Innovation and exports; different markets, different outcomes

Gabriela Barrere[1], Diego Karsaclián[2], Andrés Jung[1]

ERSA Congress 2019

Abstract

New products and new processes are the way firms located in developing countries diversify and sophisticate their export basket, and so contribute to a more complex productive and export structure that favours higher economic growth (Hausmann et al., (2007). This path of export diversification is intertwined with firm innovation strategies. A large strand of literature discuss if innovation is necessary to be more efficient and, in this way, accessing export markets , or if it is the participation in export markets the way firms access to new knowledge that enable further innovation . This discussion has mainly ignored an important component of this innovation-export interaction, as is the role played by the export destination markets (i.e. a developed or a developing economy). In this study we apply a bivariate probit estimation, fitting a maximum likelihood two-equation model to two waves of survey data (2010-2012 and 2013-2015), for 640 Uruguayan manufacturing firms. Our main findings show that, as predicted by theory, when the destination market is a developing economy, innovation precedes exports (self-selection effect). Unexpectedly, when the destination market is a developed economy, instead of finding a learning by exporting effect (exports preceding innovation), we found that innovating firms have less probability of being exporters in an immediate subsequent period. These results shed light on important issues for firm strategy and public policy.

***Key words**:* Innovation, exports, developing economies
***JEL Codes**:* D22 O31 O54 F14

[1] Departamento de Ciencias Sociales, Universidad Católica del Uruguay, Av. 8 de Octubre 2738, 11600 Montevideo, Uruguay. Comments to gbarrere@ucu.edu.uy

[2] Facultad de Ciencias Empresariales, Universidad Católica del Uruguay, Av. 8 de Octubre 2738, 11600 Montevideo, Uruguay.

1. Introduction

Latin American economies show lagging economic growth compared not only with developed but also with successful developing economies (i.e. Asian countries). Several studies stress that a poor productivity performance is the key factor behind the relative slow growth (Daude & Fernandez-Arias, 2010). During the last 50 years, despite of factor accumulation, the gap between TFP in an average Latin American country and the US has grown from 27% to 48% (Crespi et al., 2014). One of the main reasons behind this poor TFP performance is low innovation (Santi & Santoleri, 2017). In words of Lederman et al. (2014) in their study of entrepreneurship in Latin America: "…Many Firms but Little Innovation". To reach high growth rates, Latin American, and developing economies in general, need not only a better performance in innovation to boost productivity, but also export diversification (Hausmann et al., 2007). Even the relative best performers (as Chile) should diversify production and exports to reach higher growth rates (Agosin, 2019).

Following this line of thought, it is well accepted that innovation and internationalization are key drivers for economic development. Innovation, understood as the transformation of new ideas into social and economic solutions (Navarro et al., 2016), has turned into one of the most important features in the political agenda of both developed and developing economies. New products and new processes are the way firms access external markets and participate in global value chains. As stated in Hausmann et al. (2007), countries which -through innovation- diversify their productive structure, and add to their export portfolio products and services exported by developed countries, tend to grow faster.

This approach to the generation of dynamic comparative advantage through the relation between innovation and exports is not new, and may be traced back to the technological gap theory (Posner, 1961), the product-cycle theory (Vernon, 1966) and recent technological models (Greenhalgh, 1990; Hughes, 1986). Innovations occur first in countries with high technology development, and innovative products start to be sold in the home country to be exported to other developed countries, and then to developing economies. At the same time, attending to the bidirectional character of the relationship, endogenous growth literature stress that participation in export markets is one of the ways

firms access to new knowledge that enable further innovation (i.e. Grossman & Helpman, 1991; Romer, 1990).

This conceptual framework underlies the debate about the link between innovation and exports at the firm level: is innovation necessary to be more efficient and then access export markets (Melitz, 2003) or is the participation in export markets the way firms learn and develop innovation capacities (Grossman & Helpman, 1991). This debate between the so called self-selection and learning by exporting hypothesis has generated a wide strand of literature, mainly with empirical studies focused on developed countries and manufacturing firms (Bernard & Jensen, 1997; Bernard & Wagner, 1997; Clerides et al., 1998; Delgado et al., 2002; Monreal-Pérez et al., 2012; Van Beveren & Vandenbussche, 2010). Studies for developing economies and firms of the services industries are scarce.

Interestingly, and although this is a very important topic for firms and policy makers, the main bulk of studies has ignored the role of destination markets in the link innovation-exports at the firm level. In an attempt to fill this gap in the literature, the purpose of this paper is to identify the different outcomes in the relation innovation-exports when the destination market of a firm located in a developing country, is a developed or a developing economy. Our findings show that the technological and income level of the destination market, makes a major difference in how the relation innovation-exports works. This study, based on the case of Uruguay, a small and relatively open economy with a concentrated and primarized export structure, is a useful input both for firm strategy definition and for public policy, in countries facing similar situations.

The study is organized in five sections. Following this introduction, we outline the conceptual framework and the review of previous studies. In the third section, we describe the methodology and data used for our empirical analysis, and in the fourth section, we discuss our main results. Finally, in the last section, we conclude and elaborate on possible implications.

2. Theoretical Background

Developing economies have a more concentrated and less sophisticated structure of production and exports than developed countries. Hausmann et al (2007) found that this lack of 'complexity' hampers their possibility of achieving sustainable high growth rates, unless they enter a path of diversification. They argue that those countries that diversify

their export structure adding products exported by developed countries, tend to grow faster than those which do not (Agosin, et al., 2012; Hausmann et al., 2007; Hausmann & Rodrik, 2003; Hummels & Klenow, 2005). This diversification is possible when entrepreneurs explore their capacities to innovate as a mechanism of "self-discovery" (Hausmann & Rodrik, 2003). The basic rational is that growth in developing countries should rely on a more diversified and complex export structure, and this requires innovation at the firm level. Or, the other way around, innovating firms are the main agents of economic change, introducing more sophisticated products and processes and being the drivers of long run growth at a country level (Hausmann & Rodrik, 2003).

This approach to the generation of dynamic comparative advantages, may be linked to the traditional product-cycle theories (Vernon, 1966) and technological gap theories (Posner, 1961), including the new technological models (Greenhalgh, 1990; Greenhalgh et al., 1994; Hughes, 1986). According to the technological gap theory (Posner, 1961), innovations occur first in countries with high technology development. Following the product life cycle theory (Vernon, 1966), once the product is produced and consumed in the local market (new product stage), it starts to be exported to other developed countries, who demand sophisticated products as well (mature product stage). Finally, in the standardized product stage, developing countries, learning and adapting knowledge from developed economies, reproduce these innovations and export to other developing (and also developed) countries.

