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“Promoting Innovation in the Services Sector:
Towards Productivity and Competitiveness”

Innovation and productivity in services and manufactures: the case of Peru

Quantitative Analysis Component: On the Determinants of Innovation in Services and its Linkages with Productivity*

Mario D. Tello[1]

Departamento de Economía - CENTRUM CATOLICA
Pontificia Universidad Católica del Perú
Av. Universitaria 1801, San Miguel, Lima 32, Perú

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1. Introduction

Analysis of services sector and innovation activities taken separately are scanty for Peruvian economy[1] and taken together not existent. The average share of real value added of the services sector[2] out of GDP in Peru in the last decade has been about 40% (Banco Central de Reserva Del Peru, 2012) and the estimated employment share out of total occupied economic active population (OEAP) about 32%, wherein 77% of this employment comes from the informal sector.[3] Most of the work on the services sector has been oriented to the analysis of export of services, in particular on the tourism sector[4] (Tello, 2012b). On the other hand, innovation studies have been descriptive analysis of science, technology and innovation activities (STI) and information and communications technology (ICT) indicators (e.g., CONCYTEC, 2005, Kuramoto, 2008 and Tello, 2011b and 2010) and on economic policy (e.g., CTI, 2012; Kuramoto and Diaz, 2010 and 2011; Kuramoto, 2007; Tello, 2010; Sagasti, 2011 and UNCTAD-ECLA, 2011).[5]

Based upon a survey on STI activities at the level of the firm implemented by the National Council of Science and Technology (CONCYTEC) and the National Institute of Statistics and Computing (INEI), this paper will analyze the interrelationship between investment on STI, innovation results and productivity at the level of firms for Peruvian economy for the year 2004 for two sectors: services and manufactures. Further, a particular market failure related to the financial constraint which may hinder innovation is also analyzed. To accomplish these tasks, the paper is divided in 7 sections. Section 2resumes briefly the literature of subject. Section 3lists the objectives and hypotheses. Section 4 summarizes Peruvian STI policy since 1990 to 2012, being the main focus the period 2001 until now. This section also includes the responses of three experts from a tailor made STI survey. Section 5 describes the main set of data sources. Section 6 formulates two structural models of innovation and productivity. Section 7 the results from the models' estimations are reported. Section 8 lists the main conclusions of the paper and provides policy guidance to foster STI activities. At the end of the paper a list of references, an annex table and figure are presented.[6]

2. Brief Literature Review

As a consequence of surveys undertaking in science, technology and innovation (STI) and information and communications of technology (ICT) at firms' level in some Latin American Countries (LAC), a literature on the innovation process, their restrictions and its effects on firms' performance[7] have emerged. A series of contributions in this area[8] for developed and some developing economies are listed in Mairesse and Sasaenou (1991), Mairesse and Mohnen (2010), Crespi and Zuñiga (2010) and Hall (2011). The dominant methodology in most of these contributions is that proposed by Crepon,

[1] See list of references in Tello (2012b, 2011b, and 2010).
[2] This sector include: electricity and water, financial and insurance services, government services, households and enterprises services, transport, telecommunications, private health and education services and hotels and restaurants.
[3] Author´s estimation. According with the World Bank (2012) figures, the average share of the services sector out of GDP for period 2000-2010 has been 59% and employment share for the same period (without 2010) 77%. The differences in the figures is due that services data of the World Bank (2012) include wholesale and retail trade and employment is defined over the formal sector. Author´s estimations for 2009 (Tello, 2011a) indicates that close to 80% of the OEAP belongs to the informal sector.
[4] About 3% of the GDP is export of services. That means that services sector in Peru is mainly a domestic oriented industry.
[5] An exception of this type of analysis is the work of Tello (2011b) who using regression techniques analyzes the role innovation upon economic performance in manufacturing firms.
[6] Also a set of eleven complementary tables not reported are available upon request to the author.
[7] Crespi and Zuñiga (2010) use six data sets from STI surveys in Argentina (period 1998-2001), Chile (period 2004-2005), Colombia (2004), Uruguay (2006) and Costa Rica (2008) to analyze the effects of innovation on firms' productivity. Balboni. Rovira and S. Vergara (2011) use ITC surveys to analyze the effects of ITC on manufacturing firms' performance in Chile, Argentina, Uruguay, Colombia and Peru.
[8] Initiated by Griliches (1979) and Griliches and Packes (1980).

Duguet and Mairesse (1998) called the CDM model.[9] The two main features of the CDM model are, on the one hand, the specification of a structural model in which variables such as R&D expenditures, innovation outputs and firms' (labor) productivity are interrelated. On the other hand, econometric techniques are used to deal with selectivity, simultaneity biases and some statistical features of the available data.

Crespi and Zuñiga (2010) point out that CDM model consists of four stages: (i) firms decision to invest in innovation activities. This is the firms' R&D investment[10] decision equation; ii) firms decision on the amount to invest. This is firms' research intensity equation; (iii) knowledge (technology) is produced as a result of this investment (the "knowledge production" function, e.g., Griliches, 1979 and Griliches and Packes, 1984). This is the firms' innovation output equation; and (iv) output is produced using new knowledge (technological innovation) along with other inputs. This is firms' productivity equation. The same authors also report a list of relevant empirical results on the factors that are included in these four equations. Among others:

i) Firm's decision to invest in innovation (R&D) increases with its size, market share and diversification, and with demand pull and technology push forces;

ii) Firm productivity correlates positively with a higher innovation output, even when controlling for the skill composition of labor;

iii) Technological innovation (product or process) leads to superior firm economic performance[11] in European firms (e.g. Monhen and Roller, 2005)

iv) Firms that invest more intensively in R&D are more likely to develop innovations—products, process innovation or patents—once corrected for endogeneity and controlling for firm characteristics such as size, affiliation with a group, or type of innovation strategies (i.e., externalization, collaboration in R&D, etc.).

v) Evidence with regard to the ability of firms in developing economies to transform R&D into innovation is much more mixed than in the case of firms in industrialized countries. The results regarding the impact of innovation on labor productivity are equally inconclusive for Latin American firms. The failure of R&D to correlate significantly with innovation outcomes and productivity in developing countries could be explained by the fact that firms in developing countries are too far from the technological frontier and incentives to invest in innovation are weak or absent. In many Latin American economies, firms' innovations consist basically of incremental changes with little or no impact on international markets, and are mostly based on imitation and technology transfer, e.g., acquisition of machinery and equipment and disembodied technology purchasing. R&D investment is, in many cases prohibitive (both in terms of financial costs and human capital needed) and, due to its cumulative effects, it could require longer time horizons to demonstrate results.[12]

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[9] The alternative methodology is based on estimations of total factor productivity (TFP) or labor productivity (Prod) using panel and/or cross sections data.

[10] Consistent with the available survey data for Peru instead of using investment in R&D, this paper uses investment in science, technology and innovation (STI). This includes: expenditures in science and technological (ST) activities (such as research and experimental development, formation of human resources in science and technology, and scientific and technological services) and innovation activities (such as research and development, capital investment, hardware and software designed to produce innovation in products, process, organization and commercialization). ST activities are related to generation, production, dissemination and application of scientific and technical knowledge in all the fields of science and technology. Innovation activities are the actions of firms with the objectives to implement in practice new concepts, ideas, and methods to acquire, assimilate or to incorporate new knowledge.

[11] Measured through labor productivity, sales, profits and so on.

[12] Raffo *et al* (2008) also provides a comparison study on innovation in manufacturing firms from LAC (Argentina, Brazil and Mexico) and European Countries (EC) (France, Spain, and Switzerland) and find structural differences between Europe and Latin America, but also the presence of heterogeneity within each. In particular, firms tend to engage in

In addition to firm characteristics, CDM models also include external forces acting concurrently on the innovation decisions of firms. These are traditionally indicators of demand-driven innovation (i.e., environmental, health and safety regulation), technological push (i.e., scientific opportunities), innovation policy (i.e., R&D subsidies), and spillovers. One particular force pointed out by Alvarez and Crespi (2011) is financial constraints. That credit constraints could severely harm innovation is a long standing conjecture in the field of the economics of innovation. Innovation is the result of knowledge investments and there are at least four specific attributes of knowledge that might have important impacts on the financing of innovation.

The first one is the semipublic good nature of knowledge that limits innovating firms to exclude others from the use of the innovation they create. Consequently this attribute not only may explain why firms under-invest on innovation but also may explain the constraint of financing innovation. The second one is that knowledge investments produce an intangible asset that might be very difficult to use as collateral. This asset is linked to the human capital (e.g., engineers and technicians) working in the firm. Banks, however, prefer to use physical assets to secure loans and they might be reluctant to lend when the project involves the accumulation of intangible assets, partially embodied in the human capital of firm's employees that can be lost whenever they either quite the organization or they are fired. The third attribute is that knowledge investments have tacit components that are very idiosyncratic to the firm. That means that a potentially substantial share of these investments is sunk and cannot be easily deployable in other activities. The fourth attribute is the uncertainty associated with its outputs. The uncertainty in this case relates to the lack of a very well defined probability distribution of potential impacts. In this context, knowledge investments have an options-like character in the extent that some projects with very small probabilities of great success may be worth to be pursued even if they do not pass an ex-ante cost-benefit analysis. All these attributes may have important impacts for financing innovation.

Another relevant issue on the innovation and productivity literature is the specificity of the productive activities analyzed. Thus, as pointed out by Tacsir, Guaipatin, Cathles, Larsson, Magri, and Virgem (2011), services are view as activities not very prone to innovation and policymakers from developing economies usually do not consider these as strategic in their quest to achieve sustainable growth. This is not the case for developed economies since services are increasingly recognized as a sector with the greatest potential to affect economic growth and a leading job provider (e.g., Gallouj and Weinstein, 1997; Gallouj, 2002; Evangelista and Savona, 2003; Cainelli, Evangelista, and Savona,2006; Crespi, Criscuolo, Haskel, and Hawkes, 2006; Gallouj and Savona, 2009; Gallouj and Djellal, 2010; European Commission, 2011).

Theoretical, conceptual and empirical analysis on innovation in services from developed countries are reported in Gallouj and Savona (2009), Gallouj and Djellal (2008), Gallouj and Djellal (2010), and Mothe and Nguyen Thi (2010) among others. In their theoretical and conceptual approach Gallouj and Savona (2009) and Mothe and Nguyen Thi (2010),distinguish between a technologist or assimilation approach (that innovation in services is the adoption and use of technology or that services are similar to manufacturing), service oriented, differentiation or demarcation approach (that highlights the specificities in the service product and production processes and consequently service innovation requires specific theories) and the integrative or synthesizing approach (wherein innovation can occur both in services and manufacturing and given the trend of convergence between manufactured goods and services, it develop a common conceptual framework). In this regard, the CDM model applied on services seems to be best aligned with the synthesizing approach. Turning to the empirical literature on innovation in services (e.g., Gallouj and Djellal, 2010 and Carayannis, Varblane and Roolaht, 2012), the studies indicate that:

innovation activities in order to achieve better economic performance on a similar basis among countries, but their interaction with national systems is weaker in developing countries. Further, foreign subsidiary of a foreign multinational has a heterogeneous effect on innovation, whereas it leads to increased productivity in every country.

i) R&D plays only a marginal role in some services, and that patents are used infrequently by service firms to protect their innovative output from imitation;

ii) A large group of sectors that rely heavily on ICT expenditures, which after the science- based sectors, are the most innovative. These sectors actively cooperate with client industries and firms positioned downstream along the value chain (retail and financial services);

iii) A set of poor innovators, that aim at introducing cost cutting and rationalized hardware technologies, which involve ICTs to a small extent include the most traditional service sectors (public services).

iv) Characteristics of service products and production and delivery processes (as well as firm size), in terms of degree of standardization, were the main variables affecting the propensity to innovate and the type of innovation introduced.

v) Service firms tend to cooperate and establish ‘open modes’ of innovation, and to rely on high- level skills and a particular type of human capital, that is, graduates from the humanities and soft disciplines.

vi) Despite high sectoral and firm heterogeneity in the service sector innovation plays a significant role in affecting productivity gains at firm level.

Further, results on comparative studies on innovation between services and manufactures reported in Tether 2005, Rubalcaba, Gago, and Gallego, 2010, Masso and Vahter (2011) point out:

i) Firms in services activities do in fact innovate although it is not clear if the intensity is greater or lower than that of the manufacturing firms;

ii) In contrast with manufacturing, innovation in services seems to be oriented towards organizational change, use collaboration with customers and suppliers, acquiring external intellectual property and emphasizing the skills and professionalism of their workforce;

iii) Innovation is frequent in knowledge intensive business services and that (product) innovation is strongly correlated with higher productivity. As in manufacturing, the main determinant of innovation is formal knowledge resulting from R&D or from acquisitions of equipment, patents or licenses. However, the role of R&D as an input in the innovation process in the entire service sector is on average usually much lower than in the manufacturing industry. This result maybe explained from the fact that in services R&D is often carried out on a more informal basis;

iv) The effect product or process innovation on labor productivity may be higher in services compared to manufacturing;

v) The relationship between innovation input and output, as well as the relationship between innovation output and firm performance may be similar in manufacturing and services.

vi) Differences between the goods sector and the service sector as a whole are, to a certain extent, more reduced than those among some pair-wise service sectors may emerge from the heterogeneity of service activities, although this does not invalidate the existence of relevant disparities between goods and services as such;

vii) Interactive aspects of innovation between clients and suppliers are gaining ground within all economic sectors (including services and manufacturing). Evidence (in European countries) show that clients may have a highly significant role in quality impact on services, unlike goods industries.

However, the horizontal dimension of service co-productive innovation indicators is also present in any sector, manufacturing industries included;

viii) The growing integration between goods and services opens the door to an interpretation of services innovation-related studies and policies that pays attention to peculiarities, goes beyond the differences, and focuses on communalities across all productive activities. Thus, horizontal policy measures may also be used to promote a certain service-friendly policy, based on considering services innovation as a systemic dimension of any innovative system.

In contrast to advanced economies literature on innovation in services, the empirical evidence in Latin American Countries is limited. However, this indicates the increasingly importance of innovation in services (e.g. Garrido, 2009) and that LAC service firms do in fact innovate, sometimes even more than their manufacturing peers. Further, they often face burden some financial constraints when they want to innovate, and these constraints can sometimes be more binding in the service sector than in manufacturing (e.g., Llisterri and García-Alba, 2008).

The present paper attempts to fill this literature gap on the subject focusing in the interrelationship between innovation and productivity for both manufacturing and services firms from Peru using two CDM models, which are presented in section 6.

3. Objectives and Hypotheses

These two CDM models and their set of variables are similar to those found in Crespi and Zuñiga (2010).[13] The first CDM (basic) model analyzes the effects of size, international exposure, patent protection, public financial support and diverse types of information on firms' investment decision and amount invested on STI activities and the impact of innovation output on labor productivity. The second CDM (extended) model analyzes in addition the effects of financial constraint on firms' decision to invest and the amount of investment on STI activities and the impact of innovation outputs (incorporated as structural equations) on labor productivity. Drawn upon the literature, the hypotheses to be tested for the case of Peru are the following:

H1: Firms' size, the existence patent protection, and firms international exposure (through exports and foreign ownership) may incentive firms to invest on STI activities. The last two factors together with public financial support, firms' collaboration with other entities and access to information sources may increase firms' amount of investment on STI activities. Contrarily, the role of financial constraint is expected to lower the probability that firms invest on STI activities and decrease the amount of expenditure devoted to such activities.

H2: Firms' technological (i.e., product and process) and non-technological (i.e., trading and organizational) innovations outputs are positively associated to firms' amount of investment in STI activities and international exposure.

H3: Firms' labor productivity may be increased through innovation output and the amount investment in STI activities. On the other hand, it is also expected that firms' size affect positively the level of firms' labor productivity.

H4: The effects of the above mentioned factors may be different between services and manufacturing ISIC branches.

[13] For comparisons purposes.

4. Peruvian Production Structure and Science, Technology and Innovation Policy

"This *is the true and crucial dilemma that Peru faces, in the middle of the renowned economic success* [of high rate of growth of per capita GDP]. A*lthough it requires maintaining the macroeconomic and finance equilibrium and the same time it urges to advance in science, technology and innovation, in other words, in the total factor productivity of the economy. Without national prioritization of STI activities, it would not be possible to maintain the high rates of economic growth in the long run and risking the advances achieved in the social areas*". Comisión Consultiva para la Ciencia, Tecnología e Innovación (CTI), 2012. Enacted on RS. 038-2011-ED

Consistent with the previous statement, the figures of Table 2[14](below) point out that Peru has one of the lowest levels of 'innovation' as measured by the WEF (2011)[15] within Latin American Countries. Thus whereas it invest about 0.1% out of the GDP in Research and Investment activities (R&D), United States invest close to 3% out of the GDP. The low performance of innovation activities can be attributed to the low levels of: i) quality of the scientific institutions, ii) the degree of cooperation among the STI entities; iii) technological capability, and iv) technological sophistication.

In this context of low investment on STI activities, figures in Table 1, show that the productive structure of Peru concentrated on primary output and traditional services (close to 60% of the GDP and 80% of the economically active population, EAP) produces large labor productivities disparities among sectors, particularly agriculture with manufacturing and knowledge business intensive sectors.

4.1 STI Policy in Peru[16]

The analysis of STI policies has been described recently by CTI (2012), UNCTAD (2012), OECD (2011), UNCTAD-CEPAL (2011), Kuramoto (2010), Kuramoto and Diaz, (2010 and 2011), Tello (2010), and Sagasti (2011 and 2009). Thus, the OECD report (2011) indicates that the 90's decade of Peruvian represented a period of dismantling of the incipient system of research and development of the 70's and 80´s. In such decades the R&D system failed to consolidate itself due to: an over-trust in the capacity of government planning, a significant unbalance between the resources devoted to the management of STI and the ones implemented effectively in projects, an absence of a critical mass of researchers, neglecting of academic excellence in universities, migration of researchers and professionals, and the low attention to the requirements of the private sector as well as the unwillingness to include them in the formulation and management of the STI programs.

During the 90's decade, as a result of structural reforms and rationalization in the administration of public spending, additional reduction in research and development spending was experienced in universities budgets and in public institutes of research which exerted a bigger pressure on the sector (Kuramoto, 2010). In the political-institutional plan, the *National Council for Science and Technology* (CONCYTEC), which was before a planning and coordinating body, was handed out to the Education Ministry (MINEDU), losing the resources, roles and hierarchy that its previous position in the *Presidency of the Council of Ministers* (PCM) entailed.

As a result of this sustained crisis on the sector, the science and technology indicators in the 90's decade ended up at a much lower level that the ones of other economies of the region. So, for example,

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[14]All indicators in Table 2 come from WEF (1998-2011). Some country data for R&D/GDP comes also from UNESCO (2009). Innovation indices (i.e., innovation index, quality of scientific institutions, cooperation index, indices of technological innovation and capability, firms technological absorption) have been transformed to a scale from zero to 100% (=(x-Min)*100/(Max-Min), wherein x is the score of the index, Min is the minimum value of the index and Max the its maximum value.

[15] This index includes the following aspects: the capacity for innovation, the quality of scientific research institutions, company spending on R&D, university-industry collaboration in R&D, Government procurement of advanced technology products, availability of scientists and engineers, utility patents*, and Intellectual property protection.

[16] This section has been greatly expanded by the contribution of Viviana Cruzado.

in 1997 the research and development spending represented less than 0.1% of the GDP, while in Latin America this percentage was at 0.5%. In addition, the number of scientific publications registered in Peru on the SCI (Science Citation Index) index was 175, while Colombia counted 545 and Chile 1170.

In the 2000 decade, different and still weak initiatives pointed out to a renewal of the attention of the public sector in STI policies were carried out. Consequently, in 2004 the Legal Framework of Science, Technology and Innovation was promulgated and approved by supreme decree N° 032-2007-ED. This device granted to CONCYTEC the role of "directing, promote, coordinate, articulate, supervise and evaluate all actions of the State in the science's areas, technology and technologic innovation", and would conduct the role of administrative authority of the *National System for Science, Technology and Innovation* (SINACYT), composed by all institutions and agents involved in the areas of research and development and its promotion.[17] It should be mentioned that although it was considered initially to ascribe CONCYTEC to the PCM, it finally remained at the MINEDU.

Within this framework, in 2005 the *National Strategic Plan for Science, Technology and Innovation for Competitiveness and Human Development (PNCIT) 2006-2021* was formulated. Its objectives, strategies and lines of action were outlined for the promotion of technological transfer, boosting basic and applied research, improving human capital and strengthening institutions and the STI system. On the other hand, STI funds with financial support of multilateral organisms were formulated and implemented during the 2000 decade. Among others:

INCAGRO, (Innovation and Competitiveness for Peruvian Agro) launched by Peruvian Government with the support of the World Bank in 2001 with an initial budget of US$ 20 million, addressed to promote innovation, technological transfer and public-private collaboration in the agricultural sector;

FINCyT (Fund for Innovation, Science and Technology) with the financial support of the IADB was launched in 2006 with a US$36 million budget. Among other objectives were to finance technological innovation projects in businesses as well as research projects in universities, research centers and associations between them, and to promote the formation of highly qualified human capital;

FIDECOM (Fund for R&D of Competitiveness) launched in 2006 with a US$65 million budget in charge of financing technological innovation projects with a special emphasis in small businesses (MYPEs);

A network of CITEs (Technology Innovation Centers) created in 2000 by the Ministry of Production (PRODUCE) with the aim of giving extension and technological transfer services to private businesses in a specialized manner according to their economic subsector (wood, textiles, wine, etc). These were designed in a way that could be public or private. The first group of CITEs was financed by the government (PRODUCE). Later on CITEs were financed by private sources and the income originated by their services. Nowadays there are 14 CITEs: 3 public and 11 private;

Finally, in 2004 within the framework of the Canon Law, it was established that 20% of the resources transferred to regional governments were to be distributed to the public universities of the region, with the aim of promoting research.

