM and INDEC

There is an apparent over-provision (sectoral share of testing facilities that exceeds sectoral shares in GDP and exports) of laboratories in areas that have large certification and testing intensities, such as electric machinery, electronics and textiles. This over-provision, however, does not guarantee that all the compliance-related experiments can be performed.

The apparent under-provision of laboratories for sectors such as agricultural goods and food (large share of total exports and high costs of compliance) is more troubling. It may result from poor enforcement of domestic technical regulations, that reduce the demand for testing and calibration, from a relatively low domestic demand for quality, or from an orientation of exports to technically less demanding markets. All these factors may contribute to make the private benefits of provision smaller than the private costs. The distinct possibility that the social benefits of the provision of laboratories for these activities are larger than the private cost would give scope for government intervention.

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Notes

[1] IERAL-Fundación Mediterránea

[2] IERAL-Fundación Mediterránea

[3] This paper has greatly benefited from the useful comments and suggestions from Carlos Lerch. The authors wish to thank the superb research assistance of Paula Nahirñak and Rosario Flores-Vidal.

[4] Sometimes protection is the only goal of the standard. They usually apply to both national and foreign production, and thus do not correspond to the classical form of protectionism which openly discriminates against imports. In practice, standards and technical regulations may be used strategically to enhance the competitive position of countries or individual firms. Standards and technical regulations can potentially impede international trade, for example, by imposing unnecessary costly and time-consuming tests or by laying out unjustified different requirements in different markets.

[5] Chen et al (2004) perform an econometric analysis using the data from the WBTBTS, and find that technical regulations in developed countries adversely affect firms' propensity to export in developing countries. Their results indicate that testing procedures and lengthy inspections processes reduce export shares by 9 percent and 4 percent respectively. Besides, they also find empirical evidence that standards and testing procedures impede exporters' market entry, reducing the likelihood of exporting to multiple countries by 13 percent and 9 percent. Maskus, Otsuki and Wilson (2004) use the same data to estimate translogarithmic cost functions to find that fixed setup costs of compliance also raise the variable costs of production. According to their estimates, more strict standards raise variable costs of production at least as much as the setup costs.

[6] There are however, different shades of public status. Some goods are typical public goods that must be provided by the government (like having an internationally accredited and technologically updated food safety agency), other goods are industry-specific ones that can be provided by the private sector (like facilities for testing the compliance with electrical safety standards) but face a coordination (free-riding) problem that may undermine cooperation in their provision. This coordination failure can be overcome either by the intervention of the government (offering, for instance, tax deductions to those who contribute to funding the facilities) or by having a private association offer club goods, in addition to the TPG, to those that contribute to its provision (see Sercovich and Dolun, 2005, processed).

[7] The questionnaire and the characteristics of the interviewed firms are presented in Annex 1.

[8] These dynamic capabilities can be illustrated with an example related to electrical safety. A typical technical regulation faced by exports of electrical machinery to the EU deals with electromagnetic interference (EMI) parameters. In order to test for compliance a complex and costly laboratory is required. The problem is that these regulations change frequently with the appearance of new technologies, like cellular phones, that alter the previously defined EMI parameters and render obsolete these costly laboratories. Under these circumstances, private laboratories are unlikely to set up these testing facilities, and if these exports are to be promoted, the public sector would have to intervene in two ways. First, by being willing to fund updated testing laboratories. Second, by being a member and participating actively in technical committees of the International Electrotechnic Commission (IEC), which would allow it to anticipate the upcoming changes in STRs and help the private sector build trade capacity ahead of the changes in technical requirements. This same example can be easily extended to other areas like food safety.

[9] For instance, the INTI and Metrología Legal introduced the requirement that manufacturers of weighing machines must have auditable quality systems, but the lack of enforcement of this rule implies that only 10 percent of the firms in this sector comply with the regulation.

[10] This negative impact on the incentives to comply would disappear if consumers were willing (and able) to pay more for the enhanced credibility and reputation brought forth by compliance. If willingness to pay were not large enough, then complying firms would be hurt.

[11] For instance, a new Electrical Safety law, equivalent to IEC standards, was enacted in 2000, but there were not enough accredited laboratories to test compliance with the new regulation. As a result, the deadline for compliance was significantly extended. In the meantime firms were only required to show the application forms for the tests in order to be allowed to continue producing and selling. The problem was further compounded by the shortage of services of technical assistance, either from private or public laboratories. This situation was overcome only when more private laboratories were accredited.

