EXPORT PERFORMANCE, INNOVATION, AND SECTORAL EFFICIENCY: AN APPROXIMATION FROM MANUFACTURE COMPANIES IN ARGENTINA 2010-2012.

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Abstract: The aim of this work is to explore the differential role of innovation in different sectors of manufacture industry. We consider sectors and its characterization according to Ricardian, Keynesian and Shumpeterian efficiencies in a double sense. First, they define the productive structure of an economy, which is the main cause of external constrain to growth. Secondly, they also affect dynamics of innovation through industry biases that influence the innovative activity. We used anonymized microdata base from National Survey of Employment Dynamics and Innovation (ENDEI, for its acronym in Spanish) which sample 3691 Argentine industrial companies during 2010, 2011 and 2012. Results suggest export performance is conditioned by sector, and innovation has a positive impact on export performance all over the economy, but this impact varies according to the sector. We also find out defining a dynamic sector is a complex task, at least regarding to the role of innovation in exports, since for sectors expected to have a similar behavior as they are characterized with the same efficiency (Ricardian, Keynesian, or Schumpetarian), the impact of innovation on export performance varies considerably. This is our specific contribution as it had not been addressed previously, and it gives open the challenge of finding a better sectoral taxonomy, particularly for sectors with more than one efficiency. In fact, our more relevant finding is that only sectors simultaneously endowed with Keynesian and Schumpetarian efficiency are homogenous regarding export dynamism resulting from innovation.

I. Introduction

Argentina's economy has a long-lasting problem of external constraint, caused by fundamentals such us specialization and international insertion profile, denationalization of the economy and capital flight (Schorr and Wainer 2014), which limits economic growth leading to the known "stop and go" cycles (Braun and Joy 1981; Diamand 1972; Ferrer 1963; Thirlwall and McCombie 2004).

Literature has suggested a wide variety of solutions to external constraint, that we grouped on two major point of view:

1. Structural perspective stresses the importance of changing productive structure by encouraging sectors that simultaneously have Keynesian and Schumpetarian efficiency, and to move to higher productivity stages along value chain (Araujo and Lima 2007; Cimoli and Porcile 2011; Cimoli, Porcile, and Rovira 2009; Dosi 1988; Dosi, Pavitt and Soete 1990). Structural change requires sectors with rapid technical progress and high dynamism of demand to boost up investment, employment and productivity (Barletta, Robert, and Yoguel 2012).

2. Microeconomic perspective emphasizes on developing competitive capacities of enterprises to improve their performance in external markets. Innovation plays a key role in improving capabilities contributing not only to quantitatively increase exports but also to obtain an intra-sectorial up-grading towards higher value-added diversified products (Alvarez 2004; Cassiman, Golovko, and Martínez-Ros 2010; Chugan 2014; Lall and Kumar 1981; Marin 2016; Perez 2012).

There are different sectoral innovation trajectories and each sector has different capacity to spread out technical progress, so innovative activity is conditioned by sector (Dosi 1982; Malerba and Orsenigo 1997; Pavitt 1984). Moreover, structural change necessarily involves developing capacities of production of new goods and services, which are reached through innovation. We explore a mix of both responses: differential role of innovation in different productive sectors. We consider sectors and its characterization according to Ricardian, Keynesian and Shumpeterian efficiencies (Dosi 1988) in a double sense. First, they define the productive structure of an economy, which is the main cause of external constrain to growth mentioned above. Secondly, they also affect dynamics of innovation through industry biases that influence the innovative activity.

We used anonymized microdata base from National Survey of Employment Dynamics and Innovation (ENDEI, for its acronym in Spanish) which sample 3691 Argentine industrial companies during 2010, 2011 and 2012. We estimate different probit, poisson and multilevel models to check our hypothesis. Multilevel models allow us to explore how innovation influences individual and sectoral export performance.

Results suggest both perspectives previously mentioned are relevant and complementary. Export performance is conditioned by sector, and innovation has a positive impact on export performance all over the economy, but this impact varies according to the sector. We also find out defining a dynamic sector is a complex task, at least regarding to the role of innovation in exports, since for sectors expected to have a similar behavior as they are characterized with the same efficiency (Ricardian, Keynesian, or Schumpetarian), the impact of innovation on export performance varies considerably. This is our specific contribution as it had not been addressed previously, and it gives open the challenge of finding a better sectoral taxonomy, particularly for sectors with more than one efficiency. In fact, our more relevant finding is that only sectors simultaneously endowed with Keynesian and Schumpetarian efficiency are homogenous regarding export dynamism resulting from innovation.

In section II, we present theoretical framework for this work that comes from the evolutionary approach of innovation and technological change, together with nearest previous contributions and hypothesis that we propose from them. In section III, we present the empirical analysis and finally in section IV, we conclude.

II. Theoretical framework

Conceptual framework of this work combines evolutionary perspective of the firm and competition process (Teece and Pisano 1994) with those of technological trajectories (Dosi 1988) and technological regimes (Malerba and Orsenigo 1997) to account for the relationship between technological progress and competition along different industries. We also use Dosi´s concepts of Ricardian, Keynesian and Schumpetarian efficiency to link differential sectoral dynamics in international trade with innovation activities undertaken by companies within sectoral regimes and technological trajectories. We end this section by classifying theories of international according to which efficiency they are link to.

II.1 Firm and competition from an evolutionary perspective

From an evolutionary approach, each company has differential characteristics in its competitive potential, contrasting with neo-classical perspective based on a representative firm. Strategic decisions are essential for competition, that is, those decisions whose purpose is to build competitive capabilities that cannot be easily replicated by competitors. Firm´s capacity to innovate is critical in a framework of Schumpetarian competition because "firms are constantly seeking to create 'new combinations', and rivals are continuously attempting to improve their competences or to imitate the competence of their most qualified competitors" (Teece and Pisano 1994).

Dosi (1988) suggest differential productive capacities and technological inequalities between countries and companies arise from equally uneven patterns of economic signals faced by economic agents. There are three types of economic signals from environment that guides companies to adapt, corresponding to three types of adjustment strategies. First, opportunities of technological change emerging from firm´s products or others and economic benefits expected by these changes. These signals correspond to innovation strategies and they are called "Schumpetarian adjustment". Secondly, demand growth for firm´s products or others, which encourage companies to look for growth opportunities and it is called "Keynesian adjustment". Thirdly, changes in costs, prices, quantities, and benefits in firm´s products and others, which is called "Ricardian adjustment". These three types of adjustment give rise to three efficiencies: Schumpetarian, Keynesian, and Ricardian, respectively.

Since sectors differ significantly in their dynamic potential, both growing and technological, then Ricardian efficiency could oppose Schumpetarian and Keynesian efficiencies and pattern of trade based on comparative advantages may not generate reciprocal benefits for all countries as neoclassical theory postulates. Schumpetarian and Ricardian efficiency may be incompatible since technical progress is cumulative, partly appropriable, and local and technology gaps between countries or companies mismatch economic signals agents face. At the same time, Keynesian efficiency may not be compatible with Ricardian one because of widespread static and dynamic economies of scale, differential income elasticities of demand of goods, price elasticity of demand being relatively low and existence of unemployment which makes efficiency of its specialization depends on the growth of demand for the products in which specializes. In this sense, several authors have pointed out that a pattern of international trade matching static comparative advantages can doom a country to specialize in industries with low Schumpetarian and Keynesian efficiencies, that would limit its opportunities of technical advance and its long run growth compatible with external constraint (Barletta, Pereira and Yoguel 2014; ECLAC 2012; Cimoli et al. 2009; Dosi et al. 1990; Rivas and Robert 2012).