These STI initiatives, however, were subject of a series of deficiencies as pointed out in many reports on STI Peruvian policies. Thus, the UNCTAD-CEPAL (2011) reports that CONCYTEC faces the following challenges: (i) a diffuse vision on the function of the national innovation systems framework; (ii) an excessively reduced budget to carry out their functions (around US$4.5 millions between 2005 y 2010); (iii) structural weakness of others crucial subsystems for the development of the STI activities, particularly educational and industrial ones. As a result of these difficulties, at the

[17] Figure A1 show the SINACYT of Peru.

end of 2011 an Advisory Commission was formed intended to propose the fundamental outlines of a public policies' Strategic Plan for Science, Technology and Innovation (STI), and evaluate the institutional reforms needed to implement it. This commission recommended the creation of a Ministry of Science, Technology and Innovation which was not accepted. In June of 2012, CONCYTEC was ascribed to the PCM.

On the other hand, STI funds by 2011 onwards are concentrated in FINCyT due to the closure of INCAGRO, and the designation of this program as technical secretariat in charge of the execution of resources of the FIDECOM. Additionally, in the 2013 Budget Law a second operation has been generated that counts with a fund of US$100 millions for 4 years administrated by FINCyT.

Regarding the Public Research Institutes (IPI), Advansis report (2011) indicates that these institutes have the following limitations: (i) low quality in research and development activities; (ii) lack of strategic vision; (iii) weak conditions for coordination and governance; (iv) scarce financial resources; (v) inadequate preparation in the management of intellectual property rights, and (vi) conflict of interests. Advansis's assessment highlights the lack of leadership by the central government in the attention of the IPI necessities. In addition, there is not a national or sectoral strategy in which the activities of these are centrally directed, coordinates and supervised, which in this case would correspond to CONCYTEC. On the other hand, CITEs (most of them financed by private fund) lack the resources and the mission to get more intensively involved in research and development. Furthermore, they usually would not receive the projects' financing benefits from FINCyT or FIDECOM, thus damaging their own development and the objective which they officially have.

Regarding the resources generated by the Canon Law, public universities suffer a great deal of limitations in the use of such resources for research development. Besides the low human capabilities and lack of infrastructure, there is also the fact that the normative presents a series of restrictions in the formation or hiring of human capital for the development of the investigations such as: financing postgraduate studies, association with research centers, assistance to international events, or pre-feasibility studies, among others. In addition, there is no quality control system of the research financed by these resources, which endangers it effective impact on technological development and regional innovation.

4.2 STI Policy in the Services Sector[18]

Given the Peruvian productive structure oriented towards the primary and traditional services and its STI policy oriented towards production of goods,[19] it is no surprise that knowledge intensive business services, in general, have not been prioritized in such a policy. STI Policy in services has been concentrated on basic research at universities, public institutions, and research centers and on promoting Information and Communications Technologies (ICT). Even then, in most cases, the businesses within the service sector are not explicitly the target audience of these policies, although they are included in such policies.

Given the ICT cross-sectional nature and their direct relevance to the service sector (and its ISIC branches such as information technology, technological services, telecommunications, finance, education, culture, among others), the focuses of Peruvian ICT policy since 1990, similar to several Latin American Countries (LAC) (Guerra and Jordán, 2010), has been to provide and promote the infrastructure and the public services related to the Telecommunications sector under a strategy of

[18] The analysis of this section is concentrated in services sectors with a relative propensity to produce 'innovation'. Services related to the export sector such as transport and tourism are not analyzed. Tello (2012b) briefly survey the literature on tourism for exports.

[19] For example, fisheries at the IMARPE (Maritime Institute of Peru), agriculture at the INIA (National Institute of Agrarian Innovation), mining and energy at the INGEMMET (Geological, Mining and Metallurgical Institute) and manufactures branches at the CITEs.

universal access, affordability, fostering private competition, technological convergence in concordance with the evolution and development of information and communication technologies. Despite of this policy the digital gap between Peru and other LAC still persist (Tello, 2012a).

Investment in telecommunications infrastructure spread and modernized in the 90s. During this decade this market was deregulated and privatized.[20]Nevertheless, it mainly served the capital of Peru, Lima, and the most important district centers, leaving the inner regions of the country unattended, especially rural areas. Thus, nowadays there are 142 capital cities of provinces that still do not have access to optical fiber, and the mobile and fixed-line broadband penetration rate per department is below 5.2% in every department of the country except Lima and Callao. Along those lines, the e-government indicators of the Peruvian Government are below the regional and worldwide leaders (63rd place among 184 countries according to the United Nations), particularly in the case of the farthest local governments.[21]

Universal access policy of the public services in Telecommunications was declared in 1998 through the Guidelines of the Universal Access Policy (Legal devices 017-98-CD/OSIPTEL, 07/10/1998) and the creation of FITEL (Investment Fund for Telecommunications, D.S 013-93-TCC, 06/05/1993) for the provision of these services in rural areas and for social interest groups. Services for those areas and groups are being offered by the promotion of competition of mobile telephony and broadband licenses. It should be noted that the expansion of broadband infrastructure remains the key limitation to promote greater penetration of telecommunications services. To deal with this obstacle on June 28, 2012, the Law for the Promotion of Broadband and the Construction of the National Fiber Optic Backbone Network (Law No 29904) was passed to facilitate the Government participation in the promotion of broadband access through a subsidy for the private implementation of an optical fiber backbone network at inter-provincial level. This would enable to overcome market failure, which limits the private sector (given the complex geography) and finds support in the high levels of positive social and economic external factors generated.

Another ICT policy instrument was the establishment of the Information Society with the objective to elaborate and implement the so called Digital Agenda 2.0 through a Multi-sectoral Commission to develop the information society (CODESI) (R.M 181-2003-PCM, 07/06/2003 and D.S. Nº 048-2008-PCM del 16/07/2008-which redefine CODESI). This agenda contains guidelines, objectives, and strategies regarding the development of telecommunications infrastructure, human capacity, production service sectors, e-government, among others (see Table A5). The "Digital Agenda 2.0"is currently in process of implementation. This implies a cross-sectional impact on the access and use of the infrastructure, the promotion of research and innovation, the modernization of public services, among others.

Other public initiatives aimed at promoting ICT is the CITE Software intended to provide software services and technological solutions to micro, small and medium enterprises (MSME), and the "Crea Software Perú" Program aimed at promoting the trade integration of the information technology sector in external markets. Likewise, specific measures for the promotion of the call centers sector were implemented (General Sales Tax exemption and the creation of Tacna's free zone).There are also private initiatives, such as the Program to Support Competitiveness of the Software Industry (PACIS) and the Quality Decentralization Project for Software Competitiveness, among others.

[20] The major policy instruments in this area were: the privatization of the telecommunications (D.L. 702, 08/11/1991); the promotion of investment (Law of telecommunications, No 26096, 29/12/1992), competition (Law 26285, 12/01/1994) and openness of the telecommunications market (D.S. 020-98-MTC, 05/08/1998 and D.S 003-2007-MTC, Guides to Consolidate and Develop Competition of the Telecommunications services in 02/02/2007); the creation of OSIPTEL (The supervisor institution of Private Investment in Telecommunications ((DL. 702, 08/11/91) which objectives are to regulate and supervise the market of public services of telecommunications.

[21]D.S 067-2003-PCM, of 28/06/2003 established the Electronic Government in Peru.

Regarding the generation of ICT knowledge, there is a reduced and disjoined group of initiatives related to the generation of knowledge in the ICT sector. Among these initiatives is the Information and Communications Technologies Center (CTIC) of the National Engineering University (UNI), supported by the Korea International Cooperation Agency (KOICA) which conducts research on software design, miniaturized satellites, and artificial intelligence. Likewise, there is the CONCYTEC Chair in Information and Communications Technologies, aimed at developing software at San Agustín National Universityin Arequipa in cooperation with several public and private institutions involving experts from the Institut de Recherche pour le Développement (IRD) of France. The objective of this chair is to turn the region of Arequipa into one of the software industry development centers.

On the other hand, there is a National Institute for Telecommunications Research and Training (INICTEL) which objectives are to conduct research, training, and carry out studies and projects in the telecommunications field. It is currently assigned to the UNI. Public research institutes generally make intensive use of ICT-related knowledge to conduct research, among which are Peru's Geophysics Institute (IGP), Peru's National Service of Agricultural Sanitation (SENASA), the National Geographic Institute (IGN), and the National Meteorological and Hydrological Service (SENAMHI), among others.

In general, there are not public resources specifically intended for research in the ICT sector. It is important to mention that the financing sources for innovation have a restriction on the percentage of resources intended to pay researchers, representing a high barrier to research in the ICT sector since the use of labor is the major cost.

Three major shortcomings of ICT policy can be drawn from the previous description. First, an absence of a governing entity that organize the institutional framework of the ICT-related institutions, define and harmonize the policy guidelines to be followed, and coordinate and comply with its policies. In this regard, the low institutional capacity of CONCYTEC, as the governing body of SINACYT, has been a bottleneck in the structuring of this basic frame to the design and implementation of ICT promotion policies in every sector including the service sector. Although the "Digital Agenda" may be an alternative that allows us to move forward independently and in parallel to ICT promotion, nevertheless, in the absence of a basic institutional arrangement, the differentiation of roles and goals comprised in it, together with those of CONCYTEC and the National Council for Competitiveness (CNC), are not clearly defined.

Second, ICT promotion policy in the service sector does not have a clear definition of the associated sectors that could be the target of these policies. ICT policies are commonly related to the primary or secondary sector, and only indirectly to the tertiary sector in the ICT and research sector. In this context, the CITE Software is an interesting alternative for the delivery of services and technological solutions that could be evaluated for replication purposes in other service subsectors. The recent Law for the Promotion of Broadband and the Construction of the National Fiber Optic Backbone Network (on June 28/2012), if well implemented, may be a way to generate a better level of access to facilitate the delivery of higher value-added services within a wider spatial and population spectrum. On the other hand, a greater public sector participation in supporting and promoting these private initiatives could be another way to expand the focus of ICT policy to the services sector (examples of this participation has been the Program to Support Competitiveness of the Software Industry, PACIS, and the Quality Decentralization Project for Software Competitiveness).

Third, ICT policy has been oriented to provide services rather than for productive purposes. Thus, ICT tools in most of the cases are used as communication and information means. In that sense, the supply oriented ICT policy may be complemented with a promotion of the demand for ICT tools for productive purposes to enhance innovation activities to lead to higher and sustained growth of productivity.

4.3 Experts Opinion on STI Policy

Regarding the experts opinion, all of them coincided on pointing out that STI policy support in services has been partial and discretional from 1990 to nowadays. On the other hand, innovation strategy in Peru can be represented by a set of disarticulated institutions undertaking STI projects in an isolated fashion. The major actors and institutions related to STI policy are those listed in Figure 1, wherein FINCYT and FIDECOM were quoted as the most important programs/funds to support STI activities. Whereas Villarán argue that innovation, in general, is not a priority for political actors, Sagasti and Kuramoto point out that there are some particular actions from private and public entities that focus in the services sector, particularly, transport and ICT. For the experts, the relevant services sectors in Peru are those related to small and micro enterprises, SME, (e.g., trade, restaurants, hotels, personal services, and transports) and financial services. Competition and tender are the most often promotion instruments used in the services sector (and all the sectors in general) and there are only a few programs promoting independent innovation.

Experts also coincided, regarding the absence of a demand policy for innovation services and that the external conditions such as infrastructure in ICT, networks and some advance in regulation have been the most used in Peruvian economy. Finally in terms of future policy in services, there are no clear answers although one of them emphasized the generation of human capital. The question is for this expert is what we mean by services and innovation in services.

It is clear from the diversity of studies and experts opinion that in Peru there is no clear oriented STI policy in services sector. Most of STI policy diagnostic and recommendations are biased on sectors that produce tangibles goods and STI policy is reduced to increase total factor productivity through innovation through the majors 'factors' that generate them.

The policy recommendations of the advisory commission of CTI (CTI, 2012) summarize the way that most experts consider STI policy. These are: i) the need for human capital formation; ii) promoting R&D efforts; iii) STI policy should promote and facilitate social inclusion; iv) promoting innovation by enterprises; v) improving the physical and institutional infrastructure pro development of STI activities; and vi) disseminating knowledge. Moreover, in the list of prioritized 'sectors', services are not considered. Such a list includes: development of biotechnology in national crops oriented to exports, foods and seafood; development of STI (particularly nanotechnology) in materials from mining, metallurgical, and petrochemicals, development of ICT, improving traditional and cleaning technologies for SME, improving specific health diseases related to rural and poor social groups; and designing STI activities to prevent natural disasters.

Table 1
Production Structure Of Peruvian Economy (%)

Sectors	2000		2004				2008				2010			
	Q[1]	L[2]	Q[1]	L[2]	g_Q[3]	g_L[4]	Q[1]	L[2]	g_Q[3]	g_L[4]	Q[1]	L[2]	g_Q[3]	g_L[4]
Primary	16.50	34.74	17.07	38.88	4.710	6.861	15.40	35.31	6.033	0.681	14.47	34.91	1.542	2.916
Low Tech	15.05	8.48	15.59	8.86	4.752	4.754	15.51	9.58	9.218	5.596	14.84	9.10	2.491	0.826
High Tech	1.41	0.31	1.36	0.40	2.769	11.313	1.75	0.57	18.998	15.559	1.74	0.52	4.804	-0.859
Kibs, Transport and Communications	19.29	9.98	19.20	9.77	3.588	2.867	19.90	11.04	10.646	6.973	19.57	11.04	3.939	3.513
Finance	2.96	0.16	2.76	0.30	1.692	29.206	3.20	0.51	14.999	23.869	3.70	0.51	13.255	2.965
Rest of Sectors	44.80	46.35	44.01	41.80	3.210	0.672	44.24	42.98	9.571	4.081	45.68	43.91	6.653	4.676
Total	100	100	100	100			100	100			100	100		
Value[5]	109,371	12,187	125,608	13,876	3.71	3.46	172,819	15,696	9.40	3.28	189,616	16,800	4.86	3.52

Source: INEI (2012). Author's own work. [1]Share of the sector real value added out of the total real value.[2] Share of the sector economic active population out of the total economic active population. [3] Rate of growth of real value added. [4] Rate of growth of the economic active population. [5] Real value added in millions of dollars of 1994 and economic active population in thousands of people. Primary sector includes agriculture, oil, mining and fishing; Kibs include services to companies, transportation and communications; High Tech Manufacture includes other chemical products, Construction of non-electrical machinery, Electrical machinery and Construction of Material for transport.

Table 2
STI and ICT indicators, 1998-2011

Countries	Year	Innovation index[1]	R&D/GDP[2]	Private R&D[2]	Quality of scientific institutions[2]	Cooperation index[2]	Index of technological sophistication[2]	Index of technological capability[1]	Technological absorption (firms)[2]	Telephone lines (x100 inhabs.)	Mobiles (x100 inhabs.)	PC (x 100 inhabs.)	Internet users (x 100 inhabs.)
Peru	1998	n.d	0.1	21.2	24.7	30.7	26.2	n.d	34.5	6.2	3	3	1.2
	2000	27.0	0.1	23.3	25	33.3	28.3	45.2	63.3	6.6	4.9	4	3.1
	2004	19.7	0.2	26.7	30	21.7	38.3	40.8	46.7	7.5	14.9	8.4	11.7
	2009	28.5	0.1	28.3	31.7	33.3	39.8	39.8	58.3	10	72.7	10.1	24.7
	2011	28.3	0.1	26.7	31.7	36.7	n.a.	n.a.	65.0	10.9	100.1	n.a.	34.3
Chile	1998	n.d	0.5	31.8	39.3	45	53.5	n.a	60.7	20.3	6.4	6.2	1.7
	2000	40.2	0.5	28.3	45	36.7	55	57.5	68.3	21.4	22.1	9.2	16.5
	2004	29.5	0.7	36.7	45	36.7	66.7	59.2	68.3	20.6	57.4	13.3	19.4
	2009	40.2	0.7	36.7	48.3	48.3	54.7	54.7	75	21	88.3	26	32.6
	2011	33.3	0.4	35.0	50.0	51.7	n.a.	n.a.	73.3	20.2	116.0	n.a.	45.0
Brazil	1998	n.d	0.7	23.3	34.3	41.3	35.3	n.a	57.7	11.8	4.4	3	1.5
	2000	27.7	0.9	31.7	40	48.3	40	55.5	73.3	17.8	13.3	4.9	2.9
	2004	20.7	0.8	45	55	46.7	55	54	68.3	21.5	35.7	13.1	19.1
	2009	42.0	1	46.7	53.3	51.7	51	51	73.3	21.4	78.5	29.2	35.5
	2011	46.7	1.1	46.7	51.7	53.3	n.a.	n.a.	70.0	21.6	104.1	n.a.	40.7
Mexico	1998	n.d	0.4	26.5	26	37.8	28	n.a	57.7	10.4	3.5	3.7	1.3
	2000	26.8	0.4	25	38.3	41.7	40	61.7	58.3	12.6	14.4	5.8	5.2
	2004	20.0	0.5	33.3	45	35	50	52.2	53.3	17.7	37.7	11	17
	2009	33.2	0.5	31.7	45	41.7	42.2	42.2	60	19.3	70.8	14.4	21.9
	2011	33.3	0.4	33.3	50.0	50.0	n.a.	n.a.	60.0	17.5	80.6	n.a.	31.1
Argentina	1998	n.d	0.4	25	41.8	31.7	34.3	n.a	56	19.7	7.4	5.3	0.8
	2000	43.5	0.4	26.7	38.3	40	35	55.5	58.3	21.4	17.6	6.9	7.1
	2004	30.8	0.4	30	38.3	23.3	48.3	47.8	50	22.8	35.2	8.3	16
	2009	32.5	0.5	31.7	46.7	41.7	42.3	42.3	58.3	24.2	116.6	9	28.1
	2011	31.7	0.5	33.3	53.3	48.3	n.a.	n.a.	58.3	24.7	141.8	n.a.	36.0
Bolivia	1998	n.d	0.3	15.8	21.8	23.2	14	n.a	47	5.7	3	0.8	0.6
	2000	25.0	0.3	16.7	11.7	40	11.7	42	33.3	6.1	7	1.7	1.4
	2004	21.5	0.3	20	25	20	21.7	30.2	31.7	6.9	20	2.3	4.4
	2009	20.5	n.d	20	25	25	22.3	22.3	38.3	7.1	49.9	2.4	10.5
	2011	33.3	0.3	33.3	33.3	35.0	n.a.	n.a.	43.3	8.5	72.3	n.a.	20.0
Costa Rica	1998	n.d	0.3	40.8	58.3	46.3	51	n.a	65.7	19.8	2.9	8	2.7
	2000	41.8	0.4	31.7	56.7	41.7	51.7	66.2	70	22.9	5.4	15.3	5.8
	2004	19.3	0.4	43.3	53.3	35	55	49.5	61.7	31.6	21.7	21.9	20.8
	2009	44.7	0.4	46.7	60	55	45.3	45.3	68.3	31.8	41.7	31.2	33.6
	2011	40.0	0.4	43.3	60.0	55.0	n.a.	n.a.	66.7	31.8	65.1	n.a.	36.5

Table 2
STI and ICT indicators, 1998-2011

Countries	Year	Innovation index[1]	R&D/GDP[2]	Private R&D[2]	Quality of scientific institutions[2]	Cooperation index[2]	Index of technological sophistication[2]	Index of technological capability[1]	Technological absorption (firms)[2]	Telephone lines (x100 inhabs.)	Mobiles (x100 inhabs.)	PC (x 100 inhabs.)	Internet users (x 100 inhabs.)
United States	1998	n.d	2.6	75.3	86.5	76.3	92.5	n.d	35.2	65.2	25.1	45	30.7
	2000	91.7	2.7	75	95	56.7	95	90.3	91.7	68.2	38.8	57.1	43.9
	2004	90.2	2.6	80	88.3	73.3	91.7	87.3	88.3	60.7	63.1	76.4	66.3
	2009	79.5	2.7	76.7	86.7	81.7	76.8	76.8	86.7	52.6	89	80.6	72.4
	2011	70.0	2.8	71.7	80.0	78.3	n.a.	n.a.	81.7	48.9	90.2	n.a.	74.2

Source: author's own elaboration based on WEF (1998 – 2011) and UNESCO (2009). 1 Data reported for 2000 correspond to 2001; 2 For Bolivia and Costa Rica, data for 1998 corresponds to 1999; 3 Data from UNESCO (2009). Data for 1998 in Brazil corresponds to 1996 and the most recent correspond to 2005. Most recent data for Bolivia corresponds to 2002. The latest data in Chile, México, Argentina, Costa Rica and United States corresponds to 2007; 4 Most recent data corresponds to 2007.

5. Data Description

The main data source at firms' level used in this paper is the National Survey of Science, Technology and technological innovation (ENCYT-04) of 2004 implemented by CONCYTEC and INEI between October and November of 2005.[22]ENCYT-04 provides information on science, technology and technological innovation activities for 4898 firms from 44 sectors of the ISIC classification (Revision 3).