[12] Examples of programs of this type are the PROCAL (Program of Norms and Quality Accreditation), that seeks to support the development of the demand for accreditation services; the FONTAR, that provides financing and fiscal incentives for technological modernization, product and process upgrading, personnel training, and quality certification; and the Program of Argentine Food Quality, that supports the diffusion and intensive implementation of systems of quality management and assurance in the food sector, with the goal of ensuring compliance with food safety standards.

[13] Causality in the sense defined by Granger (1969) is inferred when lagged values of variable, say "ISO 9001 certifications" at time *t*, have explanatory power in a regression of a variable "exports" on lagged values of exports and ISO 9001 certifications. Id est, this analysis allows to determine whether a variable statistically precedes in time another variable. This approach was developed by Clive Granger, Nobel Prize in Economics 2003.

[14] For those more statistically inclined, the formal results of the test are shown in Annex II.

[15] The relatively high certification intensities of these activities may also arise from technical characteristics of production or the need to certify relatively more goods or processes.

[16] The low certification intensity in the food industry appears to be due to the fact that ISO certifications are not strictly required by the market (as opposed to HACCP, Eurep-GAP, GMP) in the opinion of sectoral experts. However, consultants believe that ISO 9001 certifications are a complement of all the other industry-specific certifications, and that the low certification intensity in this sector simply reflects poor levels of compliance with standards, coupled with exports to destinations with relatively weaker standards. This latter view would appear to be supported by the fact that a new standard, the ISO 22000 norm, which merges ISO 9001 features with HACCP features, is currently under development. ISO 22000:2005 specifies requirements for a food safety management system whereby an organization in the food chain needs to demonstrate its ability to control food safety hazards in order to ensure that food is safe at the time of human consumption. It is applicable to all organizations, regardless of size, that are involved in any aspect of the food chain and want to implement systems that consistently provide safe products. The means of meeting any requirements of ISO 22000:2005 can be accomplished through the use of internal and/or external resources (www.iso.org).

[17] For instance, we surveyed two comparable firms in the dairy products industry, which reported quite different costs of compliance (0.66 percent and 9.5 percent of total sales).

[18] An example of the costs of inadequate provision of TPGs is given by the differences in the costs of locally certifying different norms: certifying an ISO 14001 norm or an OSHA 19800 (occupational safety) norm costs 50 percent more than certifying an ISO 9001 norm. This cost differential is due to the relative scarcity of local certifiers of the more expensive norms. This relative scarcity is more evident in the case of norms such as the SA8000 (Social Accountability Standard), for which there are no local certifiers. The cost of certifying this standard abroad is in the US$ 10.000 – 30.000 range, about two and a half times what it costs to certify an ISO 9001 norm locally.

[19] The Argentine Institute for the Steel Industry (IAS), financed by steel producers, has an accredited testing laboratory located in San Nicolás, in the province of Buenos Aires, where most of the production takes place. The laboratories of the main oil refiner, Repsol-YPF, are used for interlaboratory comparisons by INTI.

[20] Producer surplus denotes the area between the price that producers receive and the supply curve, i.e., it is the difference between revenues and the total variable costs of production.

[21] The variable costs of compliance reduce the net price that exporters receive and drive out of the market those marginal exporters for which the net price falls below their unit costs of production. These exporters were obtaining a positive surplus before the introduction of the compliance costs (i.e., the producer price exceeded their unit cost of production), that was fully lost (i.e., it was not transferred to anyone) when they were forced out of the market, thus representing a deadweight loss to society.

[22] It could still be the case that there exist positive externalities (economies of learning at the industry level, technological upgrading associated to compliance with standards, and so on) from exporting to mature markets. In such case, there would be extra gains to society from having access to TPGs reduce private costs of compliance with foreign standards. Indeed, as Baldwin and Martin (1999) have suggested, the driving forces of the most recent waves of globalization have been the radical reductions in technical and policy barriers to international transactions, leading to an increasing role for the trade in ideas. In such an environment, the most successful developing countries have been those that were able

to integrate into global value chains, by acquiring the knowledge and technical proficiency to specialize in distinct value-adding stages. This integration requires that developing-country firms meet the standards and technical regulations in mature economies, which in turn facilitates the transmission of knowledge from the latter to the former. In this vein, Westphal (2000) argues that much of the success of the Republic of Korea and Taiwan Province of China is due to the fact that their export-led strategies facilitated important technology transfers leading to incremental technological knowledge. According to this author, "export activity serves as the stimulus for various efforts leading to technological development; it fosters and enforces the acquisition of enhanced technological capabilities." Furthermore, this author reports the results of surveys to Korean exporters in the 1970s that highlight that export buyers were considered to be either important or very important sources of technology. This author adds, "Because of the imperfect tradability of technology, externalities related to technological development can be extensive." To the extent that compliance with STRs in mature economies leads to enhanced technological capabilities, the social benefits from the provision of TPGs are likely to exceed the simple reduction in the producer surplus of exporters.