This conceptual framework underlies the debate about the link between innovation and exports at the firm level, particularly in developing economies. Literature dealing with this link, has largely focused on studying how changes in productivity are associated with such strategies, (Aw et al., 2007; Aw et al., 2011; Cassiman et al., 2010; Peters, 2009) and if there is a causal relationship between them (Bravo Ortega et al., 2013; Kostevc & Damijan, 2008; Silva et al., 2012). It is possible to find evidence that the most innovative firms have productivity gains and, in turn, the most productive units are more prone to innovate (Cainelli et al., 2006). On the other hand, firms that manage to access international markets are usually more efficient than those that cannot cope with the sunk costs of this strategy (Bernard & Wagner, 2001; Lawless, 2010; Roberts & Tybout, 1997). Most empirical studies use exports and investment in R&D and/or innovation to analyse this relationship (Venturini, 2015).

Given the fact that a diversified and sophisticated structure of exports is important for long run growth, and that innovation is the key driver to reach productivity, complexity and diversification, the question is how firms may both innovate and access export markets. Attending to the product-cycle and technology gap theories, the sequence of the process turns out to be an important question for firms located either in developed or developing economies. This is particularly the case of SMEs from developing countries who, given their limited resources, are forced to focus either on innovation or export activity (Golovko & Valentini, 2011; Hauser et al., 2013; Kafouros et al., 2008; Neves et al., 2016). The main issue may be set out as an option: a) Is innovation necessary to be more efficient and, in this way, access export markets (Melitz, 2003) or b) Is the participation in export markets the way firms access to new knowledge that enable further innovation (Grossman & Helpman, 1991). These two approaches, non-mutually exclusive, have been referred to in the literature as the **self-selection hypothesis** and the **learning by exporting hypothesis**.

The first one refers to a process of self-selection (self-selection hypothesis), where the companies that enter the international market as exporters are those that previously have a higher level of productivity, generally associated with a greater innovative activity (Bernard & Jensen, 1997; Bernard & Wagner, 1997; Clerides et al., 1998; Delgado et al., 2002; Monreal-Pérez et al., 2012; Van Beveren & Vandenbussche, 2010). This higher productivity would allow companies to face the sunk costs of entering and staying in international markets (Bernard & Wagner, 2001; Roberts & Tybout, 1997). In this case, innovation (associated with productivity) precedes exports. Several studies show positive empirical evidence in this line, especially for developed economies (Caldera, 2010; Ganotakis & Love, 2011; Hauser et al., 2013; Lachenmaier & Wößmann, 2006). Empirical evidence for developing countries is scarce (Clerides et al., 1998; Eliasson et al., 2012; Haidar, 2012). In general, these studies use firm level data from the manufacturing sector, while studies for service firms are still scarce.

The second one (learning by exporting hypothesis) suggests the idea of a learning process originated in the experience of accessing and remaining in international markets. This way, exports would influence innovation and productivity growth at the firm level, through adapting products and processes, developing networks or training the staff. The empirical evidence of this hypothesis is more controversial and is mainly identified for developing or emerging countries. Several studies show a positive link from export

activity to an innovative condition of the firm (Andersson & Lööf, 2009; Aw et al., 2007; Girma et al., 2008; Salomon & Shaver, 2005), especially in developing economies (Blalock & Gertler, 2004; Boermans & Roelfsema, 2015; Bravo Ortega et al., 2013; Fernandes & Isgut, 2015; Ketterer, 2017), and when the destination market is a high income country (Damijan & Kostevc, 2006). Some studies show mixed results, depending on the characteristics of the firm or finding a bidirectional relation (Kostevc & Damijan, 2008) and endogeneity in the relation between both variables (Aw et al., 2007; Girma et al., 2008).

Most studies refer to firm level data from the manufacturing sector (Lachenmaier & Wößmann, 2006; Pla-Barber & Alegre, 2007) of developed countries, or from specific industries (Love & Ganotakis, 2013). Empirical studies for developing economies are not abundant, particularly for Latin America (Bustos, 2011; Crespi et al., 2014; Estrada et al., 2006; Fernandes & Isgut, 2005, 2015; Martínez-Zarzoso et al., 2018). Important as it is for firms and policy makers from developing countries to better understand the relation between innovation and exports, results are not yet conclusive. Findings depend upon country context and features, sector of analysis, exports destination, types of innovation, data and methodology used (Lo Turco & Maggioni, 2015).

One of the main gaps in the literature is the analysis of the influence of export destination markets in the direction of the relation between innovation and exports. Some studies associate certain characteristics of the firms with the quantity and types of export destinations (Fassio, 2018; Ketterer, 2017; Lo Turco & Maggioni, 2015; Papalia et al., 2018; Ruane & Sutherland, 2005; Silvente & Giménez, 2007), but how the characteristics of destination markets affect the sequence between innovation and exports is an important and yet understudied subject.

When a firm located in a developing country exports to a developed economy, faces a challenging market dynamic. It may be argued that consumers in developed economies demand higher quality products, and markets tend to be more competitive than those from low-income countries. Economies on the technological frontier, tend to be innovation-driven and would trade innovative products with each other, and eventually export technology and knowledge to less technologically sophisticated countries (Schmeiser, 2012). Additionally, import requirements in developed economies are, as a general rule, more strict than those of less developed countries (Aulakh et al., 2000), and probably the *liability of foreignness* (i.e. barriers due to the geographical and cultural distance) is

stronger. Within this context, it is a major challenge for a firm based in a developing country to export innovations to economies on the frontier of knowledge (Brambilla et al., 2012; Hausmann et al., 2007; Roberts & Tybout, 1997). Instead, interacting with a demanding and technologically sophisticated market, may have spill over effects for a firm located in a developing economy, leading to a learning process and subsequent innovations (Ketterer, 2017).