In this paper, the sample of services and manufacturing firms used for the quantitative analysis of the next section is 3888 enterprises. Real value added[23] (at prices of 1994) for these represented 31.90% of total value added of such sectors of the year 2004. The firms' real value added in services represented 33.33% and 27.40% for manufactures.[24]On the other hand, employment data of these firms represented 18.23% of the total formal economic active population of these two sectors of the same year: 15.95% corresponded to firms in services branches and 24.17% for firms in manufactures.[25]

The main features of the set of STI indicators obtained from ENCYT-04 and described in Tables 3, 4 and 5are the following:

i) From firms STI output (Table 3), the share of the number of firms that innovate (either technological and non-technological innovation or both) was greater for manufacturing firms than for services firms: 38.2% and 28.1% respectively. Shares for both manufacturing branches were slightly higher than firms from both services branches. On the other hand, the respective share for firms with more than

[22]Another survey of the same features of ENCYT 2004 has been recently implemented by the same institutions gathering data for 2009 and only manufacturing firms.

[23]Firms' value added comes from sales data. These are obtained using the average ratio of value added over value of production of the respective ISIC sector of the input output matrix of 1994 and 2007 provided preliminarily by the INEI.

[24] For the fours ISIC groups the shares of the real value of the firms out of the respective real value of the universe were for Kibs 21.19%, Traditional services, 43.79%, High-Tech22.44% and Low-Tech27.37%. In the case of formal employment the figures are Kibs 12.53%, Traditional Services 18.87%, Low Tech manufactures 24.25%, High-Tech manufactures 23.56%.

[25] In the case of formal employment the figures are Kibs 12.53%, Traditional Services 18.87%, Low Tech manufactures 24.25%, High-Tech manufactures 23.56%.

10% of the total capital foreign owned in both sectors was greater than the respective share of national owned firms. Regarding the distinction between technological innovation (TI) and non-technological one (NTI), services firms did have a greater share of NTI than TI. The opposite shares had firms from the manufacturing branches.

ii) From firms STI inputs (Table 4), firms' investment intensity ratio (measured as the share of expenditure on STI activities out the total sales) was slightly higher for services (i.e., 4.9%) than for manufacturing (4.4%). Kibs and the high-tech manufacturing had the highest ratios (9.4% and 5% respectively). Further, national firms STI investment ratios were higher than foreign firms in both manufacturing and services sectors. On the other hand, and consistent with the higher share of manufactured innovative firms, the share of firms that performed 'innovation' on continuous basis in manufacturing (i.e., 14.8%) was higher than in services (9.6%). More than 50% of the total STI expenditures in both sectors were spent in other STI activities related to training, consultancy services, engineering and industrial design, software and technology services.

iii) From policy relevant STI indicators (Table 5), figures show that in general firms did not collaborated with other entities for innovation purposes. In any case, the share of manufacturing firms that did collaborated (i.e., 6.1%) was higher than the respective share of services firms (3.7%). The same low shares applies for firms' international exposure having also manufacturing firms a higher share (i.e., 4.8%) than services firms (1.6%). Similar figures are obtained for the share of firms that did have patents. On the other hand, the share of foreign firms that had collaboration, patents application and international exposure was higher than domestic firms for both sectors. Finally, the share of firms that received public financial support for innovation was higher for manufacturing (i.e., 7.9%) than for services 2.2%. Unexpectedly, the share of foreign firms that did receive this support was greater than the respective share of domestic firms in both sectors.

Summing up, the 2004 figures on firms STI activities are consistent with the low STI investment indicators at the national level and priority of STI economic policy of shown in the former section. What is striking is that despite that a third of the interviewed firms of the sample that did perform STI activities, their average amount spent on these activities per worker in both sectors were US 2353 dollars of 1994 per worker (less than 6.5 dollars per day/worker). To what extent this little amount has impacts on firms' performance (as a labor productivity) is investigated in the next sections.

Table 3:
STI Output Indicators at Firm Level, Peru 2004

		Technological Innovation					Non-Technological Innovation				
ISIC DESCRIPTION	**N**	**Product**	**Process**	**Inn[1]**	**In-house Tech-Inn[2]**	**New[3]**	**Org**	**Mark**	**Non-Tech Inn[4]**	**Any Inn[5]**	**Tech and Non-Tech Inn[6]**
Services	**2732**	**12.77**	**13.07**	**17.97**	**9.99**	**4.65**	**19.62**	**14.35**	**23.17**	**28.07**	**13.07**
KIBS	738	17.21	16.12	23.04	14.23	6.37	20.60	13.41	23.44	31.30	15.18
Traditional Services	1994	11.13	11.94	16.10	8.43	4.01	19.26	14.69	23.07	26.88	12.29
National	2592	11.54	12.08	16.55	8.91	4.44	19.06	14.08	22.61	26.85	12.31
Foreign	140	35.71	31.43	44.29	30.00	8.57	30.00	19.29	33.57	50.71	27.14
Manufactures	**1156**	**24.57**	**25.95**	**32.87**	**19.64**	**9.43**	**22.49**	**15.22**	**25.78**	**38.15**	**20.50**
Low Tech	954	23.06	24.32	30.82	17.92	8.91	20.13	13.52	23.58	35.74	18.66
High Tech	202	31.68	33.66	42.57	27.72	11.88	33.66	23.27	36.14	49.50	29.21
National	1196	25.59	26.25	34.45	20.32	10.03	22.49	14.97	25.75	39.88	20.32
Foreign	104	49.04	49.04	59.62	40.38	15.38	43.27	33.65	52.88	68.27	44.23

Source: CONCYTEC (2005). Author's own work. [1] Product or process innovation. [2] This firms produced innovation of any kind (product, process, marketing and organization), with their own funds and without any collaboration from other entities [3] New to Market product innovation. [4] Organization or marketing innovation. [5] Technological or non-technological innovation. [6] Technological and non-technological innovation. The share of firms of each STI indicator is out of the total firms of the respective ISIC group.

Table 4:
STI Input Indicators at Firm Level, Peru 2004

ISIC DESCRIPTION	N	Inputs: Expenditure on STI[7]	R&D[8]	STI Capital Goods[9]	Other STI Activities[10]	Firms that performed R&D	Firms that performed R&D on a continuous basis
Services	**2732**	**4.87**	**2.56**	**19.93**	**77.53**	**5.29**	**9.55**
KIBS	738	9.40	3.34	16.92	79.80	7.08	11.25
Traditional Services	1994	2.91	2.23	21.23	76.54	4.51	8.93
National	2592	5.16	2.52	20.83	76.68	5.14	9.07
Foreign	140	2.06	3.03	11.21	85.76	6.76	18.57
Manufactures	**1156**	**4.35**	**10.20**	**28.82**	**61.04**	**18.32**	**14.79**
Low Tech	954	4.25	8.57	31.03	60.41	15.41	12.89
High Tech.	202	4.97	16.53	22.75	60.95	29.70	23.76
National	1071	4.69	8.86	30.05	61.09	16.50	13.73
Foreign	85	2.48	20.42	23.28	56.71	32.76	28.24

Source: CONCYTEC (2005) Author's own work. [7] Total expenditures on STI (as a % of total turnover). [8] Expenditure on R&D as a % of total expenditure on STI. [9] Expenditure on STI Capital as % of total expenditure on STI[10] Expenditure on the others STI activities as a % of total expenditure on STI. These other STI activities include: training, consultancy services, engineering and industrial design, software and technology services. *Turnover from product innovations and from new to market product innovations were not available for Peruvian data.The shares of each STI indicator are out of the total firms of the respective ISIC group.

Table 5:
STI Policy Indicators at Firm Level, Peru 2004

ISIC DESCRIPTION	N	International markets[11]	Co-operated with foreign partners[12]	Co-operated[13]	Co-operated with Universities or Gov.[14]	Public Support[15]	Applied for patents[16]
All Services sector	**2732**	**1.61**	**0.44**	**3.73**	**2.05**	**2.16**	**1.21**
KIBS	738	2.03	0.95	4.20	2.57	3.12	0.81
Traditional Services	1994	1.45	0.25	3.56	1.86	1.81	1.35
National	2592	1.43	0.46	3.55	1.93	1.89	1.04
Foreign	140	5.00	0.00	7.14	4.29	7.14	4.29
Manufactures	**1156**	**4.76**	**0.78**	**6.06**	**3.81**	**7.87**	**3.89**
Low Tech	954	4.61	0.73	6.29	3.88	6.29	3.25
High Tech	202	5.45	0.99	4.95	3.47	15.35	6.93
National	1071	4.30	0.65	5.79	3.73	6.54	3.83
Foreign	85	10.59	2.35	9.41	4.71	24.71	4.71

Source: CONCYTEC(2005). Author's own work. [11] Share of firms that were active on international markets. [12] Share of firms that co-operated with foreign partners on innovation. [13] Share of firms that co-operated on innovation activities. [14] Share of firms that co-operated with Universities/Higher education or government research institutes. [15] Share of firms that received public financial support for innovation. [16] Share of firms that applied for one or more patents. These shares of firms are out of the total firms of the respective ISIC group.

6. CDM Models and Estimation Methodology

Two CDM models are estimated. The first one called basic model and the second the extended model.

6.1 Basic Model. This is composed by the following equations:

[6.1] $ID^*_i = X_{1i}.\beta_1 + \varepsilon_{1i}$; where if $ID^*_i > \mu_i$ then $D_{IDi}=1$; otherwise $D_{IDi}=0$;

[6.2] $IE^*_i = X_{2i}.\beta_2 + \varepsilon_{2i}$; where $IE^*_i = IE_i$ if $ID^*_i \geq \mu_i$, i.e., when $D_{IDi}=1$; otherwise $IE^*_i=0$;

[6.3] $TI^*_i = \delta.IE^*_i + X_{3i}.\beta_3 + \varepsilon_{3i}$; where $D_{TIi}=1$ if $TI^*_i>0$, $D_{TIi}=0$ otherwise is zero;

[6.4] $lnProd_i = \varphi_1.TI^*_i + \varphi_2.NTI_i + \varphi_3.\ IE^*_i + X_{4i}.\beta_4 + \varepsilon_{4i}$;

Wherein:

ID^*_i is the decision variable for the ith firm to invest on STI activities. It assumed that a firm decides to invest if ID^*_i is greater than zero or a threshold, μ_i. Note this latent variable is positive if the firms has in fact invested in R&D, i.e., if the dummy variable $D_{IDi}=1$;

X_{1i} is the set of factors that affects the appropriability aspect of firms' decision to invest on STI. Following Crespi and Zuñiga (2010), the set of factors considered are the following: firms' size represented by the number of workers, a dummy for export firms (D_x), another for foreign firms with capital share greater than 10% (FO) and a last one for patent protection (PatenP, if firms had patents in period 2002-2004);

IE^*_i is the firm STI investment intensity which is measured by the SIT expenditure per worker. If the firm decide to invest then IE^*_i would be the same as the actual STI expenditure per worker, IE_i otherwise IE^*_i would be zero.

X_{2i} is the set of factors that influences the firm STI investment intensity. Following Crespi and Zuñiga (2010), this set will be equal to X_{1i} plus the following dummy variables: public financial support(PFS, equal to one if firms received government financial support for STI activities, zero otherwise), market information sources ($INFO_1$equal one if firms used internet services for information search on product and services, zero otherwise), scientific information sources($INFO_2$ equal to one if firms used internet services for information search on R&D activities, otherwise zero), government institutions information($INFO_3$ equal one if firms used internet services for information on government institutions) and degree of coordination/cooperation/collaboration between firm 'i' and other entities (D_{coord} equal to one if firms have had coordination, collaboration or cooperation with other entities, otherwise, zero).

TI^*_i is the outcome of innovation process or the expected returns of innovation. This latent variable is positive if the firms has in fact have innovation outputs, i.e., if the dummy variable $D_{TIi}=1$. TI^*_i is determined by IE^*_I, and the set of factors X_{3i};

X_{3i} is the set of factors which also determine the innovation output. Following Crespi and Zuñiga (2010) the variables of this set includes: size, and the two dummy variables of exports and foreign ownership;

$Prod_i$ is the labor productivity of a firm (measured by firms' real value added[26]per worker) determined by both technological (TI) and non-technological innovation (NTI)[27]outputs, investment in STI, and X_{4i}. Following to Crespi and Zuñiga (2010)this latter variable includes: size and the ratio capital stock per worker, lnk_i (in natural logarithm).

Equation [6.1] represents the decision to invest (i.e., D_{IDi}=1) or not (i.e., D_{IDi}=0) on STI activities for firm 'i', wherein ID^*_i is a criterion (and latent) variable that may be the expected present value of profits generated by innovation activities. Firm 'i' will invest on innovation activities if ID^*_i is greater than a fixed threshold, μ_i. The variables include in $X_{1i}$are consistent with several arguments considered in the literature (e.g. Crepon *et al*1998;Braga and Willmore,1991; Kumar and Agarwal, 2000; Alvarez, 2001; Cohen and Klepper, 1996;Benavente,,2006; Crespi and Peirano, 2007;Girma, and Gorg, 2007 among others).

Although theoretical size arguments (exploitation of scale and scope economies) point out its effect upon the investment intensity equation, empirical evidence pointed that size may affect investment decision and not the STI investment intensity. For that matter and identification purposes, in this paper size is included in equation [6.1] and excluded of equation [6.2]. The Peruvian evidence shown below for the marginal effects of both equations supports these changes. Exports enhance the profitability and leaning of firms so it may determine both the decision to invest and the amount of STI investment. Similarly, foreign ownership may induce firms to invest and spend more on STI activities. The last variable considered in X_{1i} is patent protection which may well represents the capacity of the firm to manage intellectual property in order to protect innovation investments results and the strength of the intellectual property institutional regime of Peru.

Equation [6.2] represents the firms' effort or intensity of research, IE^*_i, which occurs when the firm decide to invest in STI activities (i.e., when D_{IDi}=1). This equation is the amount that firms wish to invest. X_{2i} is the set of variables that affects IE^*_i which includes the same variables that affect firms' STI investment decision except for size and add five factors: public financial support (PFS), firms collaboration with other entities (D_{coord}) and access to information on market products ($INFO_1$), R&D ($INFO_2$) and on government institutions ($INFO_3$). Those factors are found in several works in different LAC (e.g., Mexico and Argentina, Raffo, Lhuillery and Miotti,2008).

Equation [6.3] represents the outcome or production function of innovation or the knowledge that is produced by firms and is denoted by the latent variable TI^*_i (representing firms innovation in product and/or process). This outcome will be produced if firms respond that in fact innovate (i.e., D_{TIi}=1).[28] The innovation outcome depends of the firms´ effort or intensity of research, IE* and others factors, X_{3i}which are assumed to be equal to X_{1i} except for patent protection. Hahn and Park (2010), Hanley and Monreal-Perez (2011) and Ito (2011) present the argument and evidences between the links of exports and innovation, the evidence of the other two factors foreign ownership and size is provided by Crespi and Zuñiga.

Finally, equation [6.4] represents the determinants of firms' productivity, $Prod_i$. This variable depends upon innovation outcomes, TI^*_i, NTI, investment intensity in STI activities and traditional factors of the production function such as capital per worker, k_i, and firms size. Although the measurement of productivity has a variety of shortcomings not only in products (e.g., Syverson, 2011, Tybout, Katayama and Lu,2009) but also in services (e.g., Biege, Lay, Schmall, and C. Zanker, 2011; Dean and Kunze, 1992; Griliches, 1992; Gallouj and Savona, 2009; and Gallouj and Djellal, 2008), as in the work of Crespi and Zuñiga (2010), Crepon *et al* (1998) as many others this paper measure labor

[26] Value added is obtained using the average ratio of value added over value of production of the respective ISIC sector of the input output matrix of 1994 and 2007 provided preliminarily by the INEI.
[27] NTI is a dummy variable equal to one if firms have innovation output results on commercialization and organization otherwise is zero.
[28]An alternative to this dummy variable is to use the number of patents produced by firms as in Crepon *et al* (1998)

productivity as the real value added (or net sales) per worker.[29] The effect of innovation on productivity has been analyzed in section 3.

6.2 Extended Model.

The respective equations are the following:

[6.5] $ID^*_i = X_{1i}.\beta_1 + \alpha_1.FC_i + \varepsilon_{1i}$; where if $ID^*_i > \mu_i$ then $D_{IDi}=1$; otherwise $D_{IDi}=0$;

[6.6] $IE^*_i = X_{2i}.\beta_2 + \alpha_2.FC_i + \varepsilon_{2i}$; where $IE^*_i = IE_i$ if $ID^*_i \geq \mu_i$, i.e., hen $D_{IDi}=1$; otherwise $IE^*_i=0$;

[6.7] $TI^*_i = \delta.IE^*_i + X_{3i}.\beta_3 + \varepsilon_{3i}$; where $D_{TIi}=1$ if $TI^*_i>0$, $D_{TIi}=0$ otherwise is zero;

[6.8] $NTI^*_i = \delta.IE^*_i + X_{4i}.\beta_4 + \varepsilon_{4i}$; where $D_{TIi}=1$ if $TI^*_i>0$, $D_{TIi}=0$ otherwise is zero;

[6.9] $\ln Prod_i = \varphi_1.TI^*_i + \varphi_2.NTI_i + \varphi_3.\ IE^*_i + X_{5i}.\beta_5 + \varepsilon_{5i}$;

Two additions to the basic model define the extended model. One is the introduction of financial constraints in the sample selection and output equations (i.e., equations [6.5] y [6.6] respectively) and the other is the NTI innovation output equation [6.8]. Financial constraint has been analyzed by Alvarez and Crespi (2011) (see section 3). In the case of NTI in the basic model this innovation output is assumed exogenous. In the extended model NTI no longer is exogenous and is assumed determined by the same set of variables which affect TI. Consequently, $X_{4i}=X_{3i}$.

6.3 Estimation Strategy

In the different estimations implemented, quantity variables such as: size, productivity, investment expenditure are transformed into natural logarithms. The rest of variables (which are binary) are not transformed. In addition, branch heterogeneity of the four ISIC (Revision 3) groups is introduced through a binary variable $ISIC_n$. Where 'n' is the first digit of the ISIC branch. Given these transformations and dummy variables, the econometric strategy is composed of the following steps:

i) For both models (basic and extended) investment decision and intensity equations are estimated using a Generalized Tobit or Heckman maximum likelihood estimation (assuming a normal joint distribution for the errors terms of both equations). For robustness purpose, also a two step Heckman procedure or Heckit estimator (which assumes conditional normal distributions for the errors term) were estimated and reported in the complementary annex. The size variable included in the ID* equation and excluded in IE* equation allows identification in both equations. In addition PPS, D_{coord}, and the set of information variables reinforce the identifications of the parameters of both equations. Further, in the extended model to avoid spurious results in equations [6.5] and [6.6], firms that did not invest in STI activities and responded that they did not have any restrictions for innovation output were eliminated from the sample;[30]

ii) Both innovation outputs equations in both models are estimated using Probit (MLE) estimation (when equations errors are assumed uncorrelated) and BiProbit (when equations errors are assumed

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[29] The common problems associated with productivity and output measures are related to the relevant price deflators to compute the real values and the measures of product quality. In the services sector measures of output will be restricted to the amount in value (sales or value added) of the transaction (following to Griliches, 1992 and Gallouj and Savona, 2009). The characteristics of the services output represented by the so called IHIP-criteria (i.e., intangibility, I; heterogeneity, H; inseparability, I; and perish ability, P) and other considerations (for example in KIBS) pointed out by Biege *et al* (2011) (such as the innovativeness of the output; the "internal output", input figures, knowledge) will not be taken into account due to restrictions of the data.

[30] The author thanks to Gustavo Crespi for providing some insights on this reduction of the sample. The number of firms in the selective and investment intensity equations of the basic model is 3888 and in the extended model 2896.

correlated), Further to avoid potential endogeneity of the STI investment intensity, predicted values from the estimated STI investment intensity equations replace the actual values of IE. In such cases standard errors are estimated by bootstrapping;[31]

iii) Finally the productivity equations [6.4 and 6.9] are estimated using least squares estimations with bootstrap standard errors whenever predicted value for TI, NTI and IE are used as exogenous variables.[32] Further, to avoid reducing the size of sample for each sector for firms with no information on ki, the variable $\ln k_i$ is replaced by $\ln(1+k_i)$ plus a control dummy ($D_{control}$ equal to one when $k_i = 0$ otherwise zero). To avoid collinearity problems between TI, NTI with the predicted values of lnIE, all these three variables were not included in the estimations of the labor productivity equations.[33]

7. Estimation and Results

Tables from 6 to 15 show the regression coefficients and statistics of the estimations methods (particularly the Heckman method) implemented for the set equations of the two models using the sample described in Section 5.[34] Complementary tables from A2 to A16 (not reported in this paper and available upon request) show the regression coefficients of the set of equations for the two CDM models under alternative estimation methods (particularly the Heckit method). The analysis of the figures shown in all these tables is summarized in Table 16. The results indicate:

i) Under the Heckman two equations estimation,[35] only firms' size (in its uncensored version) seems to affect their investment decision on STI activities in all the industrial branches, although the marginal or (censored) effect of size for firms that decided to invest was not statistically significative. The coefficients of the rest of factors were not statistically significative On the other hand, when financial constraint is introduced[36], the former results holds and this constraint limit investment decision for firms only in traditional services and services sector. Once firms decide to invest the effect of this variable was not statistically significative;[37]

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[31] It should be noted that in equation 6.8 only uses the predicted value of IE of the extended model.

[32] Two arguments for using predicted values of the dependent variables of equations 6.2, 6.3 or 6.6, 6.7, and 6.8 in the labor productivity equations are formulated by Crespi and Zuñiga (2011). First, most Latin American surveys do not have a filter and most of the questions are asked of all firms (Chile is an exception). Second, the model assumes that all firms exert some kind of innovative effort, but not all firms report this activity. The output of these efforts produces knowledge, and we can then have an estimate of innovation efforts for all firms. Crespi and Zuñiga affirm that their strategy is debatable, as this approach assumes that the process describing innovation efforts and innovation output for firms that do not report innovation activities is the same as for reporting firms.