[23] This percentage corresponds to the case of the greatest estimated trade losses, which would accrue if the price elasticity of exports were 10, the discount rate 30 percent and the time-horizon were 5 years.

[24] This is the minimum value of the market, relative to exports, that is required to make it profitable to comply, and it applies to the case of exports of leather shoes when the time horizon is 5 years, the discount rate is 10 percent and the price elasticity of exports is 10.

[25] We should recall, however, that the estimates in most industries are based on the costs reported by relatively large, established and productive firms, and that the small firms (the marginal exporters that enjoy relatively smaller values of the market) may prefer to opt out.

[26] Due to the possibility that the STRs are more stringent in the EU and the US, it is likely that firms exporting to other destinations are smaller, less established and less productive than the ones we interviewed. As such, estimates of the revealed demand for TPGs in the case that standards applied to all markets or all exporters decided to target the EU and US markets that are based con the costs of compliance reported by the interviewed firms are likely to underestimate the true demand for TPGs.

[27] The maximum loss arises when the time horizon is 5 years and the discount rate is 10 percent, while the minimum loss occurs when the time horizon is 3 years and discount rate is 30 percent.

[28] Gargiulo (2005) has found that SENASA's traditional practice of approving inspections, responding to claims and avoiding sanitary outbreaks is not enough to deal with the increasing demands for safety certification in foreign markets. In particular, its current activity is not based on risk analysis, and is not transparent enough. Additionally, funding is scarce, and comes mainly from fees and charges to users of services; the government contributes less than 3 percent of its budget. The structure of the top management was designed for sanitary purposes, but is unfit for a food safety agency.

[29] IRAM, the national certification organization, is a non-profit organization which is funded by service fees and by membership fees from business firms that grant them access to club goods provided by IRAM. IRAM has been accredited by the national organization of accreditation and by three foreign accreditation institutions. It is also a member of different international certification networks, which facilitates the international recognition of its certifications, especially in the case of exports. Its budget includes spending in infrastructure, accreditation, membership in international mutual recognition networds, technical personnel training (both in-house and external, at home and abroad), and the regular costs of operation. IRAM not only offers certification services, but it also is the national organization of normalization. It hence actively participates in the ISO study and technical normalization committees.

[30] See IRAM (2005).

[31] The budget is the one required for a certification organization to undertake the certification of both management systems (ISO 9001, ISO 14001, etc.) and of Products, Processes and Services. The latter capability can be divided in two areas that relate to either voluntary or compulsory norms. This budget makes allowance for capabilities to certify the products from the following industries: electric machinery and electronics, food (including the capability to certify HACCP, GMP, GAP and sector-specific certifications), mechanics and metallurgy, chemicals, and a variety of services.

[32] We should additionally recall that ISO 9001 certifications may generate positive externalities (in the form of thick labor markets or of economy-wide improved organizational knowledge, for instance). In

such case, the benefits from providing TPGs that facilitate certification would be bigger than the ones estimated here.

[33] Some surveyed firms mentioned that INTI doest not homologate private laboratories for these type of tests either.

[34] In the case of fitness machines, tracing the cause of failure involves revising the geometry of circuits, which may entail changing all the hardware cards. This process takes about a month and a half.

[35] FONTAR (Argentine Technological Fund) is a program of the national government that finances investments from firms and private and public institutions that are geared towards innovation or technological modernization. To this end it offers loans, fiscal incentives and subsidies.

[36] Argentina has a national system of norms, quality and certification; a normalization institute; a national office of accreditation; a national institute of industrial technology; a national institute of agricultural technology; product certification institutions; public and private laboratories for testing, calibration and other metrology services and for clinical analysis; public programs and institutions for training and financing of quality development; regional technology centers; a legal metrology program; programs for financing technological modernization, training and quality certification; programs for the promotion of quality development in the food sector that include training, and technical and financial assistance; programs for quality development in several specific activities; an institute for auditing compliance with sanitary, phitosanitary and food safety requirements; and so on.

[37] A thorough analysis of the deficiencies, both in terms of management and in terms of technological and human capital endowments, of the Argentine food control agency (SENASA) is provided by Gargiulo (2005).