Ricardian, Keynesian and Schumpetarian efficiencies could be match with different trade theories. Regarding Ricardian efficiency, Heckscher-Ohlin model suggests international division of labor based on static comparative advantages (SCA) would bring the greatest feasible welfare to all countries (Krugman and Obstfeld 1999; Samuelson 1948). Recently contributions agree with specialization according to SCA, even from no neoclassical authors who encourage countries with an abundance of natural resources to specialized in natural resource intensive sectors taking advantages of opportunity to develop forward and backward linkages and increase diversification (IDB 2014; Perez

2012). However, these developments do not change substantially international insertion based on SCA.

Other approaches such as post-keynesian, structuralism and new theory of international trade (NTCI) highlighted the importance of Keynesian efficiency. Post-keynesian vision of open economies suggest growth has a maximum limit which depends on exports increasing and income elasticity of demand for imports (Thirlwall and McCombie 2004). Structuralist view complements post-keynesian one with a sectoral perspective that emphasizes composition effect of productive structure because ratio of trade elasticities partly depends on productive specialization, and coefficient evolution depends on direction and intensity of structural change (Araujo and Lima 2007; Cimoli and Porcile 2011). Moreover, NTCI propose countries specialized in producing goods with increasing global demand, i.e., with Keynesian efficiency, will benefit by reducing costs by scale economies and corresponding appropriation of monopoly rents (Krugman y Obstfeld 1999).

Finally, several authors have proposed different concepts to account for sectoral bias in innovative activity, corresponding to Schumpetarian efficiency. Malerba and Orsenigo (1997) suggest characteristics of knowledge accumulation specific to each sector determines the existence of different technological regimes that affect innovation. Technological regimes involve four properties of technology: conditions of opportunity and appropriability, accumulation degree of technological knowledge and relevant knowledge base. Pavitt (1984) classify sectors according to innovative activity distinguishing between production intensive sectors, specialized supplier sectors, dominated by supplier sectors and science-based sectors. Innovations do not come from a wide variety of sectors, but they are introduced by few windows, so it is essential technical progress to develop these cross-section sectors whose innovations are outsourced to other industries (Rosenberg 1963). Lastly, technological paradigms and trajectories (Dosi 1982) limits country possibilities to build capacities in technologically dynamic sectors since it is less probably to successfully develop sectors at mature phase of his technology trajectory because of scale economies. Developing countries should take windows opportunity advantage rising on early stages of new technology paradigm as it is possible to insert into markets competitively, spending relatively low capital and using knowledge acquired during previous paradigm (Perez 2005).

Previous contributions have studied relationship between innovation and performance for Argentinian companies. Milesi et al. (2007) find positive and significant link between technical progress and export performance for Argentinian SMEs and Barletta (2013) present similar findings to agricultural machinery companies. Lugones, Suarez and Le Clech (2007) suggest innovation efforts are more likely to generate productivity

gains if combine investments in different type of efforts such as organizational change, R&D, design, machinery, rather than concentrating on only one.

Barleta, Pereira, and Yoguel (2014) is the closest contribution to this work as explains export performance of Argentinian SMEs from efficiencies and their interaction with firm´s capacities. Only few companies support their international competitiveness on innovative activity and Schumpetarian efficiency, most companies' competitiveness is based in Ricardian and Keynesian efficiencies.

This work widens previous studies analyzing innovation influence on export performance at multiple levels: individual, by sector and by efficiency. We also check whether efficiencies adequately summarize idiosyncratic features of each sector. In addition, we use new data and consider large companies. Main difference with other previous contributions is that we consider sectors and efficiencies as levels of analysis that determine the influence of innovation on export performance and that we use multi-level models.

Considering theoretical framework and previous contributions, we put forward following working hypothesis:

1 - Export performance differs between sectors and efficiencies, i.e. firms have conditioned its export performance only because they belong to an specific sector or efficiency. In Argentina, companies in industries linked to natural resources exploitation have better export performance (IDB 2014; Marin 2016; Perez 2010).

2 - Innovation positively impacts on export performance and this impact differs between sectors and efficiencies. Innovation boosts export performance particularly for industries with Schumpetarian efficiency (Cimoli and Porcile 2011; Malerba, 2002; Malerba and Orsenigo, 1997, 2000).

3 - Sectors within same efficiency have similar behavior regarding to export performance and innovation because efficiencies summarize idiosyncratic features of sectors that influence on productive performance. This is a specific contribution since previous works do not verified efficiencies suitability and methodology to match efficiencies with sectors for developing countries.

III. Methodology of analysis

III.1 Data

We use data from ENDEI, carry out by Ministry of Science, Technology and Productive Innovation and Ministry of Labor, Employment and Social Security during 2010 and 2012 which sample 3,691 manufacturing companies with at least 10 employees.

ENDEI inform about export performance reporting whether firms export or not and export destinations, 39% of total surveyed companies export. ENDEI is representative by firm size and industry for two-digit ISIC Rev. 3 and four-digit for some selected sectors such as Food, Chemicals, Machinery and equipment, and Auto parts. For example, Food is subdivided into Meat, Dairy products, Wine and other fermented beverages and Other foods. Industry named "Other" includes codes of the ISIC Rev. 3 to which sample is not representative: Manufacture of tobacco products, Manufacture of coke, refined petroleum products and nuclear fuel, Manufacture of motor vehicles, trailers and semi-trailers, and Recycling. We use ENDEI´s information about export activity, innovative conduct, other features of companies that literature relates with export performance, and industries with their corresponding efficiencies (Ricardian, Keynesian, and Schumpetarian).

Dependent variable in our models is export performance of firms measured by two different indicators because of limitations of information available. Variable *exp* is a binary variable which represents export decision of a firm, while discrete variable *desexp* takes values from 0 to 6 indicating number of regions of the world to which company exports, where regions are groups of foreign countries that ENDEI reports as export destinations: MERCOSUR (Brazil, Paraguay and Uruguay) , other countries of Latin America, USA and Canada, Europe, Asia, and Africa and Oceania.

Both variables used to characterize export performance are enough dissimilar among themselves. When a company exports, it has acquired certain skills needed to meet greater requirements of international buyers and international trade. Diversification of export destinations can be interpreted as how far has external insertion of company gone and could approximate volume of external sales. Using two different variables to measure export performance gives greater robustness to conclusions of this empirical study. We cannot use an indicator of export intensity or other variables commonly used in literature because ENDEI does not report amount of exports, percentage they represent in total sales or other variables related to export.

Our causal variable of interest is innovative activity of the company. ENDEI classifies innovation results obtained by firms in product, process, organizational, and commercial innovation. We consider only product innovation because is the most important to generate capabilities to distinguish a firm from its competitors, literature indicates product innovation as the closest to export performance and it is the most frequent innovation type. Binary variable *inno* indicates if the company obtains product innovation, either new or improved.

We use as control variables other individual determinants of industrial exports considered by literature[1]. Dummies variables *size1*, *size2* and *size3* indicate whether a company is "Small" (10 to 25 employees), "Medium" (26 to 99) or "Big" (100 or more), respectively. To measure human resources qualification, we build variable *hrcal* which is the percentage of skilled workers over total workers of the firm, on average between 2010 and 2012. Continuous variable *va*[2] represents productivity measured through value added by worker[3]. We build binary variables to represent other individual determinants. Variable *pubfin* represents company's involvement in public financing programs indicating if the company requested or received public funding for innovation. Variable *links* shows if a firm is linked with universities and/or programs of science and technology. Variable *foreign* indicates if there is foreign capital as part of company´s ownership and variable *group* tells if a company belongs to a business group.