Following this line of thought, we propose our first hypotheses:

> *Hypothesis 1: For firms located in a developing economy, exporting to a developed economy in t-1 is associated with higher probabilities of innovation in t (learning by exporting process).*

The case for self-selection (i.e. innovation preceding exports) shows scarce empirical evidence for developing economies (Clerides et al., 1998; Eliasson et al., 2012; Haidar, 2012). A study by Lo Turco & Maggioni (2015) tests the self-selection hypothesis for Turkish manufacturing firms, considering innovation activity as a driver to exports, and finding a positive relation when the destination market is a developing economy (especially in the case of product innovation). Arguably, and consistent with technology gap models, firms that through innovation reach higher productivity levels or develop new products (although not in the technological frontier), have higher probabilities of exporting to developing economies, with markets that are not so competitive, products that are not technologically sophisticated an firms that are not so efficient.

In the case of firms from developing countries exporting to economies with similar technology development and income levels, innovation may precede exports, so:

> *Hypothesis 2: For firms located in a developing economy, innovating in t-1 is associated to higher probabilities of exporting to developing economies in t (self-selection effect).*

According to the previous discussion, both process innovation (i.e. more efficient production process) and product innovation (i.e. new and/or better products) may be the source of a self-selection effect, or the result of a learning by exporting process. If this is the case, both product and process innovation play in the same direction when considering exports to a developing (i.e. source of a self-selection effect) or a developed economy (i.e. learning by exporting process). Lo Turco & Maggioni (2015), testing the self-selection hypothesis for Turkish manufacturing firms, find that while product innovation

is more important when exporting to a developing country, both strategies, process and product innovation are reinforcing when exporting to richer markets. In any case, both play in the same direction.

3. Methodology & data

The purpose of this study is to test how different destination markets influence the relation between firm innovation and exports in the case of a developing economy. We consider innovations in product and in process, either for the firm, the market or the world. We think that testing the sequence of the process is relevant for strategic decisions at firm level and for policy making whatever the scope of the innovation.

Different methodological approaches have been used to analyze the relationship between firm innovation and export behavior. Considering the characteristics of the database and following the path of several authors who do so, the specification strategy adopted in this study is a bivariate probit regression model, which is an application of a general multivariate probit model (Aw et al., 2007; Ganter & Hecker, 2013; Girma et al., 2008; Kostevc & Damijan, 2008; Neves et al., 2016).[3]

We use two simultaneous equations to estimate the probability of being an exporting firm in one of them, and of carrying out innovations in the other, considering common environments. The simultaneity is required as the random error of both relevant variables, innovation and exports, are correlated (Greene, 2017). For both equations, the firm's innovative activity and export status in the past are introduced as explanatory variables to solve endogeneity issues.

The general specification of a model as proposed is the following:

$$y_1^* = x_1' \beta_1 + \varepsilon_1, \qquad y_1 = 1 \text{ si } y_1^* > 0, \text{ 0 in other case}$$

$$y_2^* = x_2' \beta_2 + \varepsilon_2, \qquad y_2 = 1 \text{ si } y_2^* > 0, \text{ 0 in other case}$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} | X_1, X_2 \sim N\left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix}\right]$$

$$\begin{cases} y_1^* = \delta_1 y_{2,t-1} + x_{i,t-1}' \beta_1 + \varepsilon_{1,it} \\ y_2^* = \delta_2 y_{1,t-1} + x_{i,t-1}' \beta_2 + \varepsilon_{2,it} \end{cases}$$

[3] Other studies follow different strategies, as dynamic generalized method of moments (DGMM) (Andersson & Lööf, 2009; Salomon & Shaver, 2005), structural equations (Boermans & Roelfsema, 2015; Oura, Zilber, & Lopes, 2016), or propensity score matching approach and differences in differences (Damijan & Kostevc, 2006; Palangkaraya, 2012; Silva, Afonso, & Africano, 2010).

Where x_i' are control variables, errors distribute normal (0,1), and ρ is the covariance term. Parameters are estimated by maximum likelihood (Greene, 2017).

This kind of model allows the joint estimation of two variables, providing a specification in the case where a probit model has an endogenous binary variable. The model is solved including both lagged outcomes in the equations. In this case, it is possible to identify if the lagged innovation (export status) influence the present export behaviour (innovation condition), given the previous export status (innovation condition).

As in Damijan & Kostevc (2006), Aw et al. (2007) and Girma et al. (2008), we estimate both equations simultaneously employing a maximum likelihood two-equation bivariate probit model:

1) $P(Exp_{it}) = \beta_1 Exp_{it-1} + \beta_2 Inn_{it-1} + \beta_3 Age + \beta_4 HumK_{it-1} + \beta_5 RD_{it-1} + \beta_{6S} Sales\_Work_{it-1} + \beta_7 LnWork + \beta_8 ForK_{it-1} + \beta_9 Sector_{it-1} + u$

2) $P(Inn_{it}) = \gamma_1 Inn_{it-1} + \gamma_2 Exp_{it-1} + \gamma_3 Age + \gamma_4 HumK_{it-1} + \gamma_5 RD_{it-1} + \gamma_6 Sales\_Work_{it-1} + \gamma_7 LnWork + \gamma_8 ForK_{it-1} + \gamma_9 Sector_{it-1} + u$

Where *Inn* refers to innovation (product or process, depending on the case) and *Exp* refers to export status (to developed or developing countries, depending on the case).

As is usual in the literature, additional firm characteristics are included as control variables (Damijan & Kostevc, 2006; Roper & Love, 2002; Wagner, 2007): age, size (as measured by the logarithm of the number of employees), human capital (as the ratio between workers with university education over all workers), productivity (as sales per worker), a dummy variable for foreign capital in the firm, investment in R&D, and a sectorial dummy. Variable specifications are included in the appendix.

We tested our hypothesis on a database of 640 Uruguayan manufacturing firms provided by the Uruguayan Investigation and Innovation Agency (ANII) for 2010-2012 and 2013-2015.

Table 1 shows the number of firms that innovated ("Innovative firms") and exported ("Exporting Firms") during the first and second period as well as during both periods. Under innovative firms, we show the percentage of firms that had product and/or process

innovations[4] during each period. It is possible for a firm to have innovated on both product and process categories during the same period. Under exporting firms, we show the percentage of exporting firms that exported to at least one developed country in its three main destinations or to developing countries only. The third column shows the number of firms that exported or innovated during both periods. There is an increase in the number of innovative firms in the second period when compared to the first period. Regarding export status, there is a decrease in the number of firms that exported to developed countries in the second period when compared to the first period, and a slight decrease in the total number of exporting firms.