Annex I. Questionnaire and profile of interviewed firms

Characteristics of interviewed firms

Firm	*Activity*	*Exporting condition*	*Size*
1	Beef products	Established	Large
2	Dairy products	Established	Large
3	Dairy products	Established	Large
4	Peanuts and peanut butter	Established	Large
5	Canned tomatoes	Recently switched to exporter to the EU	Medium
6	Leather shoes	Established	Medium
7	Steel products	Established	Large
8	Refined fuels	Established	Large
9	Fruit juices	Established	Small
10	Granular enzimes	Established	Medium
11	Shock absorbers for automobiles	Established	Medium
12	Automobiles	Established	Large
13	Valves for internal combustion engines	Established	Medium
14	Aluminum	Established	Large
15	Wine making	Established	Medium
16	Fitness equipment	Recent exporter to OECD countries	Small
17	Digital weighing machines for commercial use	Exports to Latin America. Will start exporting to the EU.	Small

- Regarding geographical distribution, 29% of the interviewed firms are located or have plants in the province of Santa Fe, other 29% are located or have plants in the province of Córdoba, 24% are located or have plants in the province of Buenos Aires, 12% operate in the province of Mendoza, 6% have operations in Neuquén, other 6% in Chubut and a final 6% in Entre Ríos.
- Regarding size, 47% are large firms, 35% are medium, and 17% are small.
- Regarding exporting condition, 82% are established exporters, 12% have recently started exporting to OECD countries, and 6% are about to start exporting to the EU.
- Regarding area of activity, 41% correspond to food and beverages, 6% to refined fuels, 12% to basic fabricated metals, 17% to automobiles and parts, and 24% to other manufactures.

Questionnaire

1. Products exported to the US and the EU:

2. Values and volumes of outputs and exports to each destination

3. What are the costs of installing a system of quality control, management and assurance to satisfy the *domestic* product and process standards and technical regulations?

    a. We refer to two basic items:

        - *Quality control and assurance*: implementation of Good Manufacturing Practices; control of processes; control of raw material and inputs; personnel training; development of a supplier network; occupational safety; logistics; packaging and labeling; product development; maintenance of machinery and equipment; etc.)

            i. We are particularly interested in the costs of laboratory services (testing, clinical analysis, calibration), either in-house or outsourced.

        - Costs of accreditation / certification. They may include:

            i. Costs of certifiying ISO 9001, ISO 14001, HACCP, OSHA 19800/IRAM 3800, SA8000 norms, and any other voluntary norm.

            ii. Costs of certifying technical regulations and any compulsory standard: electrical safety norms, traceability of weights, etc.

            iii. Costs of accrediting own laboratories, if it applies.

4. How big are the *incremental* costs (above those detailed in question 1) required to comply with the product and process standards, technical regulations, certifications, and any other product/process specification that are particularly required, either legally or by consumers/users, to export to the US and the EU?

    a. Re-tooling of plant/equipments to comply with Good Manufacturing Practices.

        i. Modifications of production facilities and equipments to comply with specific sanitary/health/safety requirements, or to avoid the usage of banned inputs (like freon gas, for instance; or the usage of nitrofurane as a pesticide in honey production).

    b. Improvements in machinery and equipment to comply with the specifications demanded by clients and/or countries of destination

        i. Investment in machinery and equipment to comply with standards that are more severe than those required in Argentina (for instance, precision filling machines to comply with the net content guarantee requirements in the US).

    c. Personnel training. To operate new machineries/processes.

    d. Improvements in quality control

        i. Investment in equipment/processes to comply with extra quality-related requirements in these destinations. For instance, the need to incorporate new laboratory analyses (in-house or outsourced) for testing, calibration,

microbiological analysis, etc.; or the requirement of new measurements or frequency changes in the statistical control process.

e. Certification of market-specific standards. For instance, EUREP-GAP, BRC and IFS in the case of food.

f. Delays/uncertainties in the inspections at destination, caused by the lack of accreditation/international recognition of certifiers/auditors/laboratories in Argentina.

5. What is your appraisal of the role played by the Argentine Public Sector in the provision of technological infrastructure (metrology; conformity assessment; documentary standards; testing and calibration laboratories; support of certification and accreditation activities; provision of generic technologies; technical assitance; National Institute of Industrial Technology, National Institute of Agricultural Technology, National Food Safety Agency; standard harmonization and enforcement; mutual recognition agreements; etc.) that may reduce the costs of compliance with foreign product standards?