Table 1. Variables

Variable	Media	Standard	Minimum	Maximum
inno	0,5391	0,4985	0	1
size1	0,4251	0,4944	0	1
size2	0,3663	0,4819	0	1
size3	0,2086	0,4064	0	1
hrcal	52,5152	34,8065	0	100
pubfin	0,1859	0,3890	0	1
links	0,2883	0,4530	0	1
group	0,1233	0,3288	0	1
foreign	0,0913	0,2881	0	1
va	173709	272541,5	214,5699	5267291

Source: Own elaboration based on ENDEI

Companies are classified according to sector and efficiency of each sector. Given the abundance of natural resources in Argentina, Ricardian efficiency corresponds to those sectors that have a proportion of intermediate consumption of natural resources out of total supplies greater than manufacture average, according to data from table of use of goods and services of Argentina's 1997 input-output matrix. Keynesian efficiency corresponds to those sectors whose exports have increased their share in world trade between 2000 and 2014. Finally, Schumpetarian efficiency corresponds to sectors whose firms have higher share of investment on internal R&D out of total sales. Sectors can have none, one, or more than one efficiency, therefore sectors are classified according to efficiencies as Table 2[4] shows.

This table shows information about relation between productive structure, export performance and innovation. By comparing percentage of exporting firms with

[1] Annex 2 summarizes literature related to determinants of export performance.

[2] Average value added per worker 2010-2012 deflated by Wholesalers Prices Index - INDEC corresponding to each sector. Excludes 8 outliers warned in the user manual of the ENDEI and other 3 additional outliers identified by the author.

[3] Variables *hrcal* and *va* are use centered and scaled by dividing by the value of quadratic medium to facilitate convergence of estimator.

[4] Annex I contains detailed description of criteria used to assign efficiencies.

percentage of total firms for each efficiency, we see that sectors with Schumpetarian and Keynesian efficiency and Schumpetarian efficiency have the highest likelihood of export. Regarding to the probability of diversify export destinations, it is higher for firms in sectors with Ricardian efficiency, Keynesian and Schumpetarian efficiency, and Ricardian and Keynesian efficiency. Sectors with the highest proportion of innovative companies are Schumpetarian and Keynesian and Schumpetarian sectors.

Table 2. Number and percentages of firms, exporting firms and innovative firms by sector and efficiency.

Efficiency	Description	Firms		Exporters		Diver. Exp.[5]		Inno.	
		N°	%	N°	%	N°	%	N°	%
None	Clothing	146	3.96	29	2.02	3	1.02	47	2.36
	Edition	136	3.68	38	2.65	5	1.70	58	2.91
	Other non-metallic minerals	130	3.52	31	2.16	4	1.36	78	3.92
	Auto parts	134	3.63	64	4.46	16	5.44	77	3.87
	Other	86	2.33	49	3.42	21	7.14	42	2.11
	Total efficiency	632	17.12	211	14.71	49	16.67	302	15,18
RE	Textiles	198	5.36	72	5.02	9	3.06	96	4.82
	Leather	135	3.66	39	2.72	7	2.38	72	3.62
	Wood	131	3.55	16	1.12	3	1.02	51	2.56
	Paper	135	3.66	36	2.51	6	2.04	61	3.07
	Wines and other beverages from fermented materials.	101	2.74	61	4.25	39	13.27	58	2.91
	Total efficiency	700	18.97	224	15.62	64	21.77	338	16.98
KE	Rubber and plastic products	192	5.2	95	6.62	9	3.06	118	5.93
	Common metals	129	3.49	41	2.86	9	3.06	58	2.91
	Other metal products	228	6.18	86	6.00	4	1.36	113	5.68
	Furniture	133	3.6	33	2.30	4	1.36	67	3.37
	Meat	175	4.74	51	3.56	24	8.16	73	3.67
	Motor vehicles, trailers and semi.	37	1.00	13	0.91	0	0.00	26	1.31
	Total efficiency	894	24.22	319	2225	50	17.01	455	22.86
SE	Machinery and equipment	121	3.28	67	4.67	8	2.72	66	3.32
	Other transport equipment	74	2.00	24	1.67	5	1.70	40	2.01
	Machine and tool for general purpose	124	3.36	85	5.93	14	4.76	82	4.12
	Household appliances	81	2.19	32	2.23	4	1.36	55	2.76
	Electrical equipment, radio and tv.	135	3.66	58	4.04	8	2.72	86	4.32
	Total efficiency	535	14.49	266	18.55	39	13.27	329	16.53
RE and KE	Food	336	9.10	103	7.18	30	10.20	176	8.84
	Dairy products	122	3.31	26	1.81	13	4.42	72	3.62

[5] Firms that diversify export destinations are those exporting to 4 destinations or more (destinations refer to the groups of countries reported by the ENDEI)

	Total efficiency	458	12.41	129	9.00	43	14.63	248	12.46
KE and SE	Chemical	181	4.90	112	7.81	16	5.44	122	6.13
	Medical instruments	79	2.14	45	3.14	8	2.72	48	2.41
	Pharmaceutical	136	3.68	85	5.93	20	6.80	98	4.92
	Agricultural and forestry machinery	76	2.06	43	3.00	5	1.70	50	2.51
	Total efficiency	472	12.79	285	19.87	49	16.67	318	15.98
	TOTAL	3691	100.00	1434	100.00	294	100.00	1990	100.00

Source: Own elaboration based on ENDEI

III.2 Econometric analysis

III.2.1 Identification analysis

Unlike previous contributions that use efficiencies or sectors as control variables, we use them as variables of interest or as stratification criteria because according to our theoretical framework and hypotheses, efficiencies and sectors influence innovation´s effect on export performance. Efficiencies embodies part of idiosyncratic features of sectors affecting innovation and on export performance. However, it is also appropriate to include sectors because they provide a greater level of disaggregation and allow to evaluate the relevance of clustering sectors according to efficiencies, as third hypothesis proposes.

At first, we estimate binary probit and multi-level binary probit models (Hedeker 2005) to explain export decision (exp). We estimate three variants of models of binary choice, which differ by contextual variables included. First model does not include contextual variables (Equation 1), second one includes efficiencies (Equation 2) and third one includes sectors of activity (Equation 3). We estimate two variants of multi-level binary choice models: one using efficiencies as stratification criteria and the other using sectors of activity (Equation 4). Then, we estimate models to explain diversification of export destinations (desexp) using count (poisson) variables models and multi-level count variables models. We estimate the same five variants of models that we estimate for export decision to test hypothesis using a different measure of export performance.

By probit and poisson models we explore the relationship between export performance and innovation (second hypothesis). Multi-level models allow to examine how efficiencies and sectors are linked with export performance and how relationship between export performance and innovation varies along efficiencies and sectors (first and third hypothesis). In addition, considering nested structure of data, multi-level models estimate standard errors with greater precision (Marín and Petralia 2015). Errors within each stratum are likely to be correlated, so it requires estimation of a random effects model.