[33] It should be noted that for the extended model in the Kibs ISIC group, 10.2% firms (of 480) produced only TI, 13% produced only NTI and 18% produced both TI and NTI. In traditional services (of 1421 firms) the respective shares were 6%, 16% and 17%. In the high tech manufacturing (of 187 firms) the respective shares were 15%, 7% and 35% and for low tech manufacturing (of 808 firms) the respective shares were16%, 7% and 24%.

[34]The sample is biased towards medium and large size firms with an average of 68 workers per firm for the basic model and 79 for the extended model. Since in general these firms may have a higher probability to invest on STI activities, the estimated coefficients would be overestimated with respect to coefficients coming from a sample with a broader size of firms.

[35] Correlation coefficients of errors of equations 6.1 and 6.2 were statistically significant only for ISIC groups of services and both sectors. Analogous results were also obtained for the correlations coefficients of the errors of equations 6.5 and 6.6.

[36] The shares of firms with financial constraints (of high importance as an obstacle for innovation)out of total firms of each ISIC group were: 21.2% (Kibs), 18.5% (traditional services), 34.3% (high-tech manufacturing), 29.4% (low-tech manufacturing) and 22.9% (for services and manufacturing).

[37] The results using the Heckman two step procedure estimation (i.e., Heckit) reported in the complementary annex were much better for the investment decision equation. Thus, the censored and uncensored coefficients of firms' size for all the sectors were statistically significative. On the other hand, the censored or marginal coefficients of public financial support and patent protection were statistically significative for all the sectors. The exporter and foreign ownership dummy variables were either not significative of doubtful statistical significance. Finally, coefficients of financial constraint were statistically significative for traditional services, services and both sectors. Correlation coefficients of the errors of equations 6.5 and 6.6 were not statistically significative.

ii) Under the same estimation method, factors that affected STI investment intensity did vary among the ISIC branches. The only common factor that affected most of the ISIC branches (being the exception the high-tech manufacturing branch) was the public financial support (PFS). Thus, latent STI investment intensity increased for all the firms in the sample. However, once firms' decided to invest in those STI activities, the effect of PFS vanish. Coefficients of the information on product and process and research activities affected positively firms STI investment intensity of Kibs (total services and both sectors). However, the effect of information on government institutions was negative for the same branch. Also the coefficient of information on research activities was statistically significative and for firms from the high tech manufacturing branch. On the other hand, the coefficient of coordination with other entities was statistically robust affecting positively to traditional services (and firms from the total services sector). In the equation with financial constraint, the coefficient of this factor only was statistically significative for firms from the traditional services sector (total services and both sectors). The coefficients of the rest of factors were either not robust or not statistically significative;[38]

iii) In the technical innovation output equation, the coefficients of the STI investment expenditure per worker and size were robust statistically for all the ISIC branches. Also, the effect of foreign ownership on technical innovation was statistically robust for the low-tech manufacturing ISIC group. However, this effect was negative. The effects of the rest of factors of this equation in both basic and extended model were not robust or statistically no significative;[39]

iv) Similar results were obtained for the non-technical innovation output equation of the extended model.[40] In this case, however, the effects of exporters and foreign firms were negative and statistically robust for traditional services ISIC group (the services branch and both sectors). This result suggests that domestic market oriented and national firms had a higher probability to produce non-technical innovation output than exporter and foreign firms from traditional services;[41]

v) Regarding the results for the productivity equations, capital labor ratio and investment expenditure per worker were the main factors that affected (statistically and positively) labor productivity for most of ISIC groups considered (with the exception of firms from high-tech manufacturing). The effects of rest of factors were not statistically robust or significative. However, when TI was introduced in a separated way, its coefficients were statistically significant for some ISIC branches. Thus, the effect of the predicted values of TI was positive and statistically significant for Kibs, traditional services, sector of services, low-tech manufacturing, manufacturing sector and both sectors. Contrarily, the effect of NTI introduced separately was not statistically significant for all the ISIC groups.[42]

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[38] Coefficients of PFS were more robust with the Heckit method. Others factors also were more important under the Heckit estimation. Thus, coefficients of financial constraint were statistically robust for both ISIC services branches (and both sectors). Analogously, the effect of patents protection variable on STI investment intensity was statistically significative for traditional services, services, low-tech manufacturing, manufactures and both sectors. Finally, export firms affected positively firms STI investment intensity. The rest of factors were either not robust or statistically not significative. All these results are reported in the complementary annex.

[39] Practically the same results were obtained with the predicted values of lnIE were estimated using the Heckit method.

[40]Correlation coefficients of the errors of equations [6.7] and [6.8] of the bi-probit estimations were statistically significative for all the ISIC groups and sectors when the predicted values of the Heckit method of the extended model for the lnIE is used. These results are report in the complementary annex.

[41] This ISIC branch includes export traders of primary export goods. When the predicted values of lnIE were estimated with the Heckit method of the extended model, the results were similar. However, the negative effect of exporters was not robust statistically and foreign ownership also affected firms from Kibs.

[42]The effects of TI and NTI for all the ISIC services branches and low tech-manufacturing were statistically robust and positive when predicted values of the TI variables are estimated with the Heckit method for the extended model. The statistically significance of the rest of factors are similar with the results found using the Heckman method.

Table 6
Censored (C) and Uncensored (u) Coefficients of the Selective (Observed) Equation 6.1 on Firms Decision to Invest on STI: Generalized Tobit or Heckman Selection Method

ISIC Branch	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Variables	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**
lnSize	0.114	0.295***	0.099	0.283***	0.103	0.283***	0.087	0.599***	0.084	0.216***	0.089	0.267***	0.112	0.283***
Dx	0.085	0.218	0.035	0.099	0.048	0.128	-0.049	-0.333	0.046	0.119	0.025	0.074	0.0371	0.094
FO	-0.002	-0.006	-0.014	-0.039	-0.005	-0.014	-0.063	-0.359	0.050	0.131	0.018	0.055	-0.0001	-0.002
PFS	0.695	7.870	0.732	6.219	0.720	6.983	0.407	7.704	0.595	7.432	0.544	8.943	0.672	7.781
$ISIC_1$									0.017	0.043	-0.031	-0.092	-0.0001	-0.001
$ISIC_2$							-0.006	-0.041	0.01	0.026	-0.021	-0.062	0.0100	0.025
$ISIC_3$			-0.310	-6.236	-0.337	-6.212							0.0269	0.068
$ISIC_4$			-0.044	-0.129	-0.048	-0.137							-0.051	-0.130
$ISIC_5$			-0.006	-0.016	-0.005	-0.013							-0.002	-0.004
$ISIC_6$					0.014	0.037							0.010	0.025
$ISIC_7$	-0.032	-0.084	-0.110	-0.339**	-0.064	-0.181							-0.073	-0.186
$ISIC_8$			0.177	0.465**	0.175	0.452**							0.176	0.446*
PatenP	0.626	7.046	0.720	5.514	0.693	6.193	0.184	7.489	0.505	7.424	0.399	8.708	0.614	7.208
Constant		-1.396***		-1.345***		-1.362***		-1.900***		-1.220***		-1.224***		-1.364***
Obser.	738	738	1994	1994	2732	2732	202	202	954	954	1156	1156	3888	3,888
ρ		0.461*		0.840***		0.767***		0.160		0.134		0.352		0.490***
σ		2.078		2.479		2.369		1.625		1.960		1.943		2.058
λ		0.957		2.082		1.818		0.261		0.262		0.684		1.144
Predicted Va.	0.396		0.306		0.333		0.922		0.590		0.724		0.414	
Obser. Va.	0.325		0.2778			0.2906	0.5		0.3742		0.3962		0.365	

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance.

Table 7
Censored (C) and Uncensored (U) Coefficients of the STI Investment Intensity Output (Observed)
Equation 6.2: Generalized Tobit or Heckman Selection Method

ISIC Bran.	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Variables	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**
Dx	0.580	0.720*	0.667	0.817***	0.604	0.770***	0.082	0.060	-0.121	-0.103	0.020	0.045	0.286	0.349**
FO	0.214	0.210	0.523	0.464	0.450	0.432	-0.636	-0.663	0.429	0.449	0.252	0.270	0.259	0.257
PFS	1.657	2.756***	0.416	2.977***	0.941	3.124***	0.430	0.601	0.459	0.709*	0.383	0.977***	0.637	1.748***
Dcoord	-0.485	-0.485	-0.456**	-0.456**	-0.486**	-0.486**	0.446	0.446	0.331	0.331	0.344	0.344	-0.146	-0.146
INFO$_1$	1.133**	1.133**	0.216	0.216	0.385*	0.385*	-0.659	-0.659	0.404	0.404	0.350	0.350	0.400**	0.400**
INFO$_2$	0.684**	0.684**	0.276	0.276	0.451***	0.451***	0.747*	0.747*	-0.059	-0.059	0.092	0.092	0.270**	0.270**
INFO$_3$	-1.088**	-1.088**	0.258	0.258	-0.024	-0.024	-0.082	-0.082	-0.442	-0.442	-0.377	-0.377	-0.230	-0.230
ISIC$_1$									-0.250	-0.243	-0.425	-0.456	0.0623	0.062
ISIC$_2$							-0.026	-0.028	0.137	0.141	-0.010	-0.031	0.327	0.344
ISIC$_3$			13.980	2.035	11.890	1.536							0.452	0.497
ISIC$_4$			0.580	0.380	0.454	0.273							0.418	0.329
ISIC$_5$			0.035	0.010	0.052	0.035							0.126	0.123
ISIC$_6$					0.249	0.297							0.284	0.301
ISIC$_7$	-0.102	-0.158	-0.084	-0.615	0.087	-0.153							0.165	0.038
ISIC$_8$			-0.140	0.531	-0.163	0.395							0.0504	0.329
PatenP	0.386	1.356	-2.502		-2.082		0.588	0.673	-0.211		0.740	1.179***	-0.999	
lnSize	-0.195		-0.432		-0.371		-0.039		-0.033		-0.089		-0.190	
Constant		4.558***		2.871***		3.190***		6.217***		5.858***		5.407***		4.335***
Observations	738	738	1994	1994	2732	2732	202	202	954	954	1156	1156	3888	3888
Pred. Value	5.814		5.737		5.742		6.102		6.000		5.735		5.714	
Obs. Value	6.104		5.891		5.955		6.357		6.134		6.184		6.036	

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. Patent Protection variable(PatenP) was excluded from Traditional, Services, Low-Tech and Total sectors for concavity problem of the likelihood function.

Table 8
Marginal Coefficients of the (Observed) Technical Innovation Output Equation 6.3: Probit Method

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
	Obs.	Heck	Obs.	Heck	Obs.	Heck	Obs.	Heck	Obs.	Heck	Obs.	Heck	Obs.	Heck
lnIE	0.0659***		0.0412***		0.0347***		0.159***		0.116***		0.124***		0.06***	
$lnIE^{e1}$		0.132***		0.130***		0.122***		0.327***		0.429***		0.379***		0.273***
lnSize	0.032***	0.076***	0.024***	0.048***	0.021***	0.039***	0.160***	0.173***	0.0515***	0.070***	0.063***	0.074***	0.033***	0.055***
Dx	0.015	-0.029	0.015	-0.0428*	0.014	-0.0450*	-0.084	-0.049	0.051	0.112***	0.042	0.041	0.019	-0.045***
FO	0.027	-0.020	0.012	-0.023	0.006	-0.015	-0.139	0.004	0.015	-0.154***	-0.018	-0.111*	0.006	-0.049**
$ISIC_1$									0.024	0.108	0.031	0.123*	0.035	0.032
$ISIC_2$							0.067	0.022	0.026	-0.036	0.040	0.007	0.041	-0.032
$ISIC_3$			0.050	-0.069	0.045	-0.104							0.022	-0.057
$ISIC_4$			-0.014	-0.030	-0.011	-0.034							-0.021	-0.075
$ISIC_5$			-0.0313*	-0.063**	-0.028	-0.063*							-0.042*	-0.098***
$ISIC_6$			-0.007	-0.051*									-0.01	-0.089***
$ISIC_7$	0.028	0.053	-0.005	-0.012	-0.018	0.005							-0.007	-0.044
$ISIC_8$			0.127	0.112	0.112	0.084							0.165	0.091
Observ.	738	785	2732	2902	1994	2117	202	224	954	1060	1156	1284	3,888	4,186
Pred. Prob.	0.079	0.216	0.049	0.170	0.042	0.154	0.296	0.438	0.171	0.336	0.190	0.355	0.0739	0.221
Obs. Prob.	0.240	0.245	0.180	0.195	0.161	0.176	0.426	0.446	0.308	0.345	0.329	0.363	0.224	0.246

Source: Table A1. Author's own work.* 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e1] Predicted Heckman values of the basic. In this case bootstrapping standard errors were used.

Table 9
Regression Coefficients of the Labor Productivity Equation 6.4 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation

Variables	KIBS							Traditional						
lnSize	-0.047	-0.133***	-0.050	-0.135**	-0.033	-0.059*	-0.053	-0.181***	-0.295***	-0.176***	-0.294***	-0.180***	-0.188***	-0.239***
ln(k+1)	0.147***	0.148***	0.147***	0.149***	0.147***	0.132***	0.146***	0.227***	0.214***	0.225***	0.212***	0.228***	0.232***	0.204***
Dcontrol	0.746**	0.763**	0.747**	0.766**	0.726**	0.636**	0.759**	1.288***	1.227***	1.248***	1.195***	1.290***	1.385***	1.156***
TI	0.250**		0.181*					0.023		0.117				
TI^{e1}		1.160***		1.123**					1.928***		2.014***			
NTI	-0.140	-0.071			-0.027			0.175**	0.126*			0.185**		
lnIE						0.036**							0.053***	
$lnIE^{e1}$							0.180***							0.388***
$ISIC_2$														
$ISIC_3$								0.508	0.053	0.491	0.036	0.514	0.255	-0.623
$ISIC_4$								1.057***	0.961***	1.057***	0.961***	1.058***	0.976***	0.852***
$ISIC_5$								1.263***	1.358***	1.273***	1.367***	1.262***	1.256***	1.209***
$ISIC_6$								0.080	0.216	0.075	0.214*	0.079	0.086	0.312***
$ISIC_7$	-0.343***	-0.409***	-0.337***	-0.405***	-0.328***	-0.290***	-0.351***	-0.484**	-0.884***	-0.481**	-0.887***	-0.480**	-0.497**	-0.720***
Constant	9.239***	9.251***	9.226***	9.241***	9.244***	9.344***	8.394***	8.651***	8.611***	8.694***	8.642***	8.650***	8.541***	7.705***
Obs.	767	767	767	767	767	721	767	2048	2048	2048	2048	2048	1931	2048
Adj-R^2	0.048	0.054	0.048	0.055	0.044	0.047	0.058	0.194	0.206	0.193	0.205	0.194	0.199	0.217
R^2	0.056	0.062	0.054	0.061	0.050	0.053	0.065	0.198	0.210	0.196	0.209	0.198	0.202	0.221

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e1] Predicted Heckman values of the basic model. In this case, bootstrapping standard errors were used.

Table 9
Regression Coefficients of the Labor Productivity Equation 6.4 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation

Variables	Services						
lnSize	-0.139***	-0.232***	-0.137***	-0.231***	-0.135***	-0.149***	-0.176***
ln(k+1)	0.196***	0.193***	0.195***	0.192***	0.197***	0.190***	0.186***
Dcontrol	1.063***	1.070***	1.052***	1.057***	1.065***	1.069***	1.034***
TI	0.112		0.152**				
TI^{e1}		1.429***		1.474***			
NTI	0.077	0.075			0.124**		
lnIE						0.049***	
$lnIE^{e1}$							0.298***
$ISIC_3$	0.555	0.222	0.547	0.213	0.582	0.319	-0.140
$ISIC_4$	1.024***	0.969***	1.024***	0.970***	1.029***	0.951***	0.891***
$ISIC_5$	1.300***	1.360***	1.304***	1.364***	1.296***	1.288***	1.252***
$ISIC_6$	0.396***	0.417***	0.397***	0.418***	0.396***	0.398***	0.299***
$ISIC_7$	0.082	0.095	0.079	0.092	0.083	0.107	0.078
$ISIC_8$	-0.472**	-0.753***	-0.470**	-0.753***	-0.454**	-0.483**	-0.607**
Constant	8.754***	8.708***	8.768***	8.723***	8.751***	8.741***	7.855***
Observations	2,815	2,815	2,815	2,815	2,815	2,652	2,815
Adj-R^2	0.202	0.211	0.202	0.211	0.202	0.204	0.219
R^2	0.205	0.214	0.205	0.213	0.205	0.207	0.222

Source: Table A1. Author´s own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e1] Predicted Heckman values of the standard model. In this case, bootstrapping standard errors were used.

Table 9
Regression Coefficients of the Labor Productivity Equation 6.4 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation

Var.	High Tech							Low Tech						
lnSize	0.030	0.093	0.029	0.094	0.036	0.010	0.042	0.000	-0.116***	0.003	-0.111***	0.003	-0.008	0.003
ln(k+1)	0.111*	0.104**	0.111*	0.103*	0.108*	0.089	0.103	0.186***	0.186***	0.184***	0.182***	0.187***	0.194***	0.184***
Dcontrol	0.712	0.647*	0.711	0.638	0.680	0.552	0.645	0.999***	1.009***	0.977***	0.965***	0.994***	1.075***	0.960***
TI	0.078		0.072					0.080		0.135*				
TI^{e1}		-0.405		-0.377					1.427***		1.456***			
NTI	-0.009	0.053			0.032			0.115	0.141**			0.159**		
lnIE						0.020							0.044***	
$lnIE^{e1}$							-0.082							0.307***
$ISIC_1$								0.031	0.020	0.026	0.015	0.035	0.008	0.108
$ISIC_2$	0.123	0.121	0.123	0.119	0.123	0.167	0.113	0.346**	0.304**	0.337**	0.295**	0.351**	0.314**	0.294**
Constant	8.766***	8.824***	8.766***	8.837***	8.795***	8.939***	9.326***	8.059***	7.962***	8.090***	8.016***	8.065***	8.010***	6.342***
Obser.	213	213	213	213	213	191	213	1,020	1,020	1,020	1,020	1,020	919	1,020
Adj-R^2	0.0007	0.004	0.006	0.008	0.005	-0.0004	0.006	0.101	0.119	0.101	0.117	0.102	0.115	0.104
R^2	0.029	0.0319	0.0290	0.0312	0.0281	0.0260	0.0299	0.108	0.125	0.106	0.123	0.107	0.121	0.109

Source: Table A1. Author´s own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e1] Predicted Heckman values of the basic model. In this case, bootstrapping standard errors were used.

Table 9
Regression Coefficients of the Labor Productivity Equation 6.4 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation

Var.	Manufacture							Total						
lnSize	0.005	-0.035	0.008	-0.031	0.009	-0.006	0.005	-0.094***	-0.181***	-0.092***	-0.179***	-0.090***	-0.105***	-0.131***
ln(k+1)	0.173***	0.176***	0.171***	0.173***	0.173***	0.174***	0.173***	0.190***	0.190***	0.189***	0.189***	0.191***	0.187***	0.185***
Dcontrol	0.943***	0.972***	0.927***	0.936***	0.930***	0.971***	0.934***	1.034***	1.060***	1.022***	1.041***	1.030***	1.047***	1.031***
TI	0.091		0.141**					0.116**		0.158***				
TI^{e1}		0.489**		0.539***					1.215***		1.259***			
NTI	0.101	0.130*			0.151**			0.082	0.090**			0.136***		
lnIE						0.043***							0.048***	
$lnIE^{e1}$							0.163**							0.435***
$ISIC_1$	-0.144	-0.122	-0.150	-0.131	-0.144	-0.139	-0.080	-0.298**	-0.393***	-0.302***	-0.396***	-0.287**	-0.290**	-0.398***
$ISIC_2$	0.209**	0.213**	0.201*	0.202*	0.212**	0.208*	0.202**	0.040	-0.099	0.035	-0.105	0.054	0.041	-0.220***
$ISIC_3$								-0.132	-0.278*	-0.131	-0.277***	-0.119	-0.146	-0.434***
$ISIC_4$								0.986***	0.948***	0.987***	0.950***	0.990***	0.915***	0.811***
$ISIC_5$								1.332***	1.376***	1.336***	1.381***	1.327***	1.319***	1.242***
$ISIC_6$								0.405***	0.421***	0.406***	0.423***	0.405***	0.407***	0.266**
$ISIC_7$								0.096	0.104	0.093	0.101	0.098	0.120	0.036
$ISIC_8$								-0.460**	-0.698***	-0.458**	-0.696**	-0.442**	-0.472**	-0.610**
Constant	8.289***	8.222***	8.313***	8.268***	8.304***	8.268***	7.449***	8.646***	8.613***	8.662***	8.635***	8.647***	8.633***	6.823***
Obser.	1,233	1,233	1,233	1,233	1,233	1,110	1,233	4,048	4,048	4,048	4,048	4,048	3,762	4,048
Adj-R^2	0.0944	0.0976	0.0939	0.0957	0.0940	0.105	0.0948	0.250	0.259	0.249	0.258	0.249	0.250	0.266
R^2	0.0995	0.103	0.0983	0.100	0.0984	0.110	0.0992	0.252	0.261	0.252	0.260	0.251	0.252	0.268

Source: Table A1. Author´s own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e1} Predicted Heckman values of the standard model. In this case, bootstrapping standard errors were used.