Annex II. Granger Causality Tests for ISO certifications, exports and GDP

Pairwise Granger Causality Tests Date: 06/16/05 Time: 16:52 Sample: 1994:1 2005:1			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Probability
ISO14001 does not Granger Cause ISO9001 ISO9001 does not Granger Cause ISO14001	42	2.65079 4.73121	0.08397 0.0148
GDP does not Granger Cause ISO9001 ISO9001 does not Granger Cause GDP	42	0.01317 1.09412	0.98692 0.34542
EXPO does not Granger Cause ISO9001 ISO9001 does not Granger Cause EXPO	42	4.44349 1.89475	0.01864 0.16466
IBIF does not Granger Cause ISO9001 ISO9001 does not Granger Cause IBIF	42	1.04142 3.21704	0.36307 0.05151
EMIVAR does not Granger Cause ISO9001 ISO9001 does not Granger Cause EMIVAR	38	0.42927 0.19603	0.65457 0.82294
MOI does not Granger Cause ISO9001 ISO9001 does not Granger Cause MOI	42	1.2419 1.17191	0.3006 0.32101
ISO9001M does not Granger Cause ISO9001 ISO9001 does not Granger Cause ISO9001M	42	6.09374 2.87224	0.00516 0.06926
ISO14001M does not Granger Cause ISO9001 ISO9001 does not Granger Cause ISO14001M	42	2.85323 3.96837	0.0704 0.02745
GDP does not Granger Cause ISO14001 ISO14001 does not Granger Cause GDP	42	0.60482 1.15531	0.55148 0.32606
EXPO does not Granger Cause ISO14001 ISO14001 does not Granger Cause EXPO	42	2.26755 0.6508	0.11777 0.5275
IBIF does not Granger Cause ISO14001 ISO14001 does not Granger Cause IBIF	42	1.86966 1.45607	0.16845 0.2462
EMIVAR does not Granger Cause ISO14001 ISO14001 does not Granger Cause EMIVAR	38	0.06155 0.46217	0.94042 0.63393
MOI does not Granger Cause ISO14001 ISO14001 does not Granger Cause MOI	42	1.62103 0.48969	0.21142 0.61673
ISO9001M does not Granger Cause ISO14001 ISO14001 does not Granger Cause ISO9001M	42	4.76147 3.86081	0.01445 0.03
ISO14001M does not Granger Cause ISO14001 ISO14001 does not Granger Cause ISO14001M	42	2.91479 3.84047	0.06675 0.03051
EXPO does not Granger Cause GDP GDP does not Granger Cause EXPO	44	8.23577 4.72897	0.00104 0.01449

IBIF does not Granger Cause GDP	44	4.08671	0.02447
GDP does not Granger Cause IBIF		5.61882	0.00717
EMIVAR does not Granger Cause GDP	38	6.03365	0.00584
GDP does not Granger Cause EMIVAR		25.6942	0.00000019
MOI does not Granger Cause GDP	44	1.67723	0.20009
GDP does not Granger Cause MOI		2.21773	0.1224
ISO9001M does not Granger Cause GDP	42	0.68318	0.51126
GDP does not Granger Cause ISO9001M		0.40649	0.66892
ISO14001M does not Granger Cause GDP	42	0.39623	0.67567
GDP does not Granger Cause ISO14001M		0.04864	0.95259
IBIF does not Granger Cause EXPO	44	5.47275	0.00804
EXPO does not Granger Cause IBIF		5.33973	0.00892
EMIVAR does not Granger Cause EXPO	38	0.64223	0.53256
EXPO does not Granger Cause EMIVAR		1.2415	0.30209
MOI does not Granger Cause EXPO	44	5.99473	0.00537
EXPO does not Granger Cause MOI		9.39613	0.00047
ISO9001M does not Granger Cause EXPO	42	1.71587	0.19381
EXPO does not Granger Cause ISO9001M		7.96085	0.00133
ISO14001M does not Granger Cause EXPO	42	1.72603	0.19201
EXPO does not Granger Cause ISO14001M		4.41664	0.01905
EMIVAR does not Granger Cause IBIF	38	7.72754	0.00177
IBIF does not Granger Cause EMIVAR		35.8417	5.3E-09
MOI does not Granger Cause IBIF	44	0.50486	0.60748
IBIF does not Granger Cause MOI		1.23226	0.30274
ISO9001M does not Granger Cause IBIF	42	3.16687	0.05376
IBIF does not Granger Cause ISO9001M		0.43194	0.65248
ISO14001M does not Granger Cause IBIF	42	4.22403	0.02227
IBIF does not Granger Cause ISO14001M		0.57891	0.5655
MOI does not Granger Cause EMIVAR	39	1.00773	0.37569
EMIVAR does not Granger Cause MOI		1.67856	0.20174
ISO9001M does not Granger Cause EMIVAR	38	0.18926	0.82846
EMIVAR does not Granger Cause ISO9001M		0.77955	0.46687
ISO14001M does not Granger Cause EMIVAR	38	0.16893	0.8453
EMIVAR does not Granger Cause ISO14001M		0.0826	0.92091
ISO9001M does not Granger Cause MOI	42	1.50674	0.23492
MOI does not Granger Cause ISO9001M		1.44155	0.24954
ISO14001M does not Granger Cause MOI	42	0.86918	0.42768
MOI does not Granger Cause ISO14001M		2.3557	0.1089
ISO14001M does not Granger Cause ISO9001M	42	0.50848	0.60555
ISO9001M does not Granger Cause ISO14001M		8.87622	0.00071