Table 1: Firms innovative and export status

	1st Period – 2010/12	2nd Period – 2013/15	Both Periods
Number of observations	640	640	640
Innovative Firms	267	286	181
As a percentage of total firms	41,7%	44,7%	28,28%
Type of innovation (as a percentage of innovative firms)			
Product	52,4%	54,2%	41,4%
IPO	82,4%	88,1%	54,4%
Exporting Firms	255	250	226
As a percentage of total firms	39.8%	39.1%	35.3%
Export destinations (as a percentage of exporting firms)			
Developing country	63,1%	65,6%	55,3%
Developed country	36,9%	34,4%	31,0%

Source: Authors elaborations with data from ANII.

The mean values of different variables are presented in table 2, with firms sorted by innovation and export status groups. For all variables, the means correspond to the values of the first period. Looking at the data by innovation groups, the table shows that firms that innovated either in product or process had a higher probability of having exporting activity, either to developing or developed countries, when compared to firms that did not innovate. In this same sense, innovative firms were, in average, older, had a higher level of human capital, higher levels of sales per worker and a larger workforce. Prevalence of R&D investment in non-innovative firms is sizeably smaller when compared to product

[4] Process innovations considers process innovation and organizational innovation.

or process innovating firms. There is a higher prevalence of foreign capital in innovating firms.

As to the firms sorted by export status, exporting firms had, on average, higher rates of innovation when compared to non-exporting firms. Although developed country exporting firms averaged more product and process innovations than developing country exporting firms, differences between them are not substantial. Exporting firms were on average older, had a higher level of human capital, higher levels of sales per worker and larger workforce than non-exporting firms. Prevalence of R&D investment is substantially higher in exporting firms compared to non-exporting firms although the difference between their means is not as pronounced as in the case of innovative and non-innovative firms. Higher prevalence of firms with foreign capital in exporting firms is observed when compared to non-exporting firms.

Table 2: Descriptive statistics (arithmetic mean)

	Innovation			Export status		
	No innovation	Product	Process	Non exporter	Developing country	Developed country
Innovation						
No innovation				67,8%	44,7%	42,6%
Product				14,5%	32,3%	34,0%
Process				26,5%	44,7%	48,9%
Export status						
Non exporter	70,0%	49,2%	46,4%			
Developing country	19,3%	37,1%	32,7%			
Developed country	10,7%	22,9%	20,9%			
Age	32,2	39,6	38,2	31,4	40,3	37,9
Human Capital	3,8%	7,7%	6,9%	3,9%	7,5%	6,7%
R&D	1,6%	58,6%	37,7%	9,4%	30,4%	29,8%
Sales per worker	3687,0	3930,3	5306,1	2386,8	6780,3	7292,5
Size of workforce	72,5	187,0	172,4	50,4	165,6	272,4
Foreign capital	11,0%	19,3%	17,7%	5,2%	28,6%	25,5%

Source: Authors elaborations with data from ANII.

Table 3 shows a correlation matrix of the variables included in the estimated models. Given their levels, none of the correlations represent a problem for the estimations.

Table 3: Correlations of variables used in models

	Mean	SD	Product Innovation	Process Innovation	Exp. Status Developed C.	Exp. Status Developing C.	Age	Human Capital	R+D	Sales per worker	Size of workforce	Foreign Capital
Dependent Variables 1315												
Product Innovation			0.3115*	0.2737*	0.0854	0.1309*	0.1597*	0.1212*	0.3400*	0.0324	0.1860*	0.0410
Process Innovation			0.2188*	0.2978*	0.0509	0.0765	0.1521*	0.0918	0.2551*	0.0378	0.2837*	0.0586
Export Status Developed C.			0.0693	0.0615	0.6636*	-0.0489	0.0610	0.0709	0.1073*	0.1301*	0.1484*	0.2322*
Export Status Developing C.			0.1814*	0.1578*	0.0508	0.6373*	0.1280*	0.0257	0.1845*	0.1353*	0.1605*	0.1600*
Independent Variables 1012												
Product Innovation	0.194	0.396	1.000									
Process Innovation	0.307	0.461	0.4145*	1.000								
Export Status Developed C.	0.107	0.309	0.1150*	0.1151*	1.000							
Export Status Developing C.	0.174	0.379	0.1475*	0.0922*	-0.1587*	1.000						
Age	30.800	20.706	0.0721	0.1255*	0.0525	0.1191*	1.000					
Human Capital	0.091	0.149	0.1115*	0.1216*	0.0822	-0.0043	-0.0039	1.000				
R+D	0.145	0.352	0.5298*	0.3910*	0.1218*	0.1901*	0.1130*	0.1582*	1.000			
Sales per worker	3441	10762	-0.0215	0.0315	0.1159*	0.0991*	0.0455	0.2116*	0.0184	1.000		
Size of workforce	3.957	1.369	0.1614*	0.2942*	0.1639*	0.1397*	0.2886*	0.1018*	0.1868*	-0.0058	1.000	
Foreign Capital	0.137	0.343	0.0706	0.0686	0.1688*	0.1538*	0.0201	0.1380*	0.0918*	0.2174*	0.2342*	1.000

Source: Authors definitions of variables. * indicate statistical significance at 5%

4. Results and discussion

The main focus of this study is the sequence innovation-exports for a firm located in a developing country, conditional to the destination market of its exports: developed or developing economies. We estimate two different models for each of the two possible export destinations, distinguishing between product and process innovations. Given that we cannot reject the null hypothesis rho = 0 for the different models, no selection bias correction was applied.

Building upon the product-cycle theory (Vernon, 1966) and the technology gap theory (Posner, 1961), complemented by the new technology gap models (Greenhalgh, 1990; Greenhalgh et al., 1994), we would expect precedence of exporting over innovation when the destination market is a developed economy and a precedence of innovation over exporting when the destination market is another developing country. Results of the bivariate probit regressions partially confirm our hypothesis, but offer also some unexpected findings (Table 4).