Table 10
Censored (C) and Uncensored (U) Coefficients of the Selective (Observed) Equation 6.5 on Firms Decision to Invest on STI: Generalized Tobit or Heckman Selection-Extended Model

Var.	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Dx	0.032	0.083	-0.001	0.051	0.007	0.018	-0.026	-0.318	0.021	0.065	0.005	0.025	0.008	0.020
FO	-0.046	-0.116	-0.136	-0.121	-0.046	-0.116	-0.058	-0.508	0.053	0.170	0.0117	0.056	-0.02	-0.077
$ISIC_1$									-0.008	-0.023	-0.0240	-0.111	-0.001	-0.002
$ISIC_2$							-0.003	-0.041	-0.026	-0.080	-0.026	-0.121	-0.007	-0.019
$ISIC_3$			-5.832	-6.632	-0.484	-6.462							0.023	0.060
$ISIC_4$			-0.147	-0.085	-0.062	-0.156							-0.057	-0.146
$ISIC_5$			-0.031	-0.025	-0.01	-0.025							-0.002	-0.006
$ISIC_6$					0.0285	0.072							0.023	0.059
$ISIC_7$	-0.0457	-0.116	-0.332**	-0.325**	-0.0681	-0.172							-0.068	-0.175
$ISIC_8$			0.430*	0.482*	0.164	0.420*							0.148	0.420
FC	-0.0763	-0.193	5.406	-0.313***	-0.109	-0.277***	-0.0164	-0.192	-0.023	-0.070	-0.0166	-0.077	-0.074	-0.19***
PFS	0.559	7.338	-0.321***	4.669	0.594	6.134	0.308	7.389	0.474	7.271	0.412	9.324	0.536	7.114
PatenP	0.463	6.398	5.459	6.413	0.553	4.714	0.112	7.235	0.369	7.373	0.245	9.047	0.462	6.748
lnSize	0.111	0.282***	0.260***	0.264***	0.104	0.261***	0.0490	0.607***	0.068	0.208***	0.0568	0.267***	0.103	0.270***
Constant		-0.99***	-0.914***	-0.922***		-0.94***		-1.67***		-0.86*		-0.93***		-0.99***
Observ.	539	539	1,411	1,411	1,950	1,950	178	178	768	768	946	946	2,896	2,896
ρ		0.610**		0.873***		0.836***		0.221		0.158		0.375**		0.602***
σ		2.171		2.512		2.465		1.630		1.960		1.946		2.130
λ		1.326		2.193		2.062		0.361		0.309		0.729		1.282
Pred. V.	0.565		0.453		0.479		0.963		0.737		0.869		0.596	
Obs. V.	0.445		0.393		0.407		0.567		0.465		0.484		0.427	

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. Patent Protection variable (PatenP) was excluded from Traditional, Services, Low-Tech and Total sectors for concavity problem of the likelihood function.

Table 11
Censored (C) and Uncensored (U) Coefficients of the STI Investment Intensity Output (Observed) Equation 6.6: Generalized Tobit or Heckman Selection Method-Extended Model

ISIC Bra.	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Variable	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**
Dx	0.556	0.621	0.885***	0.668**	0.616	0.640***	0.0943	0.076	-0.120	-0.111	0.0179	0.024	0.31	0.324**
FO	0.230	0.136	0.287	0.233	0.407	0.249	-0.625	-0.663	0.377	0.401	0.216	0.229	0.243	0.186
PFS	1.757	2.943***		2.796***	1.124	3.093***	0.460	0.644	0.493	0.727*	0.454	0.936***	0.751	1.849***
Dcoord	-0.560	-0.560	-0.381	-0.475**	-0.530***	-0.530***	0.450	0.450	0.313	0.313	0.336	0.336	-0.169	-0.169
$INFO_1$	1.136**	1.136**	0.225	0.178	0.345*	0.345*	-0.612	-0.612	0.443	0.443	0.374	0.374	0.400**	0.400**
$INFO_2$	0.723**	0.723**	0.390**	0.278	0.467***	0.467***	0.779*	0.779*	-0.0551	-0.055	0.0891	0.089	0.286**	0.286**
$INFO_3$	-1.066**	-1.066**	0.156	0.240	-0.0104	-0.01	-0.0976	-0.098	-0.441	-0.441	-0.374	-0.374	-0.204	-0.204
$ISIC_1$									-0.244	-0.247	-0.434	-0.462	0.077	0.076
$ISIC_2$			13.969				-0.0367	-0.039	0.127	0.116	-0.0280	-0.057	0.335	0.321
$ISIC_3$			0.550	4.968**	14.01	2.003							0.492	0.536
$ISIC_4$			0.047	0.571	0.441	0.228							0.406	0.296
$ISIC_5$				0.025	0.0450	0.012							0.103	0.098
$ISIC_6$					0.216	0.311							0.271	0.314
$ISIC_7$	-0.117	-0.210	-0.121	-0.546	0.0452	-0.188							0.132	0.000
$ISIC_8$			-0.207	0.596	-0.259	0.262							0.0131	0.292
FC	-0.376	-0.532	-0.243	-0.674**	-0.304	-0.684***	0.125	0.114	-0.244	-0.255	-0.193	-0.212	-0.227	-0.370**
lnSize	-0.224		-0.378		-0.348		-0.0343		-0.0307		-0.0651		-0.198	
PatenP	0.581	1.561	-2.070		-1.822		0.605	0.682	-0.185		0.841	1.145***	-0.946	
Const.		4.516***		3.493***		3.493***		6.090***		5.910***		5.530***		4.334***
Obser.	539	539			1,950	1,950	178	178	768	768	946	946	2,896	2,896
Pred-Value	5.737		5.665		5.660		6.047		5.962		5.677			

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. Patent Protection variable(PatenP) was excluded from Traditional, Services, Low-Tech and Total sectors for concavity problem in the log- likelihood function.

Table 12
MarginalCoefficients of the (Observed) Technical Innovation Output Equation 6.7: Probit Method, Extended Model

Variable	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
lnIE	0.0975***		0.133***		0.120***		0.169***		0.082***		0.087***		0.096***	
lnIE^{e2}		0.065***		0.201***		0.111***		0.128**		0.080		0.105***		0.259***
lnSize	0.0297**	0.065***	0.0619***	0.052***	0.0483***	0.0578***	0.175***	0.114***	0.0342***	0.0599***	0.040***	0.066***	0.056***	0.057***
Dx	-0.0936*	-0.0863	-0.0952***	-0.160***	-0.0881***	-0.0808***	-0.0912	-0.0816	-0.0460	-0.0137	-0.0616*	-0.0297	0.031	-0.037
FO	-0.119**	-0.118*	-0.166***	-0.125***	-0.153***	-0.115***	-0.167	0.0204	0.0703	0.103	0.0613	0.0688	0.013	-0.043
ISIC$_1$				-0.343***	-0.0246	-0.260***							0.063	0.046
ISIC$_2$			-0.0121	-0.121**	-0.00150	-0.0557							0.069	-0.014
ISIC$_3$	-0.0635	-0.0477	0.0105	0.0344	-0.0540	-0.0568							0.042	-0.040
ISIC$_4$			0.0442	-0.0382	0.0466	0.0531							-0.033	-0.066
ISIC$_5$			0.0896*	0.0222	0.0767	0.0280							-0.0716*	-0.113***
ISIC$_6$						-0.0296	0.0726		-0.115		-0.0946*		-0.014	-0.0921**
ISIC$_7$								-0.0483	-0.0613	-0.103	-0.0584	-0.0948**	-0.008	-0.036
ISIC$_8$										-0.0485		-0.0551	0.252*	0.126
Obs.	539	586	1,407	1,534	1,946	2,120	178	200	768	874	946	1,074	2896	3194
Pred. Prob	0.230	0.334	0.199	0.340	0.211	0.340	0.397	0.412	0.200	0.305	0.223	0.324	0.156	0.308
Pseu.-R^2	0.585	0.134	0.482	0.0765	0.507	0.104	0.634	0.225	0.598	0.0807	0.604	0.117	0.555	0.137
χ^2	393.3	79.13	728.9	123.9	1115	256.0	156.3	47.27	611.3	87.29	770.4	147.8	1965	629.7

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e2} Predicted Heckman values of the extended model. In this case, bootstrapping standard errors were used.

Table 13
Marginal Coefficients of the (Observed) Non-Technical Innovation Output Equation 6.8: Probit Method, Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
lnIE	0.0975***		0.133***		0.120***		0.169***		0.0815***		0.0873***		0.107***	
$lnIE^{e2}$		0.0645***		0.201***		0.111***		0.128**		0.0807		0.105***		0.137***
lnSize	0.030**	0.065***	0.062***	0.052***	0.048***	0.058***	0.175***	0.114***	0.034***	0.060***	0.040***	0.066***	0.045***	0.059***
Dx	-0.094*	-0.086	-0.095***	-0.160***	-0.088***	-0.081***	-0.091	-0.082	-0.046	-0.014	-0.062*	-0.030	-0.077***	-0.066***
FO	-0.119**	-0.118*	-0.166***	-0.125***	-0.153***	-0.115***	-0.167	0.020	0.070	0.103	0.061	0.069	-0.076***	-0.050
$ISIC_1$								-0.048	-0.061	-0.103	-0.058	-0.0948**	-0.057	-0.056
$ISIC_2$						-0.030	0.073		-0.115		-0.0946*		-0.091**	-0.095**
$ISIC_3$										-0.049		-0.055	-0.019	-0.030
$ISIC_4$			-0.012	-0.121**	-0.002	-0.056							-0.007	-0.066
$ISIC_5$			0.0896*	0.022	0.077	0.028							0.065	0.018
$ISIC_6$				-0.343***	-0.025	-0.260***							-0.025	-0.041
$ISIC_7$	-0.0635	-0.048	0.011	0.034	-0.054	-0.057							-0.055	-0.072
$ISIC_8$			0.044	-0.038	0.047	0.053							0.057	0.055
Obser.	539	586	1407	1534	1946	2120	178	200	768	874	946	1074	2896	3194
Pred. Prob	0.230	0.334	0.199	0.340	0.211	0.340	0.397	0.412	0.200	0.305	0.223	0.324	0.214	0.335

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e2} Predicted with the Heckman method of the extended model and with bootstrapping standard errors for the independent variable.

Table 14
Marginal Coefficients of the (Observed) Technical and Non-Technical Innovation Output Equation 6.8: Biprobit Method extended model from equation 2, Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Technical Innovation														
lnIE	0.108***		0.062***		0.073***		0.170***		0.143***		0.149***		0.095***	
$lnIE^{e2}$		0.136***		0.125***		0.134***		0.332***		0.350***		0.321***		0.244***
lnSize	0.055***	0.087***	0.039***	0.0441***	0.043***	0.0538***	0.176***	0.161***	0.069***	0.066***	0.082***	0.0716***	0.055***	0.058***
Dx	0.023	-0.043	0.025	-0.042	0.026	-0.032	-0.084	-0.078	0.059	0.096**	0.0455	0.039	0.030	-0.033
FO	0.041	-0.048	0.014	-0.0001	0.023	-0.017	-0.175	-0.002	0.017	-0.118**	-0.025	-0.096	0.0121	-0.049
$ISIC_1$									0.035	0.075	0.042	0.101	0.065	0.0445
$ISIC_2$							0.077	0.018	0.029	-0.047	0.046	0.00342	0.069	-0.016
$ISIC_3$			0.0586	-0.219***	0.067	-0.154							0.042	-0.039
$ISIC_4$			-0.019	-0.042	-0.024	-0.029							-0.0325	-0.067
$ISIC_5$			-0.052	-0.091**	-0.058	-0.089*							-0.070*	-0.115***
$ISIC_6$					-0.0101	-0.0548							-0.013	-0.087**
$ISIC_7$	0.049	0.067	-0.0334	-0.0087	-0.00635	-0.008							-0.007	-0.035
$ISIC_8$			0.193*	0.108	0.213*	0.156							0.251*	0.132
Obser.	539	586	1,411	1,534	1,950	2,120	178	200	768	874	946	1,074	2,896	3,194
Non-Technical Innovation														
lnIE	0.098***		0.131***		0.119***		0.107***		0.082***		0.087***		0.107***	
$lnIE^{e2}$		0.064***		0.201***		0.110***		0.128*		0.092*		0.108***		0.136***
lnSize	0.0297*	0.065***	0.061***	0.053***	0.048***	0.058***	0.080**	0.115***	0.034***	0.061***	0.040***	0.066***	0.045***	0.060***
Dx	-0.0937	-0.087	-0.093***	-0.160***	-0.087***	-0.079***	-0.177*	-0.08	-0.046	-0.015	-0.062*	-0.033	-0.077***	-0.066***
FO	-0.119**	-0.124	-0.163***	-0.126**	-0.151***	-0.117***	0.0188	0.0259	0.0671	0.0955	0.0594	0.0678	-0.0773**	-0.0506
$ISIC_1$									-0.0586	-0.0469	-0.0565	-0.0537	-0.0556	-0.0562
$ISIC_2$							-0.0507	-0.051	-0.113	-0.108	-0.0938*	-0.0974	-0.0904**	-0.0985**
$ISIC_3$			-0.199***	-0.343***	-0.211***	-0.271							-0.019	-0.032
$ISIC_4$			-0.0118	-0.123**	-0.00134	-0.0563							-0.008	-0.067

Table 14
Marginal Coefficients of the (Observed) Technical and Non-Technical Innovation Output Equation 6.8:
Biprobit Method extended model from equation 2, Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
$ISIC_5$			0.0876*	0.0192	0.0756	0.0262							0.0661	0.016
$ISIC_6$					-0.0247	-0.0305							-0.024	-0.042
$ISIC_7$	-0.0635	-0.0481	0.0102	0.0320	-0.0536	-0.0585							-0.055	-0.073
$ISIC_8$			0.0441	-0.0442	0.0466	0.0517							0.056	0.053
Observations	539	586	1,411	1,534	1,950	2,120	178	200	768	874	946	1,074	2,896	3,194

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e2] Predicted with the Heckman method of the extended model and with bootstrapping standard errors for all independent variables.

Table 15
Regression Coefficients of the Labor Productivity Equation 6.9 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation: Extended Model

Variables	Services						
lnSize	-0.132***	-0.221***	-0.132***	-0.221***	-0.129***	-0.143***	-0.167***
ln(k+1)	0.194***	0.193***	0.194***	0.193***	0.196***	0.188***	0.188***
$D_{control}$	1.087***	1.097***	1.087***	1.097***	1.091***	1.077***	1.073***
TI	0.085		0.087				
TI^{e2}		1.284***		1.281***			
NTI	0.004	-0.006			0.037		
lnIE						0.039***	
$lnIE^{e2}$							0.242***
$ISIC_3$	0.646	0.148	0.646	0.149	0.665	0.438	-0.036
$ISIC_4$	1.188***	1.108***	1.188***	1.108***	1.193***	1.117***	1.078***
$ISIC_5$	1.498***	1.468***	1.498***	1.468***	1.493***	1.500***	1.445***
$ISIC_6$	0.485***	0.422***	0.485***	0.423***	0.485***	0.499***	0.393***
$ISIC_7$	0.202	0.126	0.201	0.127	0.203	0.251*	0.194*
$ISIC_8$	-0.432*	-0.513**	-0.432*	-0.514***	-0.416*	-0.452*	-0.552**
Constant	8.659***	8.630***	8.660***	8.629***	8.656***	8.632***	7.899***
Obser.	2,044	2,044	2,044	2,044	2,044	1,881	2,044
Adj-R^2	0.238	0.246	0.239	0.246	0.238	0.241	0.254
R^2	0.242	0.250	0.242	0.250	0.242	0.245	0.258

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e2} Predicted with the Heckman method of the extended model. In this case, bootstrapping standard errors were used.

Table 15
Regression Coefficients of the Labor Productivity Equation 6.9 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation: Extended Model

Variables	High Tech							Low Tech						
lnSize	0.033	0.109	0.031	0.108	0.034	0.012	0.034	-0.001	-0.159***	0.002	-0.155***	0.001	-0.011	-0.011
ln(k+1)	0.104*	0.099	0.103*	0.100**	0.103*	0.087	0.100*	0.187***	0.185***	0.184***	0.182***	0.187***	0.198***	0.185***
$D_{control}$	0.758*	0.717	0.753*	0.720*	0.755*	0.648	0.731	1.062***	1.072***	1.043***	1.044***	1.059***	1.170***	1.052***
TI	0.006		-0.027					0.053		0.094				
TI^{e2}		-0.554		-0.567					1.988***		2.012***			
NTI	-0.062	-0.024			-0.059			0.092	0.093			0.119		
lnIE						0.002							0.039***	
$lnIE^{e2}$							-0.113							0.430***
$ISIC_1$								-0.163	-0.139	-0.169	-0.144	-0.160	-0.260	-0.053
$ISIC_2$	0.123	0.118	0.125	0.119	0.123	0.177	0.117	0.153	0.143	0.143	0.134	0.157	0.049	0.088
Constant	8.862***	8.930***	8.860***	8.924***	8.864***	8.996***	9.549***	8.253***	7.934***	8.283***	7.974***	8.259***	8.244***	5.827***
Obser.	189	189	189	189	189	167	189	836	836	836	836	836	735	836
Adj-R^2	-0.00886	0.000431	-0.00410	0.00575	-0.00336	-0.0124	0.000546	0.0978	0.133	0.0977	0.132	0.0984	0.114	0.112
R^2	0.0233	0.0323	0.0226	0.0322	0.0233	0.0181	0.0271	0.105	0.140	0.104	0.138	0.105	0.121	0.118

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e2} Predicted with the Heckman method of the extended model. In this case, bootstrapping standard errors were used.

Table 15
Regression Coefficients of the Labor Productivity Equation 6.9 With Bootstrap Standard Errors for Predicted Values Using Heckman Estimation: Extended Model

Var.	Manufacture							Total						
lnSize	0.002	-0.059*	0.005	-0.056**	0.005	-0.012	-0.004	-0.088***	-0.180***	-0.087***	-0.180***	-0.084***	-0.100***	-0.128***
ln(k+1)	0.171***	0.174***	0.169***	0.172***	0.170***	0.175***	0.172***	0.188***	0.188***	0.187***	0.188***	0.188***	0.185***	0.185***
$D_{control}$	0.995***	1.035***	0.983***	1.014***	0.988***	1.054***	1.012***	1.065***	1.089***	1.062***	1.086***	1.064***	1.077***	1.077***
TI	0.053		0.087					0.082		0.094*				
TI^{e2}		0.704**		0.736***					1.274***		1.284***			
NTI	0.072	0.079			0.099			0.027	0.018			0.062		
lnIE						0.035***							0.039***	
$lnIE^{e2}$							0.169***							0.361***
$ISIC_1$	-0.267**	-0.198	-0.273**	-0.203**	-0.267**	-0.280**	-0.196*	-0.161	-0.265***	-0.163	-0.267***	-0.152	-0.132	-0.245**
$ISIC_2$	0.099	0.092	0.092	0.083	0.100	0.084	0.097	0.189	0.044	0.187	0.042	0.200	0.215	-0.026
$ISIC_3$								0.135	-0.035	0.135	-0.035	0.145	0.155	-0.138
$ISIC_4$								1.162***	1.119***	1.163***	1.119***	1.167***	1.095***	1.013***
$ISIC_5$								1.529***	1.598***	1.531***	1.599***	1.525***	1.532***	1.447***
$ISIC_6$								0.493***	0.507***	0.494***	0.507***	0.494***	0.508***	0.365***
$ISIC_7$								0.223*	0.225**	0.222*	0.225**	0.225*	0.270**	0.171
$ISIC_8$								-0.410*	-0.689***	-0.410*	-0.689***	-0.395*	-0.432*	-0.561**
Constant	8.438***	8.288***	8.458***	8.319***	8.449***	8.410***	7.529***	8.536***	8.430***	8.542***	8.434***	8.536***	8.498***	7.060***
Obser.	1,025	1,025	1,025	1,025	1,025	902	1,025	3,069	3,069	3,069	3,069	3,069	2,783	3,069
Adj-R^2	0.0890	0.0952	0.0891	0.0949	0.0894	0.0994	0.0934	0.277	0.288	0.277	0.288	0.277	0.277	0.295
R^2	0.0952	0.101	0.0945	0.100	0.0948	0.105	0.0987	0.280	0.291	0.280	0.291	0.280	0.280	0.297

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. e2 Predicted with the Heckman method of the extended model. In this case, bootstrapping standard errors were used.