Source: UNIDO

ISO 9001: total ISO 9001 certifications
ISO 14001: total ISO 14001 certifications
GDP: Gross domestic product
EXPO: Total exports, goods and services, in quantities
IBIF: Fixed Gross Investment
EMIVAR: Manufacturing production index
MOI: Industrial exports
ISO 9001 M: Manufacturing ISO 9001 certifications
ISO 14001 M: Manufacturing ISO14001 certification

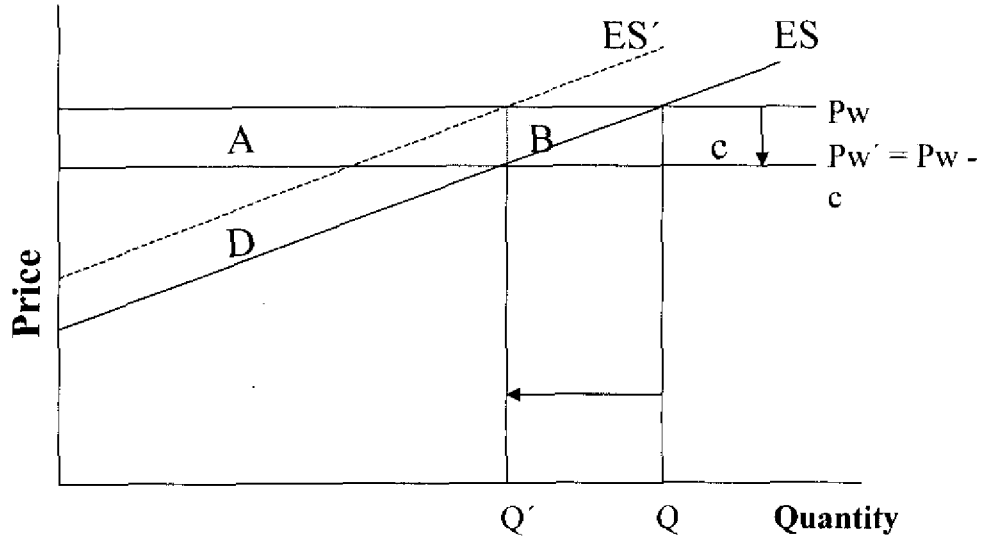
Annex III. Methodology for quantifying the firms' revealed demand for trade-related TPGs

Main features of the methodology

The economic costs from complying with foreign STRs come in the form of forgone producer surplus, which arises from being unable to enter, or remain in, a given market (in the case of setup costs of compliance like investing in new machinery and equipment, or of recurrent fixed costs like periodical product certifications), or from an eventual combination of bigger fixed costs together with reductions in the amount of exports and the net exporting price (in the case of variable costs of compliance like the use of more expensive inputs and raw material) if firms choose to enter, or remain in, the market.

In order to measure these costs Popper et al (2004) propose a partial equilibrium model that features the export supply schedule to a given market, the net price that exporters receive after complying with product standards, the fixed costs of compliance, and the associated producer surplus variations. The calculations of these costs only requires information on prices, quantities, and compliance costs and some approximation to the price elasticity of the export supply. Given that the fixed costs of compliance can be amortized over the timespan of the projected export project, the losses are measured in present discounted value terms.

Critical features of the model are the time horizon for amortizing the fixed costs of compliance and the rate at which costs are discounted, and whether the firms choose to enter, or remain in, the market. Another critical feature is whether firms have the option to re-direct their sales towards other markets with less stringent standards. It is also important to ascertain whether the exporter has market power or not, as in the latter case the (variable) costs of compliance will be fully borne by the exporter, while in the former it will be shared by exporters and importers.