Model specification

$$\mathrm{Y}_i = \phi(\beta_1 inno_i + \beta_2 size2_i + \beta_3 size3_i + \beta_4 hrcal_i + \beta_5 pubfin_i + \beta_6 links_i + \beta_7 group_i + \beta_8 foreign_i + \beta_9 va_i + r_i) \quad (1)$$

$$\mathrm{Y}_i = \phi(\beta_1 inno_i + \beta_2 size2_i + \beta_3 size3_i + \beta_4 hrcal_i + \beta_5 pubfin_i + \beta_6 links_i + \beta_7 group_i + \beta_8 foreign_i + \beta_9 va_i + \sum_{k=2}^{6} \beta_{k+8} efic\,\mathrm{k}_j + r_i) \quad (2)$$

$$\mathrm{Y}_i = \phi(\beta_1 inno_i + \beta_2 size2_i + \beta_3 size3_i + \beta_4 hrcal_i + \beta_5 pubfin_i + \beta_6 links_i + \beta_7 group_i + \beta_8 foreign_i + \beta_9 va_i + \sum_{k=2}^{26} \beta_{k+8} rama\,\mathrm{k}_j + r_i) \quad (3)$$

Where Y is alternatively variable *exp* o *desexp*. If dependent variable is *exp*, it is a probit model with conditional hope $\mathrm{P}[Y_\mathrm{i} = 1|\mathbf{x_i}]$. If dependent variable is *desexp*, it is a Poisson model with conditional hope $\mathrm{P}[Y_i = \mathrm{y}|\mathbf{x_i}]$.

$$\mathrm{Y}_i = \phi(\beta_1 inno_i + \beta_2 size2_i + \beta_3 size3_i + \beta_4 hrcal_i + \beta_5 pubfin_i + \beta_6 links_i + \beta_7 group_i + \beta_8 foreign_i + \beta_9 va_i + v_{0j} + v_{1j} inno_{ij} + r_{ij}) \quad (4)$$

Where Y is alternatively variable *exp* o *desexp*. If dependent variable is *exp*, it is a multi-level probit with conditional hope $\mathrm{P}\left[Y_\mathrm{ij} = 1|\boldsymbol{v}_j, \mathbf{x_{ij}}, \boldsymbol{z_{ij}}\right]$. If dependent variable is *desexp*, it is a poisson model with conditional hope $\mathrm{P}\left[Y_\mathrm{ij} = \mathrm{y}|\boldsymbol{v}_j, \mathbf{x_{ij}}, \boldsymbol{z_{ij}}\right]$.

We estimate the intraclass correlation coefficient (ICC)[6] (Albright and Marinova 2010) for multi-level models to verify the relevance of the stratification by sectors and efficiencies. This coefficient indicates percentage of total variance explained by stratification. Table 3 shows that proportion of total variance explained by stratification

[6] It is obtained from estimation of empty (without independent variables) linear multi-level model and it is calculated as ratio between variance of constants and sum of residual variance and variance of constants (total variance)

is higher for sectors than for efficiencies, suggesting that sectors are better indicators of industries specificities than efficiencies.

Table 3. ICC estimation for specifications of multi-level models (in %).

	dependent variable	
	exp	desexp
efficiency	6.196	2.948
sector	9.397	10.466

Source: Own elaboration based on ENDEI

In addition, LR tests are performed contrasting estimation of multi-level model with corresponding version of model in a level, i.e. multi-level probit model estimation is contrasted with probit model estimation and multilevel poisson model estimation is contrasted with poisson model estimation. Null hypothesis of equivalence between models is rejected for all cases.

III.2.1.1 Models for export decision

Table 4 shows estimation of three alternatives of probit models and two alternatives of multi-level probit models. Estimations use 3.354 of 3.691 total observations due to missing data for values of variables *hrcal* and *va*. Innovation has a positive and statistically significant association with export decision for every specification of model. Its coefficient varies along different specifications and some dummies for efficiencies and sectors are significant, which we interpret as a further evidence that it is relevant to consider efficiencies and sectors.

Table 4. Estimation of probit and multi-level probit model.

	probit			meprobit	
	(1)	(2)	(3)	(4)	(5)
inno	0,419***	0,386***	0,393***	0,389***	0,396***
	(0,051)	(0,052)	(0,053)	(0,053)	(0,054)
size					
size2	0,273***	0,349***	0,362***	0,344***	0,348***
	(0,054)	(0,055)	(0,057)	(0,055)	(0,057)
size3	0,696***	0,810***	0,860***	0,803***	0,838***
	(0,069)	(0,071)	(0,074)	(0,071)	(0,074)
hrcal	0,187***	0,142***	0,131***	0,146***	0,139***
	(0,024)	(0,025)	(0,026)	(0,025)	(0,026)
pubfin	0,356***	0,339***	0,287***	0,341***	0,296***
	(0,063)	(0,063)	(0,065)	(0,063)	(0,065)
links	0,422***	0,386***	0,389***	0,388***	0,392***
	(0,054)	(0,055)	(0,056)	(0,055)	(0,056)
group	0,310***	0,320***	0,292***	0,319***	0,297***
	(0,090)	(0,091)	(0,092)	(0,091)	(0,092)
foreign	0,414***	0,372***	0,302***	0,377***	0,320***
	(0,102)	(0,104)	(0,105)	(0,104)	(0,106)
va	0,011	0,001	0,007	0,002	0,008
	(0,024)	(0,025)	(0,025)	(0,025)	(0,025)
efficiency					
RE		0,011			
		(0,081)			
KE		0,035			

		(0,076)			
SE		0,425***			
		(0,085)			
RE y KE		-0,187**			
		(0,094)			
KE y SE		0,557***			
		(0,089)			
sector					
Textiles			0,180		
			(0,133)		
Clothing			0,037		
			(0,153)		
Leather			0,082		
			(0,150)		
Wood			-0,476***		
			(0,184)		
Paper			-0,004		
			(0,152)		
Edition			0,065		
			(0,153)		
Chemicals			0,643***		
			(0,136)		
Rubber and plastic products			0,496***		
			(0,132)		
Other non-metallic minerals			-0,261		
			(0,160)		
Common metals			0,051		
			(0,158)		
Other metal products			0,226*		
			(0,126)		
Machinery and equipment			0,761***		
			(0,151)		
Medical instruments			0,738***		
			(0,179)		
Other transport equipment			0,150		
			(0,202)		
Furniture			0,064		
			(0,153)		
Machine and tool for general purpose			1,019***		
			(0,156)		
Meat			-0,140		
			(0,142)		
Dairy products			-0,331*		
			(0,172)		
Wines and other beverages from fermented materials.			0,810***		
			(0,170)		
Pharmaceutical			0,651***		
			(0,151)		
Agricultural and forestry machinery			0,800***		
			(0,184)		
Household appliances			0,328*		
			(0,182)		
Electrical equipment, radio and tv.			0,267*		
			(0,146)		
Motor vehicles, trailers and semi.			-0,201		
			(0,249)		
Auto parts			0,436***		
			(0,146)		
Other			0,376**		
			(0,182)		
cons	-1,045***	-1,191***	-1,313***	-1,052***	-1,059***
	(0,046)	(0,071)	(0,095)	(0,109)	(0,079)
Observations	3.354	3.354	3.354	3.354	3.354
Log Likelihood	-1.873,340	-1.827,047	-1.771,685	-1.838,830	-1.813,500
Akaike Inf. Crit.	3.766,680	3.684,094	3.615,369	3.703,661	3.653,001

Source: Own elaboration based on ENDEI

* Statistically significant with 90% confidence.

** Statistically significant with 95% confidence.

*** Statistically significant with 99% confidence.

Table 5 shows bias of estimated coefficients for intercept and inno corresponding to each efficiency and estimated coefficient (sum of general coefficient and corresponding bias). Innovation has greater influence on export decision in sectors with Schumpetarian and Keynesian efficiency and Schumpetarian efficiency, although they are very slight differences. In addition, firms in sectors with mentioned efficiencies are more likely to export only by the fact of belonging to sectors with these efficiencies.

Table 5. Bias of coefficient for innovation with respect to average coefficient and bias of coefficient for constant with respect to average constant, by efficiency (model 4).