Table 4 – Results of bivariate probit regression for four different models

Destination market	Developed country		Developing country	
Type of innovation	Product (1)	IPO (2)	Product (3)	IPO (4)
Innovation $_t$				
Innovation $_{t-1}$	0.745***	0.652***	0.745***	0.648***
	(4.84)	(5.42)	(4.84)	(5.41)
Export status $_{t-1}$	-0.0627	-0.261*	0.113	-0.0364
	(-0.36)	(-1.65)	(0.82)	(-0.28)
Age	0.00788***	0.00281	0.00775***	0.00309
	(2.68)	(1.06)	(2.64)	(1.16)
Human Capital	1.049	1.797**	0.977	1.783**
	(1.39)	(2.36)	(1.29)	(2.36)
R+D	0.458***	0.203	0.443***	0.193
	(2.70)	(1.34)	(2.60)	(1.25)
Sales per worker	0.00000375	-0.00000101	0.00000379	-0.00000132
	(0.79)	(-0.19)	(0.82)	(-0.24)
Size of workforce	0.138**	0.278***	0.128**	0.255***
	(2.37)	(5.22)	(2.25)	(4.77)
Foreign capital	-0.207	-0.160	-0.233	-0.156
	(-1.12)	(-0.93)	(-1.25)	(-0.91)
Constant	-1.874***	-1.762***	-1.855***	-1.709***
	(-8.66)	(-8.82)	(-8.62)	(-8.50)
Export status $_t$				
Innovation $_{t-1}$	-0.624**	-0.412*	0.430**	0.382**
	(-2.05)	(-1.84)	(2.18)	(2.38)
Export status $_{t-1}$	2.583***	2.569***	1.993***	2.010***
	(12.50)	(12.57)	(13.56)	(13.64)
Age	0.00266	0.00298	0.00110	0.00149
	(0.73)	(0.81)	(0.35)	(0.47)
Human Capital	0.403	0.365	0.679	0.602
	(0.36)	(0.35)	(0.76)	(0.67)
R&D	0.273	0.106	0.0789	0.199
	(0.90)	(0.43)	(0.37)	(0.98)
Sales per worker	0.00000540	0.00000648	0.00000261	0.00000168
	(0.73)	(0.94)	(0.54)	(0.35)
LnWorkers	0.0698	0.0684	0.239***	0.212***
	(0.84)	(0.79)	(3.52)	(3.00)
Foreign capital	0.616***	0.607***	0.0846	0.107
	(2.72)	(2.67)	(0.42)	(0.53)
Constant	-2.395***	-2.352***	-2.563***	-2.528***
	(-7.17)	(-6.94)	(-9.46)	(-9.02)
N	640	640	640	640
Log pseudolikelihood	-412.61738	-484.20746	-499.97765	-571.9082
Wald chi2(16)	342.06	303.98	339.45	352.71
Prob > chi2	0.0000	0.0000	0.0000	0.0000
Wald test of rho=0:				
chi2(1)	1.79574	.55983	.060129	.000992
Prob > chi2	0.1802	0.4543	0.8063	0.9749

t statistics in parentheses * p<0.10 ** p<0.05 *** p<0.01

When the firm located in the developing country exports to another developing country, we find a positive and significant association of innovation in t-1 to export status in t. This means that those firms that innovate (in this case, Uruguayan firms in 2010-2012) have a higher probability of being exporters in the subsequent period (2013-2015). We consider a broad definition of innovation, because introducing an innovation either for the international or national markets, or for the firm, strengthens the efficiency of the firm, favouring its presence in international markets.

Being so, our findings confirm our hypothesis 2. Because of endogeneity, we cannot argue that there is causality from innovation to exports, but we do find a sequence that points towards a self-selection effect, that is, that innovation (broadly defined) precedes export.

These results are robust for both product and process innovation, with similar strength, which is an interesting and uncommon result. Product innovation favours the introduction of new and/or differentiated products (higher quality, new characteristics) in international markets, allowing for higher revenues (although in some cases may report higher costs). Process innovation favour lower costs, allowing for better competitive conditions, ceteris paribus (Greenan & Guellec, 2000; Hauser et al., 2013; Hervas-Oliver, Sempere-Ripoll, & Boronat-Moll, 2014; Hidalgo, Klinger, Barabási, & Hausmann, 2007; Monreal-Pérez et al., 2012). Some studies find a stronger effect of product over process innovations on the probability of exporting in a subsequent period, and even more when both product and process innovations, occur at the same time (Kannebley, Sekkel, & Araújo, 2010; Papalia et al., 2018).

Control variables show the usual signs, being the size of the firm, age and previous R&D positively and significantly associated to the probability of product innovation in the subsequent period. For process innovation, the positive and significant association is with human capital and size. Both results sustain for exports to developed and developing countries.

Interestingly, when we consider developed countries as destination markets, we find some unexpected results. Given the product-cycle and technological gap theories, we would expect a learning by exporting effect when a firm located in a developing country exports to a developed economy. Instead, we find that firms innovating (either in product or in process) in t-1, show lower probabilities of exporting to a developed country in t.

Moreover, in the case of process innovation we find also a negative and significant association between exports and innovation, meaning that a firm exporting in t-1 has lower probabilities of innovating in t. Our first hypothesis is clearly not confirmed.

This unexpected result may be explained from different standpoints. Innovation by the firm located in the developing country may require a longer period of maturation to access a developed market. These markets usually are more sophisticated and demanding, and the gap to be covered by the innovative firm is larger (Aulakh et al., 2000). Besides, these larger innovations may demand also a higher financial effort, that leaves the firm financially 'exhausted' and needing some time to recover before engaging in a new effort, this time to enter the new developed and demanding market. Following this line of thought, and in the same vein than Hauser et al. (2013), the explanation may depend not only upon the kind of innovation or the magnitude of the effort, but also upon the *liability of foreignness.* In fact, it may be argued "that foreign firms must overcome higher barriers as the geographical and cultural distance between their home base and the host country increases" (Hauser et al., 2013, p. 313).

The same arguments hold in the case of the negative and significant relation between exporting in t-1 and process innovation in t (that is in the case of the negative learning by exporting association). As it seems in this case a longer learning period, or a stronger effort to overcome the liability of foreignness, or a higher financial requirement, or a high degree of internationalization is needed before transforming knowledge from the market into an innovation (Kafouros et al., 2008; Teece, 1986). Being so, those firms located in the developing country exporting to a developed economy, may need more time before traducing the new knowledge into an effective innovation.

In general, control variables show usual signs. As could be expected in this case (innovation preceding exports to developed countries), presence of foreign capital at the firm level shows a positive and significant association with the probability of exporting in a subsequent period, meaning that foreign direct investment may contribute to overcome obstacles and resource shortages faced by firms innovating to export to developed markets.