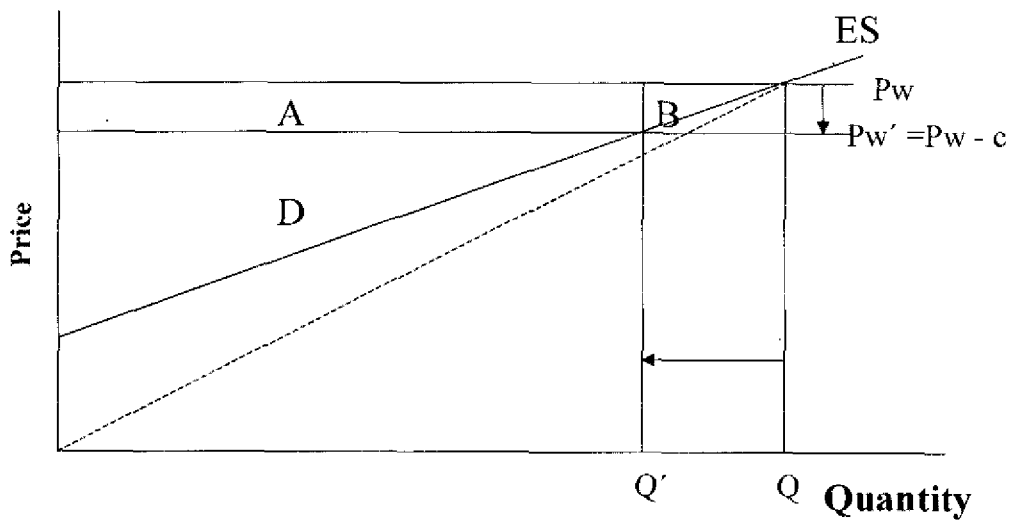


The previous figure illustrates the losses of producer surplus for exporters that arise from variable costs of compliance. The ES schedule is the export supply curve for a given market, while

the P_W curve represents the important demand for this good (and the price that exporters receive) in the absence of variable costs of compliance (this last curve is drawn assuming that the exporters have no market power and are price takers). In the absence of costs of compliance, the producer surplus obtained by exporters is equal to the area between P_W and ES (which represents the variable costs of production). When variable costs of compliance of size c are introduced, the export supply schedule shifts to the left to ES'. Assuming that exporters cannot redirect their sales to other markets with less costly STRs, exports fall from Q to Q', the net price to exporters is reduced to P_W – c, and the producer surplus is reduced by A+B. The A area represents the losses of producer surplus to infra-marginal exporters that remain in the market, while the B area represents the losses of producer surplus to marginal exporters that are forced to leave the market as their marginal costs of production exceed the net price they earn.

To these losses of producer surplus caused by variable costs of compliance we must add the fixed costs of compliance (both one-time and recurrent).

These losses from compliance must then be compared to the value-of-the-market for exporters (the total producer surplus that they obtain from exporting to this market). If the former are bigger, then exporters leave the market and the trade losses caused by the foreign STRs become equal to the forgone value-of-the-market. Otherwise the trade losses become equal to the present discounted value of the forgone producer surplus caused by compliance.



Following Popper et al (2004), the value of the market is proxied by half the value of exports (the area between P_W and the dotted line). This approximation unrealistically assumes that the marginal cost of exporting the first unit is zero, and as such over-estimates the true value of the market.

The private compliance cost-absortion of exporters (trade losses if they stay in the market and comply with foreign STRs) can be estimated according to the following formula:

$$TC = FC^I + SUM_{t=0,T} \{ [FC^P_t + c_t dX/2 + c_t X_t] / (1+r)^t \}$$

where TC denotes the total cost of compliance over the full time horizon of the export project, FC^I is the one-time or initial fixed cost, FC^P_t stands for the recurrent or periodic fixed costs, c_t is the

recurrent or periodic variable cost, dX_i is the change in the volume of exports caused by the bigger variable costs, X_i is the post-technical barrier-to-trade volume of exports, and r is the rate at which future flows are discounted to present values.

Assumptions made to measure the demand for TPGs in Argentina, and their implications

In order to make our estimations we will make the strong simplifying assumptions that exporters cannot divert their sales to alternative markets with less stringent standards, that all the costs of compliance are borne by exporters (i.e., they have no market power), that competing firms in the US and the EU face no costs of compliance, and that complying firms in Argentina do not obtain any benefit (in terms of increased producitivity and technological knowledge) from compliance. In this sense, our estimations represent an upper bound of the actual trade losses resulting from compliance.

In a case of perfect symmetry in variable costs of compliance for Argentine firms and firms elsewhere, including the imposing country, both the demand and supply of imports would contract proportionally, leaving producer surpluses everywhere. If instead the increase in the cost of compliance for Argentine firms were bigger than for competitors in the imposing country and in third countries, then they would be at a disadvantage and experience both a loss of producer surplus and of export share. When we consider fixed costs of compliance, asymmetries may arise even if the costs are identical, as the value of the market over which to amortize these costs may be smaller to Argentine firms if local firms capture bigger shares of the domestic market. Hence in the particular case of fixed costs we need not worry about the differential cost of compliance.