Table No 16
Summary of Regression Results

Sector	Services		Total	Manufacturing		Total	Both Sectors
	Kibs	Traditional		Low-Tech Man.	High- Tech		
1. Equations 6.1/6.5 (ID)							
Rb. Coef.[1]	lnSize^U	lnSize^U; FC^U	lnSize^U; FC^U	lnSize^U	lnSize^U	lnSize^U	lnSize^U; FC^U
Par. R. Coef.[2]							
Doub. Coef.[3]							
No Signf[4].	PatentP; D$_x$; FO; PFS	PatentP; D$_x$; FO; PFS	PatentP; D$_x$; FO; PFS	PatentP; D$_x$; FO; FC; PFS	PatentP; D$_x$; FO; FC; PFS	PatentP; D$_x$; FO; FC; PFS	PatentP; D$_x$; FO; PFS
2. Equations 6.2/6.6 (IE)							
Rb. Coef.[1]	INFO$_1$; INFO$_2$; INFO$_3$(-)	D$_{Coord}$;	D$_{Coord}$; INFO$_1$; INFO$_2$		INFO$_2$;		INFO$_1$; INFO$_2$
Par. R. Coef.[2]	PFS^U	PFS^U; D$_x$^{U}; FC^U	PFS^U; D$_x$^{U}; FC^U	PFS^U;		PFS^U; PatenP^U	PFS^U; D$_x$^{U}; FC^U
Doub. Coef.[3]	D$_x$^{U}						
No Signf[4].	FO; D$_{Coord}$; FC; PatenP	FO; PatenP; INFO$_1$; INFO$_2$; INFO$_3$	FO; INFO$_3$ PatenP;	D$_x$; FO; D$_{Coord}$; FC; PatenP; INFO$_1$; INFO$_2$; INFO$_3$	D$_x$; FO; PFS; D$_{Coord}$; FC; PatenP; INFO$_1$; INFO$_3$	FO; D$_{Coord}$; FC; D$_x$; INFO$_1$; INFO$_2$; INFO$_3$	FO; D$_{Coord}$; PatenP; INFO$_3$
3. Equations 6.3/6.7 (TI)							
Rb. Coef.[1]	lnIE; lnSize	lnIE; lnSize	lnIE; lnSize	lnIE; D$_x$; lnSize; FO(-)	lnIE; lnSize	lnIE; lnSize	lnIE; lnSize
Par. R. Coef.[2]							
Doub. Coef.[3]	D$_x$(-); FO	D$_x$(-); FO	D$_x$(-); FO	D$_x$; FO		D$_x$(-); FO	D$_x$(-); FO (-)
No Signf[4].					D$_x$; FO		
4. Equations 6.8 (NTI)							
Rb. Coef.[1]	lnIE; lnSize	lnIE; lnSize; D$_x$(-); FO (-)	lnIE; lnSize; D$_x$(-); FO(-)	lnIE; lnSize	lnIE; lnSize	lnIE; lnSize	lnIE; lnSize; D$_x$(-); FO (-)
Par. R. Coef.[2]							
Doub. Coef.[3]	D$_x$(-); FO (-)				D$_x$(-)	D$_x$(-)	D$_x$(-); FO (-)
No Signf[4].				D$_x$; FO	FO	FO	
5. Equations 6.4/6.9 (Prod.)							
Rb. Coef.[1]	Lnk; lnIE	lnSize (-); lnk; lnIE	lnSize (-); lnk; lnIE	Lnk; lnIE		Lnk; lnIE	lnSize (-); lnk; lnIE
Par. R. Coef.[2]							
Doub. Coef.[3]	lnSize; TI	TI; NTI	TI; NTI	lnSize; TI; NTI	lnk; TI	lnSize; TI; NTI	TI; NTI
No Signf[4].	NTI;				lnSize; TI; NTI; lnIE		

Source: Tables from 6 to 15 and from A5 to A16 from the annex of complementary tables available upon request. [1] Almost if not all the coefficients of the censored (or marginal) and uncensored equations were statistically significative. [2] Either the censored (or marginal) or the uncensored coefficients were almost if not all statistically significative. [3] Ambiguous statistical significance and/or signs of coefficients. [4] No statistical significance of the coefficients. Author' own work.

8. Conclusions

In the last decade the area of science, technology and technological innovation in Peruvian economy has been of low priority for policy makers. The institutional disarticulated national STI system (SINACYIT) was concentrated on some particular programs and funds oriented basically to foster firms' innovation activities of primary and manufactured sectors without a specific and previously designed innovation strategy. STI in services were oriented mainly in providing information and communications technology infrastructure under the principles of universal access, affordability, fostering private competition, technological convergence in concordance with the evolution and development of ICT.

Based upon a firms STI survey data of 2004 (CONCYTEC-INEI, 2004), this paper has presented robust evidence on the positive effects of firms' science, technology and innovation activities upon labor productivity of services and manufacturing firms of Peru and consequently an upgrading of the priority STI policy and its effective implementation in Peru could spur the low performance of the rate of growth of (total factor) productivity obtained in last decade (Tello, 2012c). Two CDM models were estimated with methods that overcome selection and endogeneity problems.

The statistical results in general partially support some of the hypotheses found in the literature. Specifically, firms' size seems to be a key determinant for firms' decision to invest on STI activities in all the seven ISIC groups considered in the analysis. However, for those firms motivated to invest, patent protection particularly for manufacturing firms was a determinant factor for effective investment. On the other hand, financial constraint influenced firms' decision to invest or not in STI activities only in the traditional services ISIC group. However, once firms decided to invest on STI activities, the statistical significance of this effect vanish. Second, although public financial support seems to increase the latent variable of firms' investment intensity for most of the ISIC groups (with the exception of firms from high-tech manufacturing branches), the effect on the actual investment intensity (measured through the expenditures on STI activities per worker) was not statistical significant for firms that invested on STI activities. This means public support policies seem to have more an inducement effect (making non – spending firm to start spending) than an intensive margin effect (increasing intensity by already spending firms). The same result is obtained for financial constraint of the traditional services ISIC group. The incidence of other factors on firms STI investment intensity also was statistical robust for some specific ISIC groups. Specifically, internet information on products and process for Kibs, services, and all the firms of the sample; internet information on research activities for Kibs, high tech manufacturing, services and both sectors (services and manufacturing); firms coordination with other entities for innovation purposes for traditional services and total services.

Third, across all the ISIC groups, firms size and investment intensity were the key determinants for producing both technical and non-technical innovation outputs. On the other hand, in some ISIC group domestic market oriented and national firms had a higher probability to produce technical and non-technical innovation outputs than exporters and foreign owned firms. This occurred for services and low-tech manufacturing firms. Lastly, capital per worker and STI investment intensity affected positively labor productivity of firms of most of ISIC groups (with the exception of high-tech manufacturing group).

From the perspective of economic policy, these results suggest that horizontal STI policies (at least for services and manufacturing branches) that encourage firms to increase STI investment intensity may well produce some gains in firms' labor productivity. On the other hand, the lack of a statistical effect of innovation outputs on productivity indicates the need for a micro and detailed analysis of what firms consider innovation output and for providing information on the kinds of innovation outputs that may well increase firms' labor productivity. Finally, the fact that most of firms STI activities are undertaken in an isolated fashion (i.e, firms production of innovation of any kind -product, process, marketing and organization are carried out with their own funds and without any collaboration from other entities) and the lack of statistical significance of the effect of firms' coordination with other entities on STI investment intensity indicate the need for exploiting the interactions of firms with other firms, research institutions and government in order to increase the probability to produce innovation[43] and reduce firm's STI expenditure per worker.

[43] See this result in Tello (2011b).

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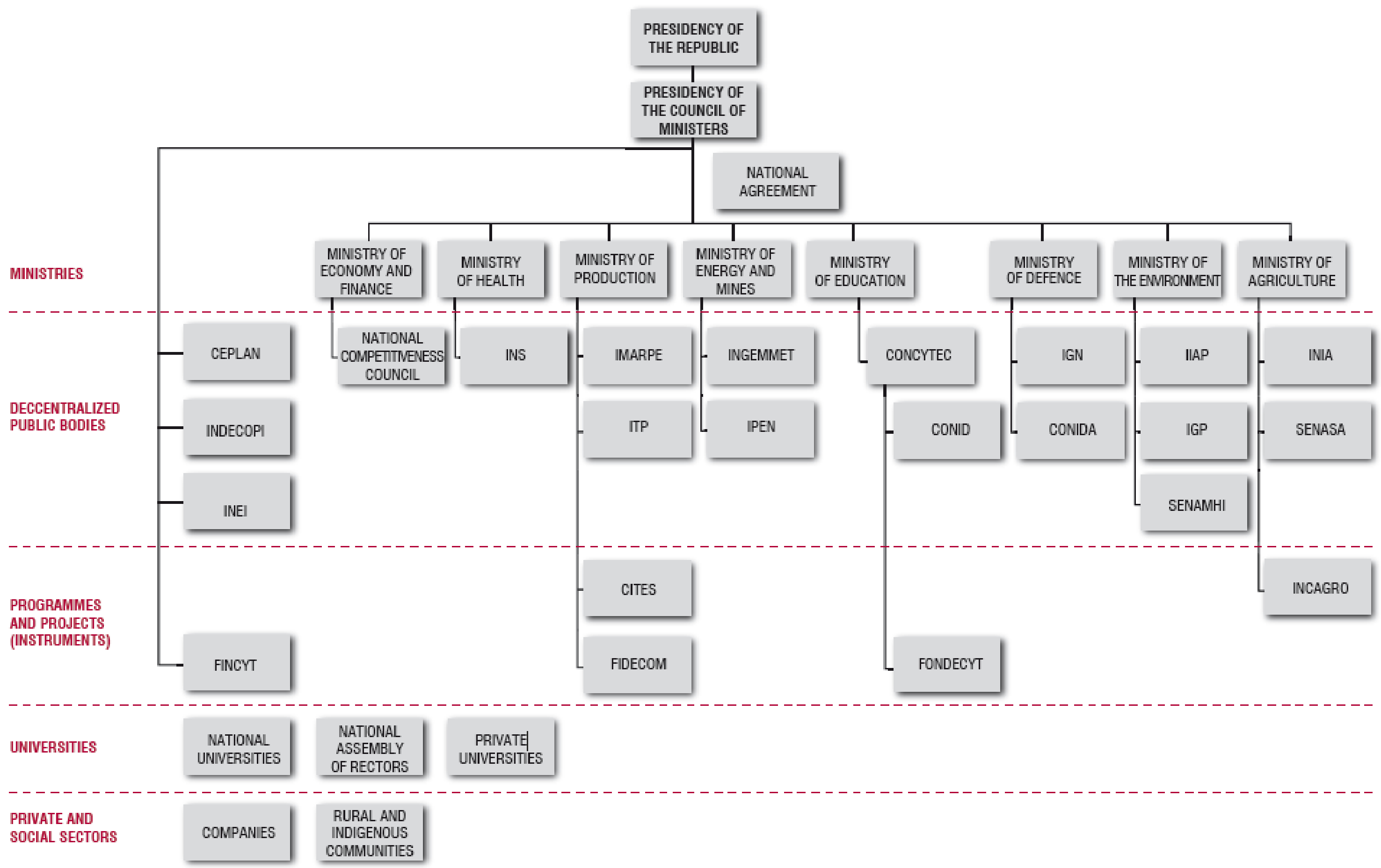
Annex 1:

Table A1
Definition of Variables

Name	Description	Source
ID	Dummy variable with value of one for firms that decided to invest on STI activities, otherwise zeros	CONCYTEC (2004), Section VI.1, item 42.h
Dx	Dummy variable with value of one for firms exporting at least two years between 1993 and 2004, otherwise zero	SUNAT(2012)
FO	Dummy variable with value one for firms with more than 10% of the total capital foreign owned; otherwise zero	PERU TOP 2000-2004
lnSize	Natural logarithm of the number of workers in a firm	CONCYTEC –INEI (2004), Section I, item 22
PatenP	Dummy variable with value of one for firms with patents, otherwise zero	CONCYTEC-INEI (2004), Section VI.1, item 48
PFS	Dummy variable with value equal to one for firms having Public Financial Support, otherwise zero	CONCYTEC-INEI (2004),Section II, item, 2, 3 and 4, Section XI, item 42.a; Section II, item 1.b
FC	Dummy variable with value of one for firms that declared that credit constraints were of high importance as an obstacle for innovation, otherwise zero	CONCYTEC-INEI (2004), Section VI.1, item 46.h
Dcoord	Dummy variable with value of one for firms that coordinated with other entities, otherwise zero	CONCYTEC-INEI (2004), Section VI, item 49
$INFO_1$	Dummy variable with value of one for firms using internet for information search on products and processes, otherwise zero	CONCYTEC-INEI (2004),Section V, item 5.1
$INFO_2$	Dummy variable with value of one for firms using internet for research activities otherwise zero	CONCYTEC-INEI (2004),Section V, item 5.1
$INFO_3$	Dummy variable with value of one for firms using internet for information on government institutions, otherwise zero.	CONCYTEC-INEI (2004),Section V, item 5.1
lnIE	Natural logarithm of firms' real value of STI investment over the number of workers	CONCYTEC-INEI (2004),Section II, item, 2, 3 and 4, Section XI, item 42.a; Section II, item 1.b
$lnIE^{e1}$	Predicted value of lnIE from Heckman's estimation of equation 6.2 or 6.6	CONCYTEC-INEI (2004),Section II, item, 2, 3 and 4, Section XI, item 42.a; Section II, item 1.b
$lnIE^{e2}$	Predicted value of lnIE from Heckman's two step estimation of equation 6.2 or 6.6	CONCYTEC-INEI (2004),Section II, item, 2, 3 and 4, Section XI, item 42.a; Section II, item 1.b
$D_{control}$	Dummy variable with value of one for firms with zero k, otherwise zero	
ln(k+1)	Natural logarithm of firms real value of capital expenditure per worker plus one	CONCYTEC(2004) Section II, item 31
lnProd	Natural Logarithm of firms real value per worker	CONCYTEC(2004) Section I, item 22 and 23,
TI	Dummy variable with value of one for firms having Technological Innovation, otherwise zero	CONCYTEC (2004), Section VI.1, item 44.h
TI^{ei}	Predicted probability of e TI. i=1 (Heckman basic model); 2 (Heckman extended model), 3(Heckit basic model) 4 (Heckit extended model)	CONCYTEC (2004), Section VI.1, item 44.h
NTI	Dummy variable with value of one for firms having Non-Technological Innovation, otherwise zero	CONCYTEC (2004), Section VI.1, item 44.h
NTI^{ei}	Predicted probability of NTI for i=1, 4.	CONCYTEC (2004), Section VI.1, item 44.h

Source: Author´s own work.

FIGURE A1
National System of Science, Technology and Technological Innovation (SINACYT)[44]



[44]UNCTAD-ECLA (2011)

Table A2:
STI Output Indicators at Firm Level, Peru 2004

ISIC DESCRIPTION	ISIC	N	Technological Innovation					Non-Technological Innovation			Any Inn[5]	Tech and Non-Tech Inn[6]
			Product	Process	Inn[1]	In-house Tech-Inn[2]	New[3]	Org	Mark	Non-Tech Inn[4]		
Services		**2732**	**12.77**	**13.07**	**17.97**	**9.99**	**4.65**	**19.62**	**14.35**	**23.17**	**28.07**	**13.07**
KIBS												
Land transport	60	252	7.14	10.32	13.1	6.75	2.38	15.08	11.9	18.25	22.22	9.13
Water transport	61	11	9.09	0	9.09	9.09	0	18.18	9.09	18.18	18.18	9.09
Air transport	62	19	21.05	21.05	26.32	15.79	10.53	15.79	10.53	21.05	31.58	15.79
Auxiliary transport activities	63	101	19.8	12.87	25.74	14.85	7.92	27.72	15.84	33.66	41.58	17.82
Post and telecommunications	64	34	20.59	17.65	26.47	20.59	11.76	14.71	17.65	23.53	32.35	17.65
Financial intermediation	65	43	44.19	32.56	48.84	37.21	4.65	32.56	16.28	32.56	51.16	30.23
Insurance and pension funding	66	26	34.62	19.23	38.46	30.77	11.54	38.46	23.08	38.46	50	26.92
Auxiliary activities to fin. inter.	67	15	13.33	6.67	20	13.33	6.67	6.67	6.67	13.33	26.67	6.67
Computer and related activities	72	49	16.33	22.45	28.57	14.29	6.12	18.37	10.2	20.41	32.65	16.33
Research and development	73	17	52.94	41.18	58.82	23.53	29.41	41.18	23.53	41.18	64.71	35.29
Business activities (excluded 749)	74	171	17.54	18.71	22.22	14.62	7.6	20.47	12.28	21.05	28.07	15.2
Subtotal		**738**	**17.21**	**16.12**	**23.04**	**14.23**	**6.37**	**20.6**	**13.41**	**23.44**	**31.3**	**15.18**

ISIC DESCRIPTION	ISIC	N	Technological Innovation: Product	Process	Inn[1]	In-house	New[3]	Non-Technological Innovation: Org	Mark	Non-Tech	Any Inn[5]	Tech and Non-Tech Inn[6]
Traditional Services												
Recycling	37	4	25	25	25	0	25	0	0	0	25	0
Electricity	40	38	23.68	18.42	28.95	13.16	2.63	31.58	13.16	31.58	39.47	21.05
Water	41	31	22.58	25.81	32.26	16.13	12.9	35.48	16.13	35.48	41.94	25.81
Motor veh. (sell. and rep.)	50	305	6.23	7.54	9.84	5.57	1.64	13.77	10.16	15.74	19.34	6.23
Wholesale trade	51	686	10.79	11.66	15.6	8.31	3.06	20.7	17.78	25.66	28.43	12.83
Retail trade	52	316	10.76	12.03	15.19	8.54	4.43	19.94	18.04	25	27.53	12.66
Hotels and restaurants	55	169	12.43	15.38	19.53	7.69	8.28	17.75	16.57	23.67	28.4	14.79
Real estate	70	71	8.45	7.04	11.27	7.04	1.41	11.27	4.23	14.08	19.72	5.63
Renting of machinery	71	27	3.7	3.7	7.41	3.7	0	14.81	7.41	14.81	14.81	7.41
Other business activities	749	158	7.59	10.13	12.66	5.7	3.8	15.19	8.23	16.46	20.89	8.23
Health and social work	85	44	31.82	34.09	43.18	22.73	11.36	36.36	25	38.64	47.73	34.09
Sewage and refuse disposal	90	10	10	0	10	0	0	30	20	40	50	0
Membership organizations	91	21	23.81	14.29	23.81	19.05	9.52	23.81	14.29	28.57	28.57	23.81
Recreational activities	92	39	25.64	17.95	35.9	23.08	5.13	28.21	10.26	30.77	41.03	25.64
Other services	93	75	10.67	10.67	16	8	5.33	17.33	9.33	20	25.33	10.67
Subtotal		**1994**	**11.13**	**11.94**	**16.1**	**8.43**	**4.01**	**19.26**	**14.69**	**23.07**	**26.88**	**12.29**
National		**2592**	11.54	12.08	16.55	8.91	4.44	19.06	14.08	22.61	26.85	12.31
Foreign		**140**	35.71	31.43	44.29	30	8.57	30	19.29	33.57	50.71	27.14

ISIC DESCRIPTION	ISIC	N	Technological Innovation: Product	Process	Inn[1]	In-house	New[3]	Non-Technological Innovation: Org	Mark	Non-Tech	Any Inn[5]	Tech and Non-Tech Inn[6]
Manufactures		**1156**	**24.57**	**25.95**	**32.87**	**19.64**	**9.43**	**22.49**	**15.22**	**25.78**	**38.15**	**20.5**
				Low Tech Manuf.								
Food products, beverages	15	288	26.04	23.26	31.6	19.44	13.19	19.79	14.24	23.61	36.46	18.75
Tobacco products	16	1	100	100	100	100	0	0	0	0	100	0
Textiles	17	65	26.15	32.31	36.92	20	9.23	30.77	20	33.85	41.54	29.23
Wearing apparel	18	60	13.33	20	23.33	10	3.33	21.67	11.67	23.33	31.67	15
Leather and footwear	19	22	13.64	22.73	27.27	9.09	4.55	13.64	13.64	18.18	31.82	13.64
Wood	20	53	16.98	16.98	20.75	15.09	3.77	18.87	11.32	18.87	24.53	15.09
Paper	21	16	37.5	50	50	37.5	6.25	25	12.5	25	50	25
Recorded media	22	101	18.81	21.78	26.73	16.83	5.94	19.8	17.82	26.73	30.69	22.77
Refined petroleum	23	1	100	0	100	100	0	100	0	100	100	100
Rubber	25	87	28.74	29.89	36.78	25.29	6.9	21.84	10.34	22.99	42.53	17.24
Non-metallic mineral products	26	57	24.56	28.07	35.09	14.04	12.28	14.04	12.28	17.54	40.35	12.28
Basic metals	27	36	33.33	33.33	44.44	19.44	13.89	19.44	13.89	25	50	19.44
Other transport equipment	35	118	19.49	20.34	27.12	16.1	6.78	16.1	12.71	21.19	31.36	16.95
Fabricated metal products	28	7	28.57	14.29	28.57	28.57	28.57	28.57	14.29	28.57	28.57	28.57
Furniture	36	42	11.9	19.05	21.43	7.14	2.38	21.43	4.76	21.43	28.57	14.29
Subtotal		**954**	**23.06**	**24.32**	**30.82**	**17.92**	**8.91**	**20.13**	**13.52**	**23.58**	**35.74**	**18.66**

ISIC DESCRIPTION	ISIC	N	Technological Innovation: Product	Process	Inn[1]	In-house	New[3]	Non-Technological Innovation: Org	Mark	Non-Tech	Any Inn[5]	Tech and Non-Tech Inn[6]
High Tech. Manuf.												
Chemicals	24	103	32.04	39.81	47.57	27.18	12.62	34.95	28.16	37.86	55.34	30.1
Machinery and equipment	29	45	22.22	20	26.67	22.22	8.89	26.67	13.33	26.67	28.89	24.44
Electrical machinery	31	29	20.69	20.69	31.03	17.24	3.45	24.14	13.79	27.59	37.93	20.69
Communication equipment	32	1	100	0	100	100	0	100	0	100	100	100
Medical, precision instruments	33	3	66.67	66.67	66.67	66.67	33.33	100	66.67	100	100	66.67
Vehicles	34	19	52.63	42.11	57.89	42.11	21.05	36.84	21.05	42.11	68.42	31.58
Other transport	35	2	100	100	100	100	50	100	100	100	100	100
Subtotal		**202**	**31.68**	**33.66**	**42.57**	**27.72**	**11.88**	**33.66**	**23.27**	**36.14**	**49.5**	**29.21**
National		**1196**	25.59	26.25	34.45	20.32	10.03	22.49	14.97	25.75	39.88	20.32
Foreign		**104**	49.04	49.04	59.62	40.38	15.38	43.27	33.65	52.88	68.27	44.23

Source: CONCYTEC (2005). Author's own work. [1] Product or process innovation. [2] This firms produced innovation of any kind (product, process, marketing and organization), with their own funds and without any collaboration from other entities [3] New to Market product innovation. [4] Organization or marketing innovation. [5] Technological or non-technological innovation. [6] Technological and non-technological innovation. The share of firms of each STI indicator is out of the total firms of the respective ISIC group.