Taken as a whole, the evidence suggests there are complex interactions between innovation and exports that show important differences depending on the development level of the destination market. In this way, for a firm located in a developing country,

the strategic decision of selecting the sequence and the timing of innovating and exporting, is highly dependent on the destination market of its exports.

5. Conclusion and implications

Reaching higher levels of productivity and a diversified production and export structure are necessary steps to foster growth in developing economies, particularly in Latin America (Agosin et al., 2012; Crespi et al., 2014; Daude & Fernandez-Arias, 2010; Hausmann et al., 2007; Hausmann & Rodrik, 2003; Hummels & Klenow, 2005). For countries willing to follow this path, innovation and internationalization at the firm level are necessary and complementary strategies (Boermans & Roelfsema, 2015; Cassiman et al., 2010; Golovko & Valentini, 2011).

Our study sheds some light on the relation between innovation and exports (as a proxy to internationalization), from the scarcely studied standpoint of how this sequence works for a firm located in a developing economy, depending upon the income level of its destination export markets.

When firms located in a developing economy export to another developing country, we find that innovation precedes exports (i.e. innovation in t-1 is associated significantly to exports in t), in line with what we would expect according to technology gap and product cycle theories. In this way, firms may transform their own R&D efforts or adapt external knowledge into new, better and/or more efficient products, paving the way to expanding and diversifying their exports to other developing markets in subsequent periods.

This conclusion holds an important message for firms located in a developing country, as innovation may be part of an export strategy to other developing markets. For policymakers, the main point is that designing adequate incentives for innovation (i.e. new and more competitive products) may have a positive impact on exports (Bannò & Morandi, 2012), and may bring subsequent higher sustainable growth. The source of knowledge for innovation may be either internal R&D or external knowledge to the firm (Girma et al., 2008).

When the export market is a developed economy, our findings show that firms are not able to cope with both strategies simultaneously or in a short period, whether innovating to access export markets or transforming knowledge from exports into innovation (Hauser et al, 2013). We may conclude that they need more time and resources to overcome the

technology gap and the *liability of foreignness*, to be able to transform knowledge from exports into innovations, and innovations into exports. Firms need a greater effort to access these demanding and dynamic markets, whatever the source of knowledge nurturing the innovation may be.

An interesting conclusion is that when a firm located in a developing country innovates, based upon its own generated knowledge (i.e. R&D) or upon learning through interaction with developed markets, its absorptive capacity plays a key role to overcome obstacles and favour a rapid access to export markets. Building absorptive capacity at the firm level turns out to be a fundamental component of innovation and internationalization strategies and policies (Cohen & Levinthal, 1989). This capacity is necessary for 'tinkering', to adapt external knowledge in any process of 'self-discovering' by a firm located in a developing economy willing to test if it is competitive enough to access and compete in export markets (Hausmann & Rodrik, 2003).

The study is not exempt of limitations. Through our empirical strategy, we may identify differences in the sequence innovation-exports when destination markets are developed or developing economies, but we cannot identify causality and we do not solve endogeneity problems. Further research, with appropriate data and different methodologies (i.e. using propensity score matching models), would be a step forward towards a better understanding of causal relations between innovation and exports, when the destination markets have different levels of development. This study is limited to a sample of Uruguayan manufacturing firms during a six years period between 2010 and 2015. Extending the period of analysis and including other developing economies and service firms may enrich the conclusions and implications. The same may occur revising the definition of developed or developing economies or analyzing separately the relation for innovation for the firm, the market or the world. These are possible avenues for further research.

Albeit its limitations, this study contributes to a better understanding of the differences in the relation between innovation and exports (i.e. its sequence), when the destination market is a developed or a developing economy. This is a small but relevant contribution with implications for firm strategy and policymaking, and particularly for productive development policies.

References

Agosin. (2019). *Una Política Mínima de Desarrollo Productivo para Chile: Una alternativa al estancamiento* (N.º wp487). Recuperado de University of Chile, Department of Economics website: https://ideas.repec.org/p/udc/wpaper/wp487.html

Agosin, M. R., Alvarez, R., & Bravo-Ortega, C. (2012). Determinants of Export Diversification Around the World: 1962–2000. *The World Economy*, *35*(3), 295-315. https://doi.org/10.1111/j.1467-9701.2011.01395.x

Andersson, M., & Lööf, H. (2009). Learning-by-Exporting Revisited: The Role of Intensity and Persistence. *The Scandinavian Journal of Economics*, *111*(4), 893-916.

Aulakh, P. S., Kotabe, M., & Teegen, H. (2000). Export Strategies and Performance of Firms from Emerging Economies: Evidence from Brazil, Chile, and Mexico. *The Academy of Management Journal*, *43*(3), 342-361. https://doi.org/10.2307/1556399

Aw, B. Y., Roberts, M. J., & Winston, T. (2007). Export Market Participation, Investments in R&D and Worker Training, and the Evolution of Firm Productivity. *World Economy*, *30*(1), 83-104. https://doi.org/10.1111/j.1467-9701.2007.00873.x

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2011). R&D Investment, Exporting, and Productivity Dynamics. *American Economic Review*, *101*(4), 1312-1344. https://doi.org/10.1257/aer.101.4.1312

Bannò, M., & Morandi, V. (2012). Innovation and internationalisation: Challenges for policy design. *regional insight*, *3*. https://doi.org/10.1080/20429843.2012.10510718

Bernard, A. B., & Jensen, J. B. (1997). *Exceptional Exporter Performance: Cause, Effect, or Both?* (Working Paper N.º 6272). https://doi.org/10.3386/w6272

Bernard, A. B., & Wagner, J. (1997). Exports and Success in German Manufacturing. *Weltwirtschaftliches Archiv*, *133*(1), 134-157.

Bernard, A. B., & Wagner, J. (2001). Export Entry and Exit by German Firms. *Weltwirtschaftliches Archiv*, *137*(1), 105-123.