Efficiency	Bias by efficiency		Efficiency coefficient	
	intercept	inno	intercept	inno
No	-0,127	-0,010	-1,179	0,379
RE	-0,116	-0,009	-1,168	0,380
KE	-0,096	-0,007	-1,147	0,382
SE	0,258	0,020	-0,793	0,409
RE y KE	-0,286	-0,022	-1,337	0,367
KE y SE	0,369	0,029	-0,683	0,418

Source: Own elaboration based on ENDEI

Table 6 shows same information for model 5, which uses sectors as stratification criteria. Besides differences are very minor, innovation has greater influence on export decision for Machine and tool for general purpose, Wines and other beverages from fermented materials, Machinery and equipment, Agricultural and forestry machinery, Medical instruments, Chemical and Pharmaceutical. They are all sectors with Schumpetarian efficiency or Keynesian and Schumpetarian efficiency, except Wines and other fermented beverages. Sectors where influence of innovation is weaker are Wood, Dairy products, Other non-metallic minerals, Meat, and Motor vehicles, trailers and semi.

Table 6. Bias of coefficient for innovation with respect to average coefficient and bias of coefficient for constant with respect to average constant, by sector (model 5).

Sector	Efficiency	Bias by sector		Efficiency sector	
		intercept	inno	intercept	inno
Food	RE and KE	-0,212	-0,029	-1,271	0,367
Textiles	RE	-0,055	-0,008	-1,114	0,389
Clothing	No	-0,170	-0,023	-1,229	0,373
Leather	RE	-0,145	-0,020	-1,203	0,376
Wood	RE	-0,551	-0,076	-1,609	0,320
Paper	RE	-0,205	-0,028	-1,263	0,368
Edition	No	-0,168	-0,023	-1,227	0,373
Chemicals	KE and SE	0,322	0,044	-0,737	0,441
Rubber and plastic products	KE	0,211	0,029	-0,847	0,425
Other non-metallic minerals	No	-0,395	-0,054	-1,453	0,342
Common metals	KE	-0,167	-0,023	-1,225	0,373
Other metal products	KE	-0,015	-0,002	-1,073	0,394
Machinery and equipment	SE	0,427	0,059	-0,632	0,455
Medical instruments	KE and SE	0,368	0,051	-0,691	0,447
Other transport equipment	SE	-0,074	-0,010	-1,133	0,386
Furniture	KE	-0,161	-0,022	-1,220	0,374
Machine and tool for general purpose	SE	0,620	0,085	-0,439	0,482
Meat	KE	-0,329	-0,045	-1,387	0,351
Dairy products	RE and KE	-0,446	-0,061	-1,505	0,335

Wines and other beverages from	RE	0,434	0,060	-0,625	0,456
Pharmaceutical	KE and SE	0,315	0,043	-0,743	0,440
Agricultural and forestry machinery	KE and SE	0,410	0,056	-0,648	0,453
Household appliances	SE	0,052	0,007	-1,006	0,403
Electrical equipment, radio and tv.	SE	0,015	0,002	-1,044	0,398
Motor vehicles, trailers and semi.	KE	-0,291	-0,040	-1,350	0,356
Auto parts	No	0,154	0,021	-0,904	0,417
Other	No	0,084	0,012	-0,975	0,408

Source: Own elaboration based on ENDEI

Variability of estimated coefficients along efficiencies is less than along sectors, reinforcing that efficiencies is less related with export decision than sectors. Some efficiencies do not seem to properly embody idiosyncratic features of sectors since sectors with same efficiency show varying degrees of association between innovation and export performance. This occurs particularly for sectors with Keynesian efficiency or none efficiency that combines sectors with high degree of association between innovation and export performance and others with very low degree of association. On the other hand, sectors with Schumpetarian and Keynesian efficiency behave homogenously, showing very high degree of association between innovation and export performance. Sector within Schumpetarian efficiency or Ricardian efficiency also have very similar behavior, but with some exceptions. Within sectors with Schumpetarian efficiency, Machinery and equipment, Machine and tool for general purpose, Electrical equipment, radio and tv, and Household appliances exhibit an association between innovation and export performance above total manufacture average, while Other transport equipment exhibits below-average association. Along sectors with Ricardian efficiency, the only sector where association is above average is Wines and other fermented beverages. This sector behaves similarly to Schumpetarians sectors regarding association of innovation with export performance.

III.2.1.2 Models for diversification of export destinations

Table 7 shows estimation of three alternatives of poisson models and two alternatives multi-level poisson models. Again, innovation has positive and statistically significant effect on export performance, as well as sectors and efficiencies.

Table 7. Estimation of poisson and poisson multi-level model.

	poisson			mepoisson	
	(6)	(7)	(8)	(9)	(10)
inno	0,404***	0,372***	0,377***	0,386***	0,444***
	(0,044)	(0,044)	(0,044)	(0,062)	(0,077)
size					
size2	0,391***	0,423***	0,443***	0,420***	0,433***
	(0,050)	(0,050)	(0,050)	(0,050)	(0,050)
size3	0,820***	0,880***	0,936***	0,873***	0,926***
	(0,053)	(0,054)	(0,055)	(0,054)	(0,055)

hrcal	0,206***	0,183***	0,164***	0,184***	0,166***
	(0,020)	(0,021)	(0,021)	(0,021)	(0,021)
pubfin	0,434***	0,427***	0,328***	0,427***	0,337***
	(0,043)	(0,043)	(0,044)	(0,043)	(0,044)
links	0,377***	0,349***	0,347***	0,352***	0,348***
	(0,040)	(0,040)	(0,040)	(0,040)	(0,040)
group	0,336***	0,340***	0,304***	0,340***	0,298***
	(0,055)	(0,055)	(0,056)	(0,055)	(0,056)
foreign	0,316***	0,297***	0,218***	0,298***	0,228***
	(0,058)	(0,058)	(0,060)	(0,059)	(0,059)
va	0,021	0,017	0,008	0,017	0,012
	(0,016)	(0,016)	(0,016)	(0,016)	(0,016)
efficiency					
RE		0,122*			
		(0,064)			
KE		-0,067			
		(0,063)			
SE		0,303***			
		(0,065)			
RE y KE		0,063			
		(0,074)			
KE y SE		0,340***			
		(0,063)			
sector					
Textiles			-0,310***		
			(0,111)		
Clothing			-0,391**		
			(0,155)		
Leather			-0,059		
			(0,125)		
Wood			-0,902***		
			(0,197)		
Paper			-0,316**		
			(0,133)		
Edition			-0,273**		
			(0,136)		
Chemicals			0,159*		
			(0,094)		
Rubber and plastic products			-0,106		
			(0,103)		
Other non-metallic minerals		-	0,648***		
			(0,147)		
Common metals			-0,225*		
			(0,131)		
Other metal products			-0,290***		
			(0,106)		
Machinery and equipment			0,331***		
			(0,109)		
Medical instruments			0,467***		
			(0,124)		
Other transport equipment			-0,180		
			(0,172)		
Furniture			-0,137		
			(0,137)		
Machine and tool for general purpose			0,553***		
			(0,100)		
Meat			0,067		
			(0,105)		
Dairy products			-0,209		
			(0,134)		
Wines and other beverages from fermented materials.			0,884***		
			(0,096)		
Pharmaceutical			0,273***		
			(0,099)		
Agricultural and forestry machinery			0,334**		
			(0,130)		
Household appliances			-0,016		
			(0,146)		
Electrical equipment, radio and tv.			-0,052		
			(0,117)		

Motor vehicles, trailers and semi.			-0,905***		
			(0,239)		
Auto parts			0,250**		
			(0,106)		
Other			0,227**		
			(0,113)		
cons	-1,145***	-1,255***	-1,133***	-1,138***	-1,230***
	(0,046)	(0,063)	(0,079)	(0,074)	(0,115)
Observations	3.354	3.354	3.354	3.354	3.354
Log Likelihood	-4.295,073	-4.259,871	-4.108,321	-4.268,742	-4.146,982
Akaike Inf. Crit.	8.610,146	8.549,742	8.288,642	8.563,483	8.319,963

Source: Own elaboration based on ENDEI.
* Statistically significant with 90% confidence.
** Statistically significant with 95% confidence.
*** Statistically significant with 99% confidence.