Table A3: STI Input Indicators at Firm Level, Peru 2004

ISIC DESCRIPTION	ISIC	N	Inputs: Expenditure on STI[7]	R&D[8]	STI Capital Goods[9]	Other STI Activities[10]	Firms that performed R&D	Firms that performed R&D on a continuous basis
Services		**2732**	**4.87**	**2.56**	**19.93**	**77.53**	**5.29**	**9.55**
KIBS								
Land transport	60	252	5.83	0.17	31.26	68.57	1.75	8.33
Water transport	61	11	1	0	0	100	0	0
Air transport	62	19	2.3	10.47	13.31	76.22	14.29	5.26
Auxiliary transport activities	63	101	4.51	0	12.89	87.11	0	10.89
Post and telecommunications	64	34	2.81	0	9.71	90.29	0	5.88
Financial intermediation	65	43	3.06	0.62	16.96	83.12	4.17	20.93
Insurance and pension fund.	66	26	1.79	0	0	100	0	23.08
Auxiliary activities to f-int.	67	15	9.22	10.65	0	89.35	50	6.67
Computer and related act.	72	49	11.18	5.57	13.79	80.63	11.11	16.33
Research and development	73	17	66.66	30.31	3.23	66.46	63.64	23.53
Business act. (excluded 749)	74	171	12.11	4.48	16.61	78.91	5.88	11.7
Subtotal		***738***	***9.4***	***3.34***	***16.92***	***79.8***	***7.08***	***11.25***
Traditional Services								
Recycling	37	4	57.02	100	0	0	100	0
Electricity	40	38	4.32	10.07	9.09	80.83	26.67	10.53
Water	41	31	2.17	0	28.9	71.1	0	6.45
Motor veh. (sell. and rep.)	50	305	1.76	0.81	24.53	74.66	1.59	4.59
Wholesale trade	51	686	1.66	2.92	18.26	78.82	5.45	10.79
Retail trade	52	316	2.05	0.42	20.08	79.5	1.14	6.96
Hotels and restaurants	55	169	4.15	1.68	37.7	60.62	6.12	10.65
Real estate	70	71	8.7	0	11.77	88.23	0	7.04
Renting of machinery	71	27	10.79	0	71.55	28.45	0	3.7
Other business activities	749	158	1.66	2.42	14	83.57	2.94	9.49
Health and social work	85	44	8.21	1.87	18.85	79.28	9.52	18.18
Sewage and refuse disposal	90	10	0.72	0	2.82	97.18	0	10
Membership organizations	91	21	3.03	14.29	18.31	67.4	14.29	14.29
Recreational activities	92	39	7.15	0	35.51	64.49	0	15.38
Other services	93	75	4.69	0	18.58	81.42	0	6.67
Subtotal		***1994***	***2.91***	***2.23***	***21.23***	***76.54***	***4.51***	***8.93***
National		**2592**	5.16	2.52	20.83	76.68	5.14	9.07
Foreign		**140**	2.06	3.03	11.21	85.76	6.76	18.57

ISIC DESCRIPTION	ISIC	N	Inputs: Expenditure on STI[7]	R&D[8]	STI Capital Goods[9]	Other STI Activities[10]	Firms that performed R&D	Firms that performed R&D on a continuous basis
Manufactures			**4.35**	**10.2**	**28.82**	**61.04**	**18.32**	**14.8**
Low Tech Manuf.								
Food products, beverages	15	288	3.59	10.26	24.3	65.44	17.43	11.11
Tobacco products	16	1	6.64	0	75	25	0	0
Textiles	17	65	4.89	2.03	37.96	60.01	3.33	20
Wearing apparel	18	60	3.03	0.16	37.76	62.08	4.55	10
Leather and footwear	19	22	1.42	0	40.08	59.92	0	18.18
Wood	20	53	7.21	0	31.5	68.5	0	1.89
Paper	21	16	2.43	23.62	38.76	37.62	37.5	31.25
Recorded media	22	101	4.58	3.57	43.92	52.51	6.45	16.83
Refined petroleum	23	1	5.33	0	40.23	59.77	0	0
Rubber	25	87	3.38	11.92	39.59	48.5	17.95	12.64
Non-metallic mineral products	26	57	5.77	24.15	29.22	46.64	40	12.28
Basic metals	27	36	3.39	17.44	12	70.56	38.89	16.67
Other transport equipment	28	118	4.19	3.73	25.47	70.8	10.26	14.41
Fabricated metal products	35	7	1.05	0	0	100	0	0
Furniture	36	42	10.87	2.38	42.36	55.26	8.33	9.52
Subtotal		***954***	***4.25***	***8.57***	***31.03***	***60.41***	***15.41***	***12.89***
High Tech. Manuf.								
Chemicals	24	103	5.71	20.04	24.23	55.72	36.21	29.13
Machinery and equipment	29	45	1.84	14.38	7.66	77.96	15.38	6.67
Electrical machinery	31	29	6.99	22.16	14.67	64.51	45.45	27.59
Communication equipment	32	1	8.82	0	93.01	6.99	0	100
Medical, precision inst.	33	3	0.76	0	0	100	0	0
Vehicles	34	19	4.17	5.84	40.76	53.4	15.38	26.32
Other transport	35	2	2.47	0	0	100	0	50
Subtotal		***202***	***4.97***	***16.53***	***22.75***	***60.95***	***29.7***	***23.76***
National		**1071**	4.69	8.86	30.05	61.09	16.5	13.73
Foreign		**85**	2.48	20.42	23.28	56.71	32.76	28.24

Source: CONCYTEC (2005) Author's own work. [7] Total expenditures on STI (as a % of total turnover). [8] Expenditure on R&D as a % of total expenditure on STI. [9] Expenditure on STI Capital as % of total expenditure on STI [10] Expenditure on the others STI activities as a % of total expenditure on STI. These other STI activities include: training, consultancy services, engineering and industrial design, software and technology services. *Turnover from product innovations and from new to market product innovations were not available for Peruvian data. The shares of each STI indicator are out of the total firms of the respective ISIC group.

Table A4: STI Policy Indicators at Firm Level, Peru 2004

ISIC DESCRIPTION	ISIC	N	International markets11	Co-operated with foreign partners12	Co-operated13	Co-operated with Universities or Gov.14	Public Support15	Applied for patents16
Services		**2732**	**1.61**	**0.44**	**3.73**	**2.05**	**2.16**	**1.21**
KIBS								
Land transport	60	252	1.19	0	1.19	0.4	0.79	0.4
Water transport	61	11	0	0	0	0	0	0
Air transport	62	19	15.79	0	5.26	0	5.26	0
Auxiliary transport activities	63	101	3.96	1.98	6.93	4.95	0	0
Post and telecommunications	64	34	2.94	0	2.94	0	0	2.94
Financial intermediation	65	43	0	2.33	6.98	0	4.65	2.33
Insurance and pension fund.	66	26	3.85	3.85	7.69	3.85	0	0
Auxiliary activities to f-int.	67	15	0	6.67	13.33	13.33	13.33	0
Computer and related activities	72	49	0	0	2.04	2.04	8.16	4.08
Research and development	73	17	0	0	11.76	11.76	35.29	0
Business act. (excluded 749)	74	171	1.75	1.17	5.26	4.09	3.51	0.58
Subtotal		**738**	**2.03**	**0.95**	**4.2**	**2.57**	**3.12**	**0.81**
Traditional Services								
Recycling	37	4	0	0	25	0	25	25
Electricity	40	38	2.63	0	13.16	7.89	10.53	5.26
Water	41	31	0	0	9.68	3.23	3.23	0
Motor veh. (sell. and rep.)	50	305	0.33	0	0.98	0.66	0.98	0.66
Wholesale trade	51	686	1.31	0.29	2.48	1.46	2.19	1.6
Retail trade	52	316	0.95	0.32	2.85	0.95	0.32	1.58
Hotels and restaurants	55	169	6.51	0.59	8.28	5.92	1.78	1.18
Real estate	70	71	0	0	2.82	1.41	2.82	1.41
Renting of machinery	71	27	0	0	3.7	0	0	0
Other business activities	749	158	0.63	0.63	4.43	1.9	0.63	0.63
Health and social work	85	44	2.27	0	4.55	2.27	6.82	0
Sewage and refuse disposal	90	10	0	0	10	0	0	10
Membership organizations	91	21	0	0	9.52	4.76	4.76	0
Recreational activities	92	39	2.56	0	7.69	5.13	0	0
Other services	93	75	1.33	0	1.33	0	1.33	1.33
Subtotal		***1994***	***1.45***	***0.25***	***3.56***	***1.86***	***1.81***	***1.35***
National		**2592**	1.43	0.46	3.55	1.93	1.89	1.04
Foreign		**140**	5	0	7.14	4.29	7.14	4.29

ISIC DESCRIPTION	ISIC	N	International markets11	Co-operated with foreign partners12	Co-operated13	Co-operated with Universities or Gov.14	Public Support15	Applied for patents16
Manufactures		**1156**	**4.76**	**0.78**	**6.06**	**3.81**	**7.87**	**3.89**
			Low Tech Manuf.					
Food products, beverages	15	288	4.51	1.39	7.99	5.9	7.29	4.51
Tobacco products	16	1	0	0	0	0	0	0
Textiles	17	65	12.31	1.54	7.69	4.62	1.54	1.54
Wearing apparel	18	60	6.67	0	8.33	6.67	1.67	6.67
Leather and footwear	19	22	0	0	4.55	0	0	9.09
Wood	20	53	3.77	0	1.89	0	0	0
Paper	21	16	0	0	0	0	18.75	0
Recorded media	22	101	0	0.99	3.96	1.98	4.95	1.98
Refined petroleum	23	1	0	0	0	0	0	0
Rubber	25	87	1.15	0	4.6	2.3	8.05	4.6
Non-metallic mineral products	26	57	5.26	0	10.53	5.26	17.54	3.51
Basic metals	27	36	13.89	2.78	16.67	5.56	19.44	2.78
Other transport equipment	28	118	4.24	0	3.39	2.54	3.39	1.69
Fabricated metal products	35	7	14.29	0	0	0	0	0
Furniture	36	42	4.76	0	2.38	2.38	2.38	0
Subtotal		**954**	**4.61**	**0.73**	**6.29**	**3.88**	**6.29**	**3.25**
			High Tech. Manuf.					
Chemicals	24	103	6.8	0.97	6.8	4.85	20.39	7.77
Machinery and equipment	29	45	2.22	0	0	0	6.67	0
Electrical machinery	31	29	3.45	0	3.45	0	17.24	3.45
Communication equipment	32	1	0	0	0	0	0	0
Medical, precision instruments	33	3	0	0	0	0	0	66.67
Vehicles	34	19	5.26	5.26	10.53	10.53	10.53	15.79
Other transport	35	2	50	0	0	0	0	0
Subtotal		**202**	**5.45**	**0.99**	**4.95**	**3.47**	**15.35**	**6.93**
National		1071	4.3	0.65	5.79	3.73	6.54	3.83
Foreign		85	10.59	2.35	9.41	4.71	24.71	4.71

Source: CONCYTEC (2005). Author's own work. (11) Share of firms that were active on international markets. (12) Share of firms that co-operated with foreign partners on innovation. (13) Share of firms that co-operated on innovation activities. (14) Share of firms that co-operated with Universities/Higher education or government research institutes. (15) Share of firms that received public financial support for innovation. (16) Share of firms that applied for one or more patents. . The shares of each STI indicator are out of the total firms of the respective ISIC group.

Table A5
Censored (C) and Uncensored (U) Coefficients of the Selective (Observed) Equation 6.1 on Firms Decision to Invest on STI: Heckman Two Step or Heckit Method

Branch	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Variable	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**	**C**	**U**
Dx	0.088	0.224	0.05	0.136	0.0583*	0.156*	-0.056	-0.323	0.051	0.13	0.035	0.094	0.0477*	0.121*
FO	-0.006	-0.015	-0.018	-0.05	-0.009	-0.024	-0.081	-0.389	0.055	0.143	0.025	0.069	0.005	0.013
PFS	0.697***	7.546	0.726***	7.104	0.718***	7.607	0.422***	7.133	0.601***	6.929	0.569***	7.089	0.674***	7.622
PatenP	0.631***	6.834	0.716***	7.223	0.691***	7.141	0.208***	6.92	0.518***	6.905	0.456***	7.048	0.618***	7.093
$CIIU_1$									0.016	0.04	-0.037	-0.098	-0.006	-0.015
$CIIU_2$							-0.008	-0.048	0.008	0.021	-0.028	-0.075	0.005	0.012
$CIIU_3$			-0.322***	-5.586	-0.343***	-5.567							0.026	0.066
$CIIU_4$			-0.042	-0.12	-0.046	-0.129							-0.051	-0.13
$CIIU_5$			-0.009	-0.024	-0.006	-0.016							-0.007	-0.019
$CIIU_6$					0.006	0.016							0.005	0.012
$CIIU_7$	-0.036	-0.093	-0.112**	-0.338**	-0.073	-0.204							-0.08	-0.207
$CIIU_8$			0.163*	0.428*	0.170*	0.437*							0.171*	0.431*
lnSize	0.113***	0.295***	0.0902***	0.253***	0.0973***	0.266***	0.103***	0.596***	0.0811***	0.207***	0.0919***	0.248***	0.103***	0.261***
Const.		-1.396***		-1.273***		-1.317***		-1.888***		-1.194***		-1.167***		-1.298***
Obser.	738	738	1,994	1,994	2,732	2,732	202	202	954	954	1,156	1,156	3,888	3,888
ρ		0.281		0.999		0.822		0.207		0.762		0.647		0.743
σ		1.997		2.962		2.461		1.629		2.299		2.097		2.288
Mills- λ		0.561		2.960***		2.023***		0.338		1.752***		1.357***		1.701
Predic. Value		0.39		0.318		0.34		0.902		0.571		0.65		0.407
χ^2		28.72		64.53		84.26		8.96		24.41		28.64		94.12

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance.

Table A6
Uncensored (U) Coefficients of the Selective (Observed) Equation 6.1 on STI Investment Output
Heckman Two step or Heckit Method

	KIBS	Traditional	Services	Hi-Tech	Low-Tech	Manufacture	Total
D_x	0.637*	0.969***	0.792***	0.086	0.242	0.207	0.514***
FO	0.109	0.559	0.441	-0.667	0.758*	0.372	0.379*
PFS	2.361***	3.634***	3.233***	0.646	1.888***	1.515***	2.251***
PatenP	1.022	2.917***	2.028***	0.707	2.166***	1.687***	1.858***
D_{coord}	-0.462	-0.531**	-0.467**	0.456	0.375	0.35	-0.14
$INFO_1$	1.101**	0.236	0.377*	-0.639	0.454	0.353	0.425**
$INFO_2$	0.625**	0.277	0.406***	0.760*	-0.025	0.105	0.282**
$INFO_3$	-1.111**	0.318	-0.018	-0.091	-0.324	-0.33	-0.19
$CIIU_1$					-0.303	-0.487	-0.063
$CIIU_2$				-0.03	0.111	-0.058	0.274
$CIIU_3$		-0.48	-0.31				0.336
$CIIU_4$		0.4	0.258				0.346
$CIIU_5$		-0.14	-0.028				0.029
$CIIU_6$			0.372				0.359
$CIIU_7$	-0.101	-0.788*	-0.117				-0.011
$CIIU_8$		0.863	0.544				0.573
Constant	5.051***	1.805***	2.929***	6.125***	3.920***	4.617***	3.460***
Observations	738	1,994	2,732	202	954	1,156	3,888
ρ	0.281	0.999	0.822	0.207	0.762	0.647	0.743
σ	1.997	2.962	2.461	1.629	2.299	2.097	2.288
Mills- λ	0.561	2.960***	2.023***	0.338	1.752***	1.357***	1.701
χ^2	28.72	64.53	84.26	8.96	24.41	28.64	94.12

Source: Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance

Table A7
Probit Coefficients of the (Observed) Technical Innovation Output Equation 6.3

	KIBS		**Traditional**		**Services**		**Hi-Tech**		**Low-Tech**		**Manufacture**		**Total**	
lnIE	0.448***		0.389***		0.407***		0.459***		0.457***		0.458***		0.426***	
$lnIE^{e1}$		0.452***		0.514***		0.514***		0.829***		1.177***		1.018***		0.918***
lnSize	0.217***	0.258***	0.240***	0.164***	0.235***	0.190***	0.463***	0.439***	0.203***	0.193***	0.233***	0.199***	0.237***	0.185***
Dx	0.095	-0.101	0.144	-0.205*	0.136	-0.181*	-0.242	-0.123	0.195	0.306***	0.152	0.109	0.132	-0.156***
FO	0.168	-0.068	0.064	-0.063	0.108	-0.094	-0.451	0.011	0.056	-0.472**	-0.07	-0.317*	0.043	-0.176*
$CIIU_1$									0.095	0.295	0.113	0.327*	0.224	0.103
$CIIU_2$							0.199	0.057	0.101	-0.098	0.149	0.02	0.257	-0.11
$CIIU_3$			0.368	-0.618	0.367	-0.319							0.143	-0.208
$CIIU_4$			-0.142	-0.156	-0.155	-0.127							-0.169	-0.282
$CIIU_5$			-0.279	-0.253*	-0.301*	-0.248**							-0.319*	-0.341***
$CIIU_6$					-0.069	-0.215*							-0.074	-0.333***
$CIIU_7$	0.18	0.176	-0.234	0.023	-0.055	-0.047							-0.053	-0.156
$CIIU_8$			0.720**	0.308	0.730**	0.379*							0.741**	0.279
Constant	-2.997***	-3.781***	-2.761***	-2.943***	-2.812***	-3.177***	-3.402***	-6.542***	-2.789***	-8.046***	-2.888***	-6.670***	-2.887***	-5.478***
Obs.	738	785	1,994	2,117	2,732	2,902	202	224	954	1,060	1,156	1,284	3,888	4,186
Pseudo R^2	0.644	0.153	0.546	0.121	0.577	0.135	0.668	0.213	0.643	0.1	0.648	0.148	0.613	0.164
χ^2	512.6	117.3	961.7	346.5	1485	236.2	184.1	31.6	757.9	134	948.9	286.4	2529	734.2

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e1] Predicted with the Heckman method of the basic model and bootstrapping standard errors for the independent variables..

Table A8
Marginal and Non-Marginal Coefficients of the (Observed) Technical Innovation Output Equation 6.7, Heckit Method

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
$lnIE^{e3}$	0.493***	0.144***	0.298***	0.0709***	0.412***	0.104***	0.825***	0.325***	0.608***	0.222***	0.748***	0.279***	0.574***	0.171***
lnSize	0.260***	0.076***	0.171***	0.041***	0.196***	0.050***	0.435***	0.171***	0.162***	0.059***	0.193***	0.072***	0.180***	0.054***
Dx	-0.082	-0.023	-0.053	-0.012	-0.11	-0.027	-0.146	-0.057	0.032	0.012	-0.005	-0.002	-0.120**	-0.035**
FO	-0.025	-0.007	-0.021	-0.005	-0.074	-0.018	0.005	0.002	-0.384	-0.129*	-0.319*	-0.112*	-0.162*	-0.046*
$CIIU_1$									0.124	0.046	0.235	0.088	-0.051	-0.015
$CIIU_2$							0.057	0.023	-0.029	-0.011	0.034	0.013	-0.048	-0.014
$CIIU_3$			0.506	0.15	0.536	0.168							-0.068	-0.02
$CIIU_4$			-0.058	-0.014	-0.083	-0.02							-0.008	-0.002
$CIIU_5$			-0.217*	-0.0543*	-0.230**	-0.0588**							-0.341***	-0.097***
$CIIU_6$					-0.217**	-0.0514**							-0.350***	-0.093***
$CIIU_7$	0.166	0.05	-0.058	-0.014	-0.07	-0.017							-0.185*	-0.052*
$CIIU_8$			0.341	0.094	0.369*	0.109*							0.165	0.052
Constant	-4.193***		-1.970***		-2.728***		-6.451***		-3.568***		-4.635***		-3.299***	
Observ.	785	785	2,117	2,117	2,902	2,902	224	224	1,060	1,060	1,284	1,284	4,768	4,768
Pseudo R^2	0.15	0.216	0.116	0.154	0.131	0.17	0.216	0.439	0.133	0.338	0.152	0.357	0.162	0.222
χ^2	139.2		209		380.8		49.92		100.9		149		942.9	

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e3] Predicted value with Heckit method of the basic model and with bootstrapping standard errors for the independent variables.