Blalock, G., & Gertler, P. J. (2004). Learning from exporting revisited in a less developed setting. *Journal of Development Economics*, *75*(2), 397-416. https://doi.org/10.1016/j.jdeveco.2004.06.004

Boermans, M. A., & Roelfsema, H. (2015). The Effects of Internationalization on Innovation: Firm-Level Evidence for Transition Economies. *Open Economies Review*, *26*(2), 333-350. https://doi.org/10.1007/s11079-014-9334-8

Brambilla, I., Lederman, D., & Porto, G. (2012). Exports, Export Destinations, and Skills. *American Economic Review*, *102*(7), 3406-3438. https://doi.org/10.1257/aer.102.7.3406

Bravo Ortega, C., Benavente Hormazábal, J., & González, Á. (2013). Innovation, exports and productivity: Learning and self-selection in Chile. *Repositorio Académico - Universidad de Chile*. Recuperado de http://repositorio.uchile.cl/handle/2250/122757

Bustos, P. (2011). Trade Liberalization, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms. *American Economic Review*, *101*(1), 304-340. https://doi.org/10.1257/aer.101.1.304

Cainelli, G., Evangelista, R., & Savona, M. (2006). Innovation and economic performance in

services: A firm-level analysis. *Cambridge Journal of Economics*, *30*(3), 435-458. https://doi.org/10.1093/cje/bei067

Caldera, A. (2010). Innovation and exporting: Evidence from Spanish manufacturing firms. *Review of World Economics / Weltwirtschaftliches Archiv*, *146*(4), 657-689.

Cassiman, B., Golovko, E., & Martínez-Ros, E. (2010). Innovation, exports and productivity. *International Journal of Industrial Organization*, *28*(4), 372-376. https://doi.org/10.1016/j.ijindorg.2010.03.005

Clerides, S. K., Lach, S., & Tybout, J. R. (1998). Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco. *The Quarterly Journal of Economics*, *113*(3), 903-947.

Cohen, W. M., & Levinthal, D. A. (1989). Innovation and Learning: The Two Faces of R&D. *The Economic Journal*, *99*(397), 569-596. https://doi.org/10.2307/2233763

Crespi, G., Arias-Ortiz, E., Tacsir, E., Vargas, F., & Zuñiga, P. (2014). Innovation for economic performance: The case of Latin American firms. *Eurasian Business Review*, *4*(1), 31-50. https://doi.org/10.1007/s40821-014-0001-1

Damijan, J. P., & Kostevc, Č. (2006). Learning-by-Exporting: Continuous Productivity Improvements or Capacity Utilization Effects? Evidence from Slovenian Firms. *Review of World Economics*, *142*(3), 599-614. https://doi.org/10.1007/s10290-006-0083-7

Daude, C., & Fernandez-Arias, E. (2010). *On the Role of Productivity and Factor Accumulation in Economic Development in Latin America and the Caribbean* (SSRN Scholarly Paper N.º ID 1817273). Recuperado de Social Science Research Network website: https://papers.ssrn.com/abstract=1817273

Delgado, M. A., Fariñas, J. C., & Ruano, S. (2002). Firm productivity and export markets: A non-parametric approach. *Journal of International Economics*, *57*(2), 397-422. https://doi.org/10.1016/S0022-1996(01)00154-4

Eliasson, K., Hansson, P., & Lindvert, M. (2012). Do firms learn by exporting or learn to export? Evidence from small and medium-sized enterprises. *Small Business Economics*, *39*(2), 453-472. https://doi.org/10.1007/s11187-010-9314-3

Estrada, S., Heijs, J., & Buesa, M. (2006). Innovación y comercio internacional: Una relación no lineal. *Información comercial española : ICE ; revista de economía*, (830).

Fassio, C. (2018). Export-led innovation: The role of export destinations. *Industrial and Corporate Change*, *27*(1), 149-171. https://doi.org/10.1093/icc/dtx028

Fernandes, A. M., & Isgut, A. E. (2005). *Learning-By-Doing, Learning-By-Exporting, And Productivity: Evidence From Colombia*. https://doi.org/10.1596/1813-9450-3544

Fernandes, A. M., & Isgut, A. E. (2015). Learning-by-Exporting Effects: Are They for Real? *Emerging Markets Finance and Trade*, *51*(1), 65-89. https://doi.org/10.1080/1540496X.2015.998073

Ganotakis, P., & Love, J. H. (2011). R&D, product innovation, and exporting: Evidence from UK new technology based firms. *Oxford Economic Papers*, *63*(2), 279-306. https://doi.org/10.1093/oep/gpq027

Ganter, A., & Hecker, A. (2013). Persistence of innovation: Discriminating between types of innovation and sources of state dependence. *Research Policy*, *42*(8), 1431-1445.

https://doi.org/10.1016/j.respol.2013.04.001

Girma, S., Görg, H., & Hanley, A. (2008). R&D and Exporting: A Comparison of British and Irish Firms. *Review of World Economics*, *144*(4), 750-773. https://doi.org/10.1007/s10290-008-0168-6

Golovko, E., & Valentini, G. (2011). Exploring the complementarity between innovation and export for SMEs' growth. *Journal of International Business Studies*, *42*(3), 362-380.

Greenan, N., & Guellec, D. (2000). Technological Innovation and Employment Reallocation. *LABOUR*, *14*(4), 547-590.

Greene, W. H. (2017). *Econometric Analysis* (8th edition). Pearson Education.

Greenhalgh, C. (1990). Innovation and Trade Performance in the United Kingdom. *The Economic Journal*, *100*(400), 105-118. https://doi.org/10.2307/2234188

Greenhalgh, C., Taylor, P., & Wilson, R. (1994). Innovation and Export Volumes and Prices—A Disaggregated Study. *Oxford Economic Papers*, *46*(1), 102-135.

Grossman, G. M., & Helpman, E. (1991). Trade, knowledge spillovers, and growth. *European Economic Review*, *35*(2), 517-526. https://doi.org/10.1016/0014-2921(91)90153-A

Haidar, J. I. (2012). Trade and productivity: Self-selection or learning-by-exporting in India. *Economic Modelling*, *29*(5), 1766-1773. https://doi.org/10.1016/j.econmod.2012.05.005

Hauser, C., Hogenacker, J., & Wagner, K. (2013). International market diversification of innovative European SMEs – what role do various innovation strategies play? *International Journal of Entrepreneurial Venturing*, *5*(3), 310-326. https://doi.org/10.1504/IJEV.2013.055296

Hausmann, R., Hwang, J., & Rodrik, D. (2007). What You Export Matters. *Journal of Economic Growth*, *12*(1), 1-25.

Hausmann, R., & Rodrik, D. (2003). Economic development as self-discovery. *Journal of Development Economics*, *72*(2), 603-633.