Our working assumption will be that costs of compliance are bigger for Argentine firms than for their counterparts in the US and the EU for several reasons. First, because STRs in the latter usually reflect previous innovative efforts in products, process and quality management practices undertaken by their own firms, whereas Argentine firms are standard and regulation takers, that must learn about the new STRs, and invest in compliance, after these STRs have been adopted. Second, because of a possibly weaker technological infrastructure (laboratories, metrology services, infrastructure for accreditation and conformity assessment, international recognition of local tests, inspections and certifications) that raises the costs of compliance for Argentine firms. Third, because the existence of home bias in consumption in the US and EU markets, together with a likely smaller size of Argentine firms, makes it safe to assume that Argentine firms would have a smaller value-of-the-market for the amortization of fixed costs of compliance. Fourth, there may be an asymmetry in the requirements: because of informational asymmetries, problems of reputation and/or credibility, firms in developing countries may subject to demands of certifications that are not requested to firms in the US or the EU.

We additionally make the assumption that the costs of compliance reported by the surveyed firms are representative of the industry-averages. The interviewed firms in four of the covered industries (dairy products, refined fuel, metals, and oil seed products) are large, well established, highly productive and global players. The estimated trade losses in these industries thus possibly represent a lower bound of the actual losses for the average firm in this industry. Nevertheless, these industries are highly concentrated and the estimations are likely to be largely representative. The interviewed firms in three of the covered industries (fitness equipment, canned tomatoes and digital weighing machines) are small (fitness equipment) and medium sized (the other two), but have been significantly increasing both their sizes and productivities in the past few years. Additionally, the

digital weighing machines firm additionally controls 40% of the local market, the fitness machine firm is the main manufacturer in Argentina and the canned tomatoes firm is one of the leaders in the local market. In this sense, the estimations of trade losses based on the costs of compliance reported by these firms are likely to be quite representative. However, there exists large heterogeneity within the weighing machines industry, as only 10% of the firms in this industry comply with domestic technical regulations, whereas the remaining 90% are "technically informal" and are likely to have larger costs of compliance if they decide to start exporting to mature markets. As such, the estimation for this industry may be biased towards a lower bound. The remaining firm (corresponding to the leather shoe industry) is small and of medium productivity, and the resulting estimations are likely to be biased towards an upper bound for this industry.

The working assumptions made regarding the inability to pass on to consumers the costs of compliance with foreign STRs and the lack of alternative markets with less stringent standards bias the estimations of the trade losses towards an upper bound. On the other hand, the characteristics of the interviewed firms offset this bias to some extent.

Methodology for extrapolating the industry-wide demand for TPGs to the economy-wide demand

These extrapolations from the industry-wide demands for TPGs related to exports to the US and the EU to the economy-wide demand for TPGs related to exports to these destinations are done by applying the average percentage loss of US and EU values-of-the-market for the surveyed industries to the estimated value-of-the-market for all exports to these destinations.

When doing this it must be kept in mind that: a) the interviewed firms correspond to industries that represent 10% of all exports to these destinations, b) the majority of these industries display relatively low certification intensities, which tend to be associated to relatively lower costs of compliance; the only two high certification intensity activities in our sample are weighing machines, which has a relatively important participation in exports, and fitness equipment, which has a very small participation in exports. This last clarification suggests that the extrapolation would be biased towards a lower bound of the actual demand for TPGs. The conjecture that the extrapolation is biased towards a lower bound is further reinforced by the fact that most of the reported firms are relatively large, well established and productive firms.

The extrapolations from the economy-wide demands for TPGs related to exports to the US and the EU to the economy-wide demand for TPGs related to exports to all destinations are done again by applying the average percentage loss of US and EU values-of-the-market for the surveyed industries to the estimated value-of-the-market for all exports to all destinations. When doing this it must kept in mind that the exports of these industries to all destinations represent 36% of all exports to all destinations. Again, the certification intensities of the surveyed industries, along with the characteristics of the interviewed firms, suggest that this extrapolation is biased towards a lower bound of the true demand for trade related TPGs. This bias is strengthened by the fact that the interviewed firms, which are currently exporting to the US and the EU, are likely to be larger, more established and more productive than those exporting to other, less demanding, destinations.

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Printed in Austria
V.05-89008—November 2005—100

About the cover illustration:
The graph on the cover, generated by means of fractal geometry model, simulates a pattern formed by three ring vortices playing catch up with one another (also called 'chaotic leapfrogging').

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