Table 8 shows bias of estimated coefficient for *intercept* and *inno* for each efficiency and estimated coefficients for each efficiency, resulting from adding general coefficient and corresponding bias (model 9). Innovation has more influence on export diversification for sectors with Ricardian efficiency, Schumpetarian efficiency, and Ricardian and Keynesian efficiency, although variability of coefficient *inno* is very low. On the other hand, companies in sectors with Schumpetarian efficiency and Keynesian and Schumpetarian efficiency are more likely to diversify export destinations just because of belonging to those sectors.

Table 8. Bias of coefficient for innovation with respect to average coefficient and bias of coefficient for constant with respect to average constant, by efficiency (model 9).

Efficiency	Bias by efficiency		Efficiency coefficient	
	intercept	inno	intercept	inno
No	-0,084	-0.045	-1.222	0.341
RE	-0,057	0,084	-1,195	0,470
KE	-0,095	-0,126	-1,233	0,261
SE	0,113	0,063	-1,025	0,450
RE y KE	-0,097	0,066	-1,236	0,452
KE y SE	0,228	-0,044	-0,910	0,343

Source: Own elaboration based on ENDEI.

Table 9 shows same information for model 10, which use sectors as stratification variable. In this case is more difficult to draw conclusions because unlike estimation of model 5, sectors in which coefficient estimated for intercept is bigger have a lower coefficient estimated for *inno* and vice versa. This could be due to the method of estimation that calculates a low intercept for sectors with few exporting companies (many observations with *desexp*=0) and consequently calculates a high slope for these same sectors to approximate the value of *desexp* of exporting companies.

However, it is possible to extract some interesting reflections from estimation obtained. Behavior of sectors that corresponding to each efficiency is much more heterogeneous than for estimation of model 9. Again, sectors with Keynesian and

Schumpetarian efficiency have more homogeneous behaviour. Considering both coefficients, for intercept and for *inno*, sectors obtaining high estimated coefficients in model 5 also obtain high coefficients in model 10, but there are also some sectors obtaining high coefficients in model 10 which obtain very low coefficients in model 5, such as Food, Leather, and Wood. These sectors correspond to Ricardian efficiency and Ricardian and Keynesian efficiency, so in estimation of model 10 there is no clear predominance of any efficiency in sectors with higher estimated coefficients, unlike model 5 estimation. Better performance of mentioned sectors in models for diversification of destinations may be due to that Argentina have absolute advantages in sectors related to natural resources, then firms of these sectors are more likely to be internationally competitive and to access to a greater number of foreign markets.

Table 9. Bias of coefficient for innovation with respect to average coefficient and bias of coefficient for constant with respect to average constant, by sector (model 10).

Sector	Efficiency	Bias by sector		Efficiency sector	
		intercept	inno	intercept	inno
Food	RE and KE	-0,087	0,185	-1,317	0,629
Textiles	RE	-0,250	0,023	-1,480	0,467
Clothing	No	-0,351	0,137	-1,581	0,580
Leather	RE	-0,038	0,047	-1,268	0,491
Wood	RE	-0,968	0,412	-2,198	0,856
Paper	RE	-0,311	0,114	-1,541	0,558
Edition	No	-0,100	-0,125	-1,330	0,318
Chemicals	KE and SE	0,393	-0,242	-0,837	0,201
Rubber and plastic products	KE	0,058	-0,135	-1,172	0,308
Other non-metallic minerals	No	-1,057	0,576	-2,287	1,019
Common metals	KE	-0,062	-0,123	-1,292	0,321
Other metal products	KE	-0,387	0,222	-1,617	0,666
Machinery and equipment	SE	0,377	-0,028	-0,853	0,416
Medical instruments	KE and SE	0,672	-0,265	-0,558	0,179
Other transport equipment	SE	-0,061	-0,048	-1,291	0,396
Furniture	KE	0,046	-0,150	-1,184	0,293
Machine and tool for general purpose	SE	0,750	-0,222	-0,480	0,222
Meat	KE	0,325	-0,329	-0,905	0,114
Dairy products	RE and KE	-0,139	-0,001	-1,369	0,443
Wines and other beverages from	RE	1,124	-0,302	-0,106	0,142
Pharmaceutical	KE and SE	0,289	0,011	-0,941	0,455
Agricultural and forestry machinery	KE and SE	0,455	-0,135	-0,775	0,309
Household appliances	SE	-0,077	0,107	-1,307	0,551
Electrical equipment, radio and tv.	SE	-0,241	0,272	-1,471	0,716
Motor vehicles, trailers and semi.	KE	-0,848	0,247	-2,078	0,691
Auto parts	No	0,176	0,141	-1,054	0,585
Other	No	0,631	-0,546	-0,599	-0,102

Source: Own elaboration based on ENDEI.

Finally, it should be noted that this analysis is not extent of limitations. First, source of information prevents for using other indicators to characterize performance export of firms. Second, it also restricts control variables that can be used to eliminate bias of econometric models. At last, cross-section information does not allow to analyze dynamic effects of innovation on competitive performance, which requires using panel data.

IV. Conclusions

This work seeks to explore, from theoretical and empirical perspectives, links between innovation and export performance of firms, as well as its sectoral determinants. Innovation policy of a firm is part of their strategic decisions and determines its learning and internal technological transfer. Innovation improves dynamic capabilities of firms generating attributes difficult to imitate and increasing their ability to compete both in local and international markets. In addition, incorporation of technology into exported products favors to obtain monopolistic rent of innovation and increase profits of companies and wages of workers. We find evidence of positive association between innovation and export performance, measured by export decision and diversification of export destinations, verifying part of first hypothesis.

Regarding contextual determinants of the relation between innovation and export performance, we explore the influence of sectors and their efficiencies. Signals from free markets encourage firms to take advantage of opportunities offered by Ricardian adjustment, which can offset exploitation of opportunities offered by Keynesian and Schumpetarian efficiencies. This sectorial analysis is relevant for developing countries such as Argentina to guide promoting efforts to those sectors that are more profitable in terms of technical progress and exports.

We find that relation between innovation and export performance varies according to efficiencies. Sectors with Schumpetarian and Keynesian efficiency and Schumpetarian efficiency have the strongest association between innovation and export decision, while Ricardian efficiency, Ricardian and Keynesian efficiency, and Keynesian and Schumpetarian efficiency exhibits the strongest association between innovation and diversification of export destinations. However, as difference find between sectors is quantitatively low, recommendation is to drive innovation in all sectors, although sectors with Keynesian and Schumpetarian efficiency have a slight advantage. Second part of the first hypothesis is partially verified, since difference among sectors is narrow and Keynesian and Schumpetarian efficiency is the most dynamic efficiency, rather than Schumpetarian one, as we originally thought.

Productive structure is relevant to explain export performance, i.e., how is conditioned export performance of a firm just because they belong to certain sector or efficiency. In this aspect, there are do quantitatively more important differences among sectors. Those

with Schumpetarian efficiency and Schumpetarian and Keynesian efficiency increase probability of exporting. At the same time, sectors with Ricardian efficiency, Ricardian and Keynesian efficiency, and Keynesian and Schumpetarian efficiency increase probability of diversifying export destinations. This evidence is another way to empirically support the idea that composition of economic structure strongly affects exporting insertion of an economy.

As contextual determinant, efficiencies are intended to characterize those idiosyncratic aspects of each sector influencing signals and opportunities faced by firms. Classification of sectors according to efficiencies is partially appropriate because sectors sharing same set of efficiencies behave similarly or not, depending on the aspect considered. Behavior of sectors within each set of efficiencies is more homogeneous regarding to export performance than regarding to influence of innovation on export performance. Efficiencies seem to adequately reflect relation of sectors with export performance, but not a more complex dimension as the relationship between innovation and exports in each sector, so third hypothesis is partially validated.