Hervas-Oliver, J.-L., Sempere-Ripoll, F., & Boronat-Moll, C. (2014). Process innovation strategy in SMEs, organizational innovation and performance: A misleading debate? *Small Business Economics*, *43*(4), 873-886. https://doi.org/10.1007/s11187-014-9567-3

Hidalgo, C. A., Klinger, B., Barabási, A.-L., & Hausmann, R. (2007). The Product Space Conditions the Development of Nations. *Science*, *317*(5837), 482-487. https://doi.org/10.1126/science.1144581

Hughes, K. S. (1986). Exports and innovation: A simultaneous model. *European Economic Review*, *30*(2), 383-399. https://doi.org/10.1016/0014-2921(86)90050-4

Hummels, D., & Klenow, P. J. (2005). The Variety and Quality of a Nation's Exports. *American Economic Review*, *95*(3), 704-723. https://doi.org/10.1257/0002828054201396

Kafouros, M. I., Buckley, P. J., Sharp, J. A., & Wang, C. (2008). The role of internationalization in explaining innovation performance. *Technovation*, *28*(1), 63-74. https://doi.org/10.1016/j.technovation.2007.07.009

Kannebley, S., Sekkel, J. V., & Araújo, B. C. (2010). Economic performance of Brazilian manufacturing firms: A counterfactual analysis of innovation impacts. *Small Business Economics*, *34*(3), 339-353. https://doi.org/10.1007/s11187-008-9118-x

Ketterer, T. D. (2017). *Learning-by-Exporting across Export Destinations: Evidence from Lithuanian Manufacturing* (N.º 050). Recuperado de Directorate General Economic and Financial Affairs (DG ECFIN), European Commission website: https://ideas.repec.org/p/euf/dispap/050.html

Kostevc, C., & Damijan, J. (2008). *Causal Link between Exporting and Innovation Activity. Evidence from Slovenian Firms* (N.º DYNREG22). Recuperado de Economic and Social Research Institute (ESRI) website: https://ideas.repec.org/p/esr/wpaper/dynreg22.html

Lachenmaier, S., & Wößmann, L. (2006). Does Innovation Cause Exports? Evidence from Exogenous Innovation Impulses and Obstacles Using German Micro Data. *Oxford Economic Papers*, *58*(2), 317-350.

Lawless, M. (2010). Geography and firm exports: New evidence on the nature of sunk costs. *Review of World Economics*, *146*(4), 691-707. https://doi.org/10.1007/s10290-010-0070-x

Lederman, D., Messina, J., Pienknagura, S., & Rigolini, J. (2014). *El Emprendimiento en América Latina: Muchas empresas y poca innovación*. World Bank Publications.

Lo Turco, A., & Maggioni, D. (2015). Dissecting the impact of innovation on exporting in Turkey. *Economics of Innovation and New Technology*, *24*(4), 309-338. https://doi.org/10.1080/10438599.2014.946311

Love, J. H., & Ganotakis, P. (2013). Learning by exporting: Lessons from high-technology SMEs. *International Business Review*, *22*(1), 1-17. https://doi.org/10.1016/j.ibusrev.2012.01.006

Martínez-Zarzoso, I., Peluffo, A., & Silva, E. (2018). *New stuff or better ways: What matters to access international markets?* (Working Paper N.º 238). Recuperado de Discussion Papers, Ibero-America Institute for Economic Research (IAI) website: https://www.econstor.eu/handle/10419/184669

Melitz, M. J. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, *71*(6), 1695-1725.

Monreal-Pérez, J., Aragón-Sánchez, A., & Sánchez-Marín, G. (2012). A longitudinal study of the relationship between export activity and innovation in the Spanish firm: The moderating role of productivity. *International Business Review*, *21*(5), 862-877. https://doi.org/10.1016/j.ibusrev.2011.09.010

Navarro, J. C., Benavente, J. M., & Crespi, G. (2016). *The New Imperative of Innovation: Policy Perspectives for Latin America and the Caribbean*. https://doi.org/10.18235/0000245

Neves, A., Teixeira, A. A. C., & Silva, S. T. (2016). Exports-R&D investment complementarity and economic performance of firms located in Portugal. *Investigación Económica*, *75*(295), 125-156. https://doi.org/10.1016/j.inveco.2016.03.004

Oura, M. M., Zilber, S. N., & Lopes, E. L. (2016). Innovation capacity, international experience and export performance of SMEs in Brazil. *International Business Review*, *25*(4), 921-932. https://doi.org/10.1016/j.ibusrev.2015.12.002

Palangkaraya, A. (2012). *The Link between Innovation and Export: Evidence from Australia fs Small and Medium Enterprises* (N.º DP-2012-08). Recuperado de Economic Research Institute for ASEAN and East Asia (ERIA) website: https://ideas.repec.org/p/era/wpaper/dp-2012-08.html

Papalia, R. B., Bertarelli, S., & Mancinelli, S. (2018). Innovation, complementarity, and

exporting. Evidence from German manufacturing firms. *International Review of Applied Economics*, *32*(1), 3-38. https://doi.org/10.1080/02692171.2017.1332576

Peters, B. (2009). Persistence of innovation: Stylised facts and panel data evidence. *The Journal of Technology Transfer*, *34*(2), 226-243. https://doi.org/10.1007/s10961-007-9072-9

Pla-Barber, J., & Alegre, J. (2007). Analysing the link between export intensity, innovation and firm size in a science-based industry. *International Business Review*, *16*(3), 275-293. https://doi.org/10.1016/j.ibusrev.2007.02.005

Posner, M. V. (1961). INTERNATIONAL TRADE AND TECHNICAL CHANGE. *Oxford Economic Papers*, *13*(3), 323-341.

Roberts, M. J., & Tybout, J. R. (1997). The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs. *The American Economic Review*, *87*(4), 545-564.

Romer, P. (1990). Endogenous Technological Change. *Journal of Political Economy*, *98*(5), S71-102.

Roper, S., & Love, J. H. (2002). Innovation and export performance: Evidence from the UK and German manufacturing plants. *Research Policy*, *31*(7), 1087-1102.

Ruane, F., & Sutherland, J. (2005). Export Performance and Destination Characteristics of Irish Manufacturing Industry. *Review of World Economics*, *141*(3), 442-459. https://doi.org/10.1007/s10290-005-0038-4

Salomon, R. M., & Shaver, J. M. (2005