Table A9
Regression Coefficients of the Labor Productivity Equation 6.5 With Bootstrap Standard Errors for Predicted Values Using Heckit Estimations

Variables	KIBS			Traditional			Services		
lnSize	-0.138***	-0.139**	-0.049	-0.305***	-0.303***	-0.222***	-0.238***	-0.237***	-0.169***
ln(K+1)	0.149***	0.149***	0.147***	0.216***	0.215***	0.212***	0.193***	0.192***	0.188***
$D_{control}$	0.765***	0.768**	0.757**	1.250***	1.219***	1.211***	1.073***	1.061***	1.045***
TI^{e3}	1.210***	1.174**		2.104***	2.187***		1.518***	1.563***	
NTI	-0.069			0.131**			0.075		
$lnIE^{e3}$			0.183***			0.234***			0.246***
$CIIU_1$									
$CIIU_2$									
$CIIU_3$				0.005	-0.01	0.237	0.197	0.189	0.334
$CIIU_4$				0.944***	0.944***	0.915***	0.960***	0.961***	0.912***
$CIIU_5$				1.363***	1.372***	1.247***	1.361***	1.365***	1.265***
$CIIU_6$							0.414***	0.416***	0.292***
$CIIU_7$	-0.412***	-0.409***	-0.354***	0.226**	0.223**	0.249**	0.093	0.09	0.061
$CIIU_8$				-0.926***	-0.928***	-0.706**	-0.775***	-0.775***	-0.618***
Const.	9.251***	9.242***	8.291***	8.578***	8.611***	8.346***	8.703***	8.718***	8.078***
Obser.	767	767	767	2,048	2,048	2,048	2,815	2,815	2,815
Adj-R^2	0.0543	0.055	0.0558	0.207	0.206	0.211	0.211	0.211	0.217
R^2	0.0617	0.0611	0.0619	0.211	0.21	0.214	0.214	0.214	0.22

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. e3 Predicted values with the Heckit method of the basic model using bootstrapping standard errors for independent variables.

Table A9
Regression Coefficients of the Labor Productivity Equation 6.5 With Bootstrap Standard Errors for Predicted Values Using Heckit Estimations

	Hi Tech			Low Tech			Manufacture			Total		
lnSize	0.089	0.091	0.043	-0.046	-0.042	-0.014	-0.033	-0.029	-0.004	-0.164***	-0.162***	-0.123***
ln(K+1)	0.104**	0.103*	0.104**	0.192***	0.189***	0.190***	0.176***	0.173***	0.174***	0.191***	0.190***	0.188***
$D_{control}$	0.649	0.64	0.649*	1.060***	1.021***	1.033***	0.972***	0.937***	0.952***	1.067***	1.049***	1.051***
TI^{e3}	-0.382	-0.355		0.621**	0.661***		0.466**	0.516**		1.029***	1.074***	
NTI	0.053			0.139*			0.129*			0.092***		
$lnIE^{e3}$			-0.068			0.152***			0.154***			0.243***
$CIIU_1$				0.028	0.024	0.053	-0.123	-0.132	-0.078	-0.376***	-0.379***	-0.441***
$CIIU_2$	0.122	0.119	0.114	0.330**	0.321**	0.306**	0.213**	0.202**	0.206**	-0.086	-0.092	-0.172*
$CIIU_3$										-0.266**	-0.265**	-0.353***
$CIIU_4$										0.928***	0.927***	0.909***
$CIIU_5$										1.359***	1.363***	1.243***
$CIIU_6$										0.408***	0.409***	0.260***
$CIIU_7$										0.093	0.089	0.017
$CIIU_8$										-0.668***	-0.666***	-0.648***
Constant	8.822***	8.835***	9.230***	7.962***	8.010***	7.480***	8.223***	8.269***	7.603***	8.611***	8.633***	7.920***
Obser.	213	213	213	1,020	1,020	1,020	1,233	1,233	1,233	4,049	4,049	4,049
Adj-R^2	0.0034	0.00756	0.00589	0.107	0.105	0.108	0.0974	0.0955	0.0987	0.256	0.256	0.262
R^2	0.0316	0.031	0.0293	0.113	0.11	0.113	0.103	0.0999	0.103	0.259	0.258	0.264

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. e_3 Predicted values with the Heckit method or the basic model with bootstrapping standard errors for the independent variables.

Table A10

Censored (C) and Uncensored (U) Coefficients of STI Investment Selective Equation 6.5: Heckman Two Steps or Heckit Method Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
	C	U	C	U	C	U	C	U	C	U	C	U	C	U
Dx	0.032	0.081	0.018	0.046	0.02	0.049	-0.03	-0.309	0.027	0.079	0.014	0.048	0.02	0.052
FO	-0.05	-0.126	-0.051	-0.128	-0.045	-0.112	-0.072	-0.543	0.06	0.186	0.021	0.072	-0.021	-0.054
PFS	0.561***	7.249	0.592***	6.614	0.583***	7.127	0.320***	7.037	0.483***	6.742	0.453***	6.912	0.538***	7.165
PatenP	0.467***	6.545	0.578***	6.9	0.544***	6.845	0.123***	6.849	0.385***	6.854	0.324***	6.847	0.464***	6.858
FC	-0.078	-0.196	-0.121***	-0.309***	-0.111***	-0.281***	-0.016	-0.164	-0.025	-0.073	-0.023	-0.077	-0.077***	-0.200***
$CIIU_1$									-0.009	-0.235	-0.035	-0.168	-0.009	-0.024
$CIIU_2$							-0.005		-0.029		-0.041		-0.017	-0.043
$CIIU_3$			-0.481***	-5.98	-0.507***	-5.82							0.02	0.06
$CIIU_4$			-0.05	-0.13	-0.06	-0.14							-0.06	-0.15
$CIIU_5$			-0.02	-0.05	-0.01	-0.03							-0.01	-0.03
$CIIU_6$					0.01	0.04							0.01	0.04
$CIIU_7$	-0.05	-0.126	-0.134**	-0.343**	-0.08	-0.21							-0.08	-0.21
$CIIU_8$			0.142	0.36	0.15	0.38							0.139*	0.39
lnSize	0.111***	0.282***	0.084***	0.211***	0.092***	0.232***	0.057***	0.604***	0.066***	0.195***	0.071***	0.243***	0.091***	0.237***
Const.		-0.993***		-0.782***		-0.856***		-1.659***		-0.821***		-0.860***		-0.892***
Observ.	539	539	1411	1411	1950	1950	178	178	768	768	946	946	2896	2,896
ρ		0.354		1		0.953		0.262		0.847		0.72		0.855
σ		2.016		3.901		2.726		1.634		2.386		2.143		2.427
Mills-λ		0.713		3.901		2.599***		0.429		2.021		1.543***		2.076

Table A11
Marginal Coefficients of the Uncensored (Latent) STI Investment Intensity Output Equation 6.6: Heckit Method, Extended Model

Variables	KIBS	Traditional	Services	Hi-Tech	Low-Tech	Manufacture	Total
Dx	0.564	0.873**	0.694***	0.098	0.205	0.187	0.467***
FO	0.041	0.314	0.275	-0.667	0.741*	0.343	0.279
PFS	2.432***	4.021***	3.456***	0.677	1.904***	1.502***	2.344***
PatenP	1.118	3.240***	2.209***	0.709	2.162***	1.675***	1.927***
Dcoord	-0.497	-0.552*	-0.492**	0.456	0.357	0.346	-0.148
$INFO_1$	1.104**	0.2	0.352*	-0.602	0.493	0.374	0.419**
$INFO_2$	0.626**	0.306	0.421***	0.791*	-0.018	0.103	0.286**
$INFO_3$	-1.103**	0.337	0.004	-0.101	-0.32	-0.322	-0.177
FC	-0.426	-1.185***	-0.833***	0.11	-0.355	-0.25	-0.497***
$CIIU_1$					-0.382	-0.507	-0.065
$CIIU_2$				-0.039	-0.023	-0.113	0.226
$CIIU_3$		0.013	0.075				0.356
$CIIU_4$		0.287	0.183				0.285
$CIIU_5$		-0.258	-0.1				-0.011
$CIIU_6$			0.394				0.38
$CIIU_7$	-0.121	-0.98	-0.197				-0.059
$CIIU_8$		0.76	0.46				0.521
Constant	5.114***	1.798**	2.985***	6.022***	4.106***	4.735***	3.549***
Obser.	539	1,411	1,950	178	768	946	2,896
ρ	0.354	1	0.953	0.262	0.847	0.72	0.855
σ	2.016	3.901	2.726	1.634	2.386	2.143	2.427
Mills-λ	0.713	3.901	2.599***	0.429	2.021	1.543***	2.076

Source: Table A1. Author's own work * 10% level of significance; **5% level of significance; *** less than 1% level of significance.

Table A12
Probit coefficients of the (Observed) Technical Innovation Output Equation 6.7: Extended model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
lnIE	0.422***		0.364***		0.379***		0.439***		0.434***		0.436***		0.402***	
$lnIE^{e2}$		0.394***		0.417***		0.444***		0.873***		0.944***		0.756***		0.735***
lnSize	0.216***	0.246***	0.228***	0.139***	0.240***	0.173***	0.455***	0.415***	0.202***	0.165***	0.233***	0.191***	0.232***	0.161***
Dx	0.086	-0.128	0.139	-0.149	0.051	-0.171*	-0.237	-0.128	0.183	0.256***	0.14	0.118	0.126	-0.107
FO	0.151	-0.115	0.076	0.011	0.106	-0.055	-0.463	-0.042	0.082	-0.307	-0.056	-0.244	0.051	-0.126
$CIIU_1$									0.084	0.207			0.242	0.127
$CIIU_2$							0.191	0.021	0.082	-0.11			0.265	-0.039
$CIIU_3$			0.291	-1.631**							-0.124	-0.076	0.163	-0.117
$CIIU_4$			-0.118	-0.131									-0.148	-0.198
$CIIU_5$			-0.28	-0.281**									-0.313*	-0.330***
$CIIU_6$													-0.058	-0.278**
$CIIU_7$	0.186	0.19	-0.217	-0.034	0.138	0.174*							-0.032	-0.105
$CIIU_8$			0.759**	0.327									0.782**	0.335
Const.	-2.832***	-3.186***	-2.571***	-2.505***	-2.830***	-2.913***	-3.246***	-6.519***	-2.626***	-6.355***	-2.613***	-4.975***	-2.732***	-4.321***
Observ.	539	586	1,411	1,534	1,950	2,120	178	200	768	874	946	1,074	2,896	3,194
Pseudo-R^2	0.585	0.134	0.482	0.0765	0.507	0.104	0.634	0.225	0.598	0.0807	0.604	0.117	0.555	0.137
χ^2	393.3	79.13	728.9	123.9	1115	256	156.3	47.27	611.3	87.29	770.4	147.8	1965	629.7

Source: Table A1. Author's own work * 10% level of significance; **5% level of significance; *** less than 1% level of significance Observations with any restriction to innovation and innovation activities considered. [e2] Predicted values with the Heckman method of the extended model . In this case, bootstrapping standard errors were used for the independent variables.

Table A13
Probit Coefficients of the (Observed) Non-Technical Innovation Output Equation 6.8, Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
lnIE	0.321***		0.477***		0.417***		0.297***		0.291***		0.293***		0.368***	
lnIE^{e2}		0.177***		0.549***		0.304***		0.329**		0.23		0.292***		0.375***
lnSize	0.098**	0.178***	0.222***	0.142***	0.167***	0.158***	0.220*	0.293***	0.122***	0.171***	0.134***	0.182***	0.154***	0.163***
Dx	-0.342	-0.248	-0.384**	-0.476***	-0.338***	-0.229***	-0.497	-0.21	-0.166	-0.039	-0.208*	-0.083	-0.280***	-0.184***
FO	-0.460*	-0.349*	-0.884***	-0.371***	-0.710***	-0.339***	0.051	0.052	0.232	0.278	0.194	0.186	-0.297**	-0.141
$CIIU_1$									-0.221	-0.139	-0.2	-0.155	-0.207	-0.157
$CIIU_2$							-0.141	-0.123	-0.411	-0.296	-0.315*	-0.263**	-0.343*	-0.273**
$CIIU_3$				-2.948***		-0.990*							-0.068	-0.206
$CIIU_4$			-0.044	-0.358**	-0.005	-0.157							-0.026	-0.082
$CIIU_5$			0.345*	0.061	0.268	0.077							0.219	0.049
$CIIU_6$					-0.087	-0.082							-0.089	-0.113
$CIIU_7$	-0.215	-0.132	0.037	0.093	-0.197	-0.158							-0.202	-0.19
$CIIU_8$			0.15	-0.107	0.153	0.141							0.183	0.146
Const.	-1.747***	-1.713***	-2.693***	-2.849***	-2.271***	-1.985***	-1.863***	-2.946***	-1.693***	-2.185**	-1.739***	-2.423***	-2.067***	-2.556***
Observ.	539	586	1,407	1,534	1,946	2,120	178	200	768	874	946	1,074	2,896	3,194
Pseudo-R^2	0.416	0.0482	0.611	0.0533	0.544	0.0544	0.374	0.0847	0.364	0.0489	0.367	0.0589	0.475	0.0535
χ^2	281.5	46.62	1086	100.8	1335	205.2	90.12	26.03	337.8	44.06	432.7	104.4	1727	215.5

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. Observations with any restriction to innovation and innovation activities considered. Observations with FC and innovation activities considered. ^{e2} Predicted values with the Heckman method of the extended model. In this case, bootstrapping standard errors were used for the independent variables.

Table A14
Biprobit coefficients of the (Observed) Technical and Non-Technical Innovation Ouput Equations 6.7 and 6.8: Extended Model

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
Technical Innovation														
lnIE	0.422***		0.364***		0.381***		0.439***		0.434***		0.436***		0.403***	
$lnIE^{e2}$		0.385***		0.416***		0.424***		0.832***		0.899***		0.818***		0.420***
lnSize	0.215***	0.247***	0.228***	0.146***	0.227***	0.170***	0.455***	0.404***	0.209***	0.168***	0.238***	0.182***	0.233***	0.173***
Dx	0.085	-0.124	0.14	-0.144	0.131	-0.104	-0.217	-0.196	0.178	0.246***	0.132	0.1	0.124	-0.053
FO	0.151	-0.139	0.077	0	0.112	-0.054	-0.483	-0.006	0.05	-0.317	-0.074	-0.251	0.05	-0.103
$CIIU_1$									0.106	0.191	0.122	0.257*	0.25	0.149
$CIIU_2$							0.202	0.046	0.087	-0.12	0.134	0.009	0.266	0.079
$CIIU_3$			0.288	-1.603	0.295	-0.637							0.165	0.068
$CIIU_4$			-0.118	-0.146	-0.133	-0.096							-0.148	-0.096
$CIIU_5$			-0.281	-0.289**	-0.298	-0.283*							-0.312	-0.273*
$CIIU_6$					-0.054	-0.181							-0.057	-0.202
$CIIU_7$	0.186	0.186	-0.218	-0.029	-0.034	-0.027							-0.029	-0.068
$CIIU_8$			0.759**	0.323	0.768**	0.439**							0.784**	0.358
Const.	-2.824***	-3.138***	-2.564***	-2.516***	-2.630***	-2.631***	-3.245***	-6.237***	-2.692***	-6.095***	-2.783***	-5.387***	-2.754***	-2.631***
Obser.	539	586	1,411	1,534	1,950	2,120	178	200	768	874	946	1,074	2,896	3,194

Variables	KIBS		Traditional		Services		Hi-Tech		Low-Tech		Manufacture		Total	
	Non-Technical Innovation													
lnIE	0.321***		0.477***		0.417***		0.296***		0.294***		0.295***		0.369***	
$lnIE^{e2}$		0.175***		0.549***		0.300***		0.33		0.261*		0.300***		0.230***
lnSize	0.098*	0.180***	0.222***	0.144***	0.167***	0.159***	0.219**	0.297***	0.123***	0.175***	0.135***	0.185***	0.154***	0.169***
Dx	-0.342	-0.25	-0.383**	-0.474***	-0.337***	-0.223**	-0.492*	-0.231	-0.167	-0.043	-0.211*	-0.093	-0.280***	-0.163***
FO	-0.459*	-0.369	-0.885***	-0.376**	-0.710***	-0.344**	0.051	0.066	0.224	0.26	0.19	0.183	-0.297**	-0.13
$CIIU_1$									-0.213	-0.134	-0.195	-0.151	-0.205	-0.145
$CIIU_2$							-0.138	-0.129	-0.408	-0.308	-0.314*	-0.270**	-0.343*	-0.217
$CIIU_3$			-6.613***	-2.979	-6.427***	-1.065							-0.067	0.008
$CIIU_4$			-0.044	-0.368*	-0.005	-0.159							-0.028	-0.137
$CIIU_5$			0.343	0.053	0.266	0.072							0.222	0.076
$CIIU_6$					-0.088	-0.084							-0.086	-0.088
$CIIU_7$	-0.215	-0.134	0.037	0.086	-0.198	-0.164							-0.2	-0.192
$CIIU_8$			0.151	-0.124	0.154	0.138							0.18	0.146
Const.	-1.746***	-1.706***	-2.690***	-2.845***	-2.268***	-1.971***	-1.854***	-2.954**	-1.723***	-2.371***	-1.762***	-2.472***	-2.075***	-1.751***
Observ.	539	586	1,411	1,534	1,950	2,120	178	200	768	874	946	1,074	2,896	3,194
ρ	-0.022	0.623***	-0.023	0.672***	-0.02	0.647***	-0.088	0.709***	0.210***	0.711***	0.178***	0.711***	0.063	0.668***
χ^2	403.7	105.1	2064	215	2539	278.5	197.9	57.5	537.9	197.7	718.3	253.8	2039	1047

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. ^{e2} Predicted values with the Heckman method of the extended model. In this case, bootstrapping standard errors were used for the independent variables.

Table A15

Regression Coefficients of the Labor Productivity Equation 6.9 With Bootstrap Standard Errors for Predicted Values Using Heckit Estimation: Extended Model

Variables	KIBS			Traditional			Services		
lnSize	-0.138***	-0.139***	-0.049	-0.305***	-0.303***	-0.222***	-0.238***	-0.237***	-0.169***
ln(K+1)	0.149***	0.149***	0.147***	0.216***	0.215***	0.212***	0.193***	0.192***	0.188***
$D_{control}$	0.765***	0.768***	0.757**	1.250***	1.219***	1.211***	1.073***	1.061***	1.045***
TI^{e4}	1.210***	1.174***		2.104***	2.187***		1.518***	1.563***	
NTI	-0.069			0.131*			0.075		
$lnIE^{e4}$			0.183***			0.234***			0.246***
$CIIU_1$									
$CIIU_2$									
$CIIU_3$				0.005	-0.01	0.236	0.197	0.189	0.334
$CIIU_4$				0.944***	0.944***	0.915***	0.960***	0.961***	0.912***
$CIIU_5$				1.363***	1.372***	1.247***	1.361***	1.365***	1.265***
$CIIU_6$							0.414***	0.416***	0.292***
$CIIU_7$	-0.412***	-0.409***	-0.354***	0.226**	0.223**	0.249**	0.093	0.09	0.061
$CIIU_8$				-0.926***	-0.928***	-0.706***	-0.775***	-0.775***	-0.618***
Const.	9.251***	9.242***	8.291***	8.578***	8.611***	8.346***	8.703***	8.718***	8.078***
Obser.	767	767	767	2,048	2,048	2,048	2,815	2,815	2,815
Adj-R^2	0.0543	0.055	0.0558	0.207	0.206	0.211	0.211	0.211	0.217
R^2	0.0617	0.0611	0.0619	0.211	0.21	0.214	0.214	0.214	0.22

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e4] Predicted values with the Heckit method for the extended model. In this case, bootstrapping standard errors were used for the independent variables.

Table A15
Regression Coefficients of the Labor Productivity Equation 6.9 With Bootstrap Standard Errors for Predicted Values Using Heckit Estimation: Extended Model

Variables	High Tech			Low-Tech			Manufacture			Total		
lnSize	0.089	0.091	0.043	-0.046	-0.042	-0.014	-0.033	-0.029	-0.004	-0.173***	-0.171***	-0.123***
ln(K+1)	0.104**	0.103	0.104*	0.192***	0.189***	0.190***	0.176***	0.173***	0.174***	0.191***	0.190***	0.188***
$D_{control}$	0.649	0.64	0.649	1.060***	1.021***	1.033***	0.972***	0.937***	0.952***	1.068***	1.049***	1.049***
TI^{e4}	-0.382	-0.355		0.621***	0.661***		0.466***	0.516***		1.113***	1.159***	
NTI	0.053			0.139*			0.129*			0.094**		
$lnIE^{e4}$			-0.068			0.152***			0.154***			0.256***
$CIIU_1$				0.028	0.024	0.053	-0.123	-0.132	-0.078	-0.385***	-0.389***	-0.369***
$CIIU_2$	0.122	0.119	0.114	0.330**	0.321**	0.306**	0.213***	0.202**	0.206**	-0.089	-0.095	-0.134
$CIIU_3$										-0.271**	-0.269*	-0.312*
$CIIU_4$										0.947***	0.948***	0.871***
$CIIU_5$										1.368***	1.373***	1.284***
$CIIU_6$										0.416***	0.418***	0.301***
$CIIU_7$										0.101	0.097	0.057
$CIIU_8$										-0.680**	-0.677***	-0.606***
Constant	8.822***	8.835***	9.230***	7.962***	8.010***	7.480***	8.223***	8.269***	7.603***	8.609***	8.631***	7.802***
Observations	213	213	213	1,020	1,020	1,020	1,233	1,233	1,233	4,048	4,048	4,048
Adj-R^2	0.0034	0.00756	0.00589	0.107	0.105	0.108	0.0974	0.0955	0.0987	0.257	0.256	0.262
R^2	0.0316	0.031	0.0293	0.113	0.11	0.113	0.103	0.0999	0.103	0.259	0.259	0.264

Source: Table A1. Author's own work. * 10% level of significance; **5% level of significance; *** less than 1% level of significance. [e4] Predicted values with the Heckit method for the extended model. In this case, bootstrapping standard errors were used for the independent variables.

cinve
Centro de Investigaciones Económicas
Avda. Uruguay 1242 - Montevideo CP 11100 - Uruguay
Tel./ fax (598) 2900 3051 / 2908 1533 - E mail: cinve@cinve.org.uy
http://www.cinve.org.uy