Sectors with Keynesian efficiency and Schumpetarian efficiency have more homogeneous behavior and better performance in terms of export and incorporation of technology to exports, challenging second hypothesis that propose sectors with Ricardian efficiency to have this characteristic. While sectors based on natural resources have an outstanding performance, evidence indicates that other sectors also have high potential. Development requires structural change, enabling a country to tread a path of rapid growth, technical change and without external constraint. Such structural change must focus on sectors with Keynesian and Schumpetarian efficiency which are the most dynamic sectors regarding technical progress and exporting growth.

V. Annexes

V.1 Annex: efficiencies

We allocate Ricardian efficiency as Barletta, Pereira, and Yoguel (2014), who use data from the table of use of goods and services of Argentina's 1997 input-output matrix. Ricardian efficiency corresponds to those sectors in which share of intermediate consumption of natural resources out of total of supplies is greater than industry average. Above-mentioned work use sectors at three-digit ISIC level, but ENDEI is available with a level of disaggregation of two digits, or four digits for some sectors. Table 9 shows how to reconcile this difference of aggregation.

Table 9. Ricardian efficiency.

Sector from ENDEI ISIC rev. 3 code	Description (ENDEI)	RE	Sector B, P & Y ISIC rev. 3 code	B, P & Y RE
1511	Meat	NO	151	NO
1520	Dairy products	YES	152	YES
15	Food	YES	153	YES
			154	YES
1552	Wines and other beverages.	YES	155	YES
17	Textiles	YES	171	YES
			172	YES
18	Clothing	YES	181	NO
			182	YES
19	Leather	YES	191	YES
			192	YES
20	Wood	YES	201	NO
			202	YES
21	Paper	YES	210	YES
22	Edition	YES	221	YES
			222	NO
			223	YES
24	Chemicals	NO	241	YES
2423	Pharmaceutical	NO	242	NO
			243	NO
25	Rubber and plastic products	NO	251	NO
			252	NO
26	Other non-metallic minerals	NO	261	NO
			269	NO
27	Common metals	NO	271	NO
			272	NO
			273	NO
28	Other metal products	NO	281	NO
			289	NO
29	Machinery and equipment	NO	291	NO
292	Machine and tool for general purpose	NO	292	NO
2921	Agricultural and forestry machinery	NO		
2930	Household appliances	NO	293	NO
3012	Electrical equipment, radio and tv.	NO	300	NO
			311	NO
			312	NO
			313	NO
			314	NO
			315	NO
			319	NO
			322	NO
			323	NO
33	Medical instruments	NO	331	NO
			332	NO
			341	NO
3420	Motor vehicles, trailers and semi	NO	342	NO
3430	Auto parts	NO	343	NO
35	Other transport equipment	NO	351	NO
			352	NO
			359	NO
36	Furniture	NO	361	NO

			369	YES
9999	Other	NO		

Source: Own elaboration based on Barletta, Pereira and Yoguel (2014) y United Nations Statistics Division.

To estimate Keynesian efficiency, we follow the methodology proposed by Barletta, Pereira, and Yoguel. It characterized as sectors with Keynesian efficiency those whose share in world trade has increased in a period. In our case, are those sectors whose exports have increased their participation in world trade between 2000 and 2014.

We take international trade data from United Nations COMTRADE. Information is not classified according to ISIC rev 3 as companies surveyed by ENDEI, but it is offered as SITC rev 3. Compatibility has been made at discretion of the author according to descriptions provided by each classification system. Table 10 presents how we match both encodings, sectors to which we assign Keynesian efficiency and sectors assigned with Keynesian efficiency by Barletta, Pereira and Yoguel (2014).

Comparison with allocation made by authors mentioned above is not simple because of differences on disaggregation level. Fifth column of Table 10 say "mixed" to indicate that authors assigned Keynesian efficiency to some sub-divisions in that sectors and others do not. When most of the sub-divisions coincide, we indicate meaning of that majority.

Table 10. Keynesian Efficiency.

Code ISIC	Sector from ENDEI	Code SITC rev 3	KE	B, P & Y KE
15	*Food*	035, 037, 046, 047, 048, 056, 058, 059, 062,	YES	mixed, majority NO
17	*Textiles*	65	NO	NO
18	*Clothing*	84	NO	NO
19	*Leather*	61	NO	NO
20	*Wood*	24	NO	NO
21	*Paper*	64	NO	NO
22	*Edition*	892	NO	NO
24	*Chemicals*	5, excepto 54, 57 y 58	YES	mixed, majority YES
25	*Rubber and plastic products*	57, 58 y 62	YES	mixed
26	*Other non-metallic minerals*	66	NO	NO
27	*Common metals*	67 y 68	YES	mixed, majority YES
28	*Other metal products*	69	YES	YES
29	*Machinery and equipment*	73 y 74	NO	mixed, majority NO
33	*Medical instruments*	774	YES	mixed
35	*Other transport equipment*	79	NO	NO
36	*Furniture*	82 y 89	YES	NO
299	*Machine and tool for general*	723, 724, 725, 726, 727 y 728	NO	YES
1511	*Meat*	01	YES	NO
1520	*Dairy products*	22, 23 y 24	YES	NO
1552	*Wines and other beverages*	121.1 y 121.2	NO	NO
2423	*Pharmaceutical*	54	YES	YES
2921	*Agricultural and forestry*	721 y 722	YES	YES
2930	*Household appliances*	775	NO	NO
3012	*Electrical equipment, radio*	76	NO	NO
3420	*Motor vehic., trailers and semi*	786	YES	NO
3430	*Auto parts*	7843	NO	YES
9999	*Other*	12, 66 y 68 except previously included	NO	

Source: Own elaboration based on Barletta, Pereira and Yoguel (2014) y COMTRADE.

To estimate Schumpetarian efficiency, we also follow methodology used in Barletta, Pereira, and Yoguel (2014). They use their own classification since OECD classification is based in developed countries with very different productive structure from Argentinian one. To identify sectors with high levels of technology, they consider an indicator of the built-in technology spending in R&D out of sales. They use data from "National Survey to Companies on innovation, R&D and ICT" (INDEC, 2006).

We use data from ENDEI to calculate share of investment in internal R&D activities out of sales. We exclude 8 companies that ENDEI presents as outliers regarding their investments in innovation activities. We also exclude 13 companies with the highest proportion of internal R&D investment out of sales because they are too far away from the rest of the companies in this feature: 2 corresponds to Food, 1 to Edition, 2 to Chemicals, 1 to Other non-metallic minerals, 5 to Pharmaceutical, 1 Agricultural and forestry machinery and 1 to Other. We assign Schumpetarian efficiency to those sectors with a proportion mayor to 0.20%.

Table 11 shows percentage of expenditure on internal R&D out of sales for each sector, if we assign Schumpetarian efficiency, and comparison with the classification of Barleta, Pereira, and Yoguel (2014). Again, remember that comparison is difficult due to different levels of disaggregation.

Table 11. Schumpetarian Efficiency.

Code ISIC	Sector	R&D/sales(%)	SE	SE (B, P & Y)
15	*Food*	0,1142658	NO	NO
17	*Textiles*	0,0634874	NO	mixed
18	*Clothing*	0,0626706	NO	NO
19	*Leather*	0,1004991	NO	NO
20	*Wood*	0,0739654	NO	mixed
21	*Paper*	0,1298638	NO	NO
22	*Edition*	0,0462064	NO	NO
24	*Chemicals*	0,4295624	YES	NO
25	*Rubber and plastic products*	0,1702262	NO	NO
26	*Other non-metallic minerals*	0,0899744	NO	mixed
27	*Common metals*	0,1479676	NO	NO
28	*Other metal products*	0,1323981	NO	mixed
29	*Machinery and equipment*	0,2992577	YES	YES
33	*Medical instruments*	0,4217476	YES	mixed
35	*Other transport equipment*	0,3669226	YES	NO
36	*Furniture*	0,1880997	NO	NO
299	*Machine and tool for general purpose*	0,4083286	YES	YES
1511	*Meat*	0,0835937	NO	NO
1520	*Dairy products*	0,1573352	NO	NO
1552	*Wines and other beverages from fermented materials.*	0,1820834	NO	NO
2423	*Pharmaceutical*	1,216,695	YES	YES
2921	*Agricultural and forestry machinery*	0,2633525	YES	YES
2930	*Household appliances*	0,2387361	YES	YES
3012	*Electrical equipment, radio and tv.*	0,2777415	YES	NO
3420	*Motor vehic., trailers and semi*	0,1654141	NO	NO
3430	*Auto parts*	0,1075361	NO	YES
9999	*Other*	0,1365008	NO	

Source: Own elaboration based on Barletta, Pereira and Yoguel (2014) and ENDEI.

Finally, Table 12 summarizes how we grouped sectors according to their efficiencies.

Table 12. Summary.

Efficiency	Code ISIC rev. 3	Description
No	18	Clothing
	22	Edition
	26	Other non-metallic minerals
	3430	Auto parts
	9999	Other
RE	17	Textiles
	19	Leather
	20	Wood
	21	Paper
	1552	Wines and other beverages from fermented
KE	25	Rubber and plastic products
	27	Common metals
	28	Other metal products
	36	Furniture
	1511	Meat
	3420	Motor vehicles, trailers and semi.
SE	29	Machinery and equipment
	35	Other transport equipment
	299	Machine and tool for general purpose
	2930	Household appliances
	3012	Electrical equipment, radio and tv.
RE and KE	15	Food
	1520	Dairy products
KE and SE	24	Chemicals
	33	Medical instruments
	2423	Pharmaceutical
	2921	Agricultural and forestry machinery

Source: Own elaboration

V.2 Annex: previous contributions

Article	Country	Type of data	Method of analysis	Dependent variables	Individual independent variables	Contextual independent variables	Result
Alvarez (2004)	Chile	Micro panel	Probit	Export decision	Product innovation; process innovation; organizational innovation; innovation efforts; perceived obstacles to export; participation in public programs; size	Sector; obstacles national e international to export	Positive, except perceived obstacles to export that has negative association
Archarungroj and Yasuo Hoshino (1998)	Thailand	Cross-section	ANOVA	Export intensity; profit from exports; export trajectory; growth of export; expected growth of export; export scope	Size		Mixed
Ayan and Percin (2011)	Turkey	Cross-section	Factorial exploratory analysis	Export intensity; Realization of expectations	Size; antiquity; exporting experience; product differentiation; promotion; distribution channel; price strategy; economic situation; attitude toward export; training of personnel	Legal environment; cultural environment	Mixed
Barletta (2013)	Argentina	Cross-section	Probit y Tobit	Export decision; export intensity	Innovation efforts; training of human resources; linkages; position in the production network	Sector	Positive, except for bindings that is ambiguous
Barletta, Pereira and Yoguel (2014)	Argentina	Cross-section	Biprobit y Tobit	Export decision; export intensity	Antiquity; Size; innovation efforts; bindings	Efficiencies; Sector	Positive
Cadogan, Sundqvist, Puumalainen and Salminen (2012)	Finland	Cross-section	Structural equation model	Export level	Export flexibility; behavior oriented to the market; exporting experience; flexibility on decisions taking; business coordination	Competitive environment; legal environment	Mixed
Cassimana, Golovkoby and Martínez-Rosc (2010)	Spain	Micro panel	Descriptive statistics	Export decision	Product innovation; process innovation		Positive, but innovation process is not significant
Christensen, Rocha and Gertner (1987)	Brazil	Micro panel	Descriptive statistics	Successful exporter (6 years exporting)	product quality; size; growth; diversification; growth of exports; Marketing Mix; exporting effort; perceived barriers to exporting; perceived importance of marketing mix; attitude toward Government incentives; Introduction to exporting		Positive, except perceived obstacles to export that has negative association

Chugan (2007)	India	Cross-section	Ordinary Least Squares	Export intensity	Size; innovation efforts; net benefits; foreign capital; average salary; spending on highly used payments; export orientation; value added per worker	Sector	Positive, innovation efforts are most crucial for small and medium-sized enterprises and technology sectors
Couto, Tiago, Vieira and Ferreira Silva (2011)	European countries	Cross-section	Probit y Tobit	Export decision; export intensity	Size; foreign capital; antiquity	Public expenditure; country; sector	Positive but the size is not significant
Deng, Menguc and Benson (2003)	China	Cross-section	Ordinary Least Squares	Export intensity; growth of export	Method of selection of the personnel; training; evaluation of performance; reward for performance; size; antiquity; exporting experience; marketing strategies		Positive
Domínguez and Sequeira (1993)	Honduras, Guatemala, El Salvador, Costa Rica y Panamá	Cross-section	Descriptive statistics by clusters	Export value, export intensity; growth of export	Commitment and motivation exporting, export strategy, diversification of product		Positive but some determinants are not significant for some clusters
Gençtürk and Kotabe (2001)	USA	Cross-section	Ordinary Least Squares	Export efficiency; Export effectiveness; competitive position	Export commitment; public program; commitment to the use of the program		Positive
Gomez-Mejia (1988)	USA (Florida)	Micro panel	Multiple regression by steps	Change in global share, change in export intensity; export intensity compare within sector	size; antiquity; adaptability to local market; investment in r & d; life cycle of its products; perception about the international economy of their administrators; exposure of administrators to international level; perceptions and aspirations of managers about the risks; expectations of profit; importance of the foreign investment plans of the company; strength of various business objectives; approach of the firm on foreign markets		Positive, except for size, age, previous external exposure, perception about the economy and strength of certain objectives related with export performance
Grønhaug and Tore (1983)	Norway	Cross-section	Descriptive statistics	Export activities	Subsidies; Size	Sector	Positive
Karelakis, Mattas and Chryssochoidis (2008)	Greece	Cross-section	Ordinary Least Squares	Export revenue; export intensity; market diversification; growth of export	competencies of the company; knowledge of the export channel; adaptation of the product; competitive price; help of the distributor; cooperation	Hostility; heterogeneity; Price competition	Mixed

Lages Silva and Styles (2009)	Portugal	Cross-section	Partial Least Squares	Relation between exporters and importers	Size; quality of the product; innovation; commitment to learning; vision shared in the Organization; openness to innovation; quality of communication; capacities to relate		Positive
Lall and Kumar (1981)	India	Micro panel	Ordinary Least Squares	Export level; export intensity; growth of export	Sales; benefits; innovation	sector	Positive innovation in relation to growth of exports, but negative with the level of exports. Negative for the benefits and not significant for the other variables
Lugones, Suarez and Le Clech (2005)	Argentina	Pool of Cross-section	Ordinary Least Squares	Labor productivity	Innovation efforts; human capital; export intensity; size		Positive
Rodrik (1994)	Korea and Taiwan	Macro panel	Ordinary Least Squares	Quality of exported goods		Industry concentration	Positive
Tookey(1964)	Great Britain	Pool of Cross-section	Descriptive statistics	Export intensity	Size; export policy; marketing; adaptation of the product; quality of the product; use of services and export marketing		Positive

Source: Own elaboration based on consulted bibliography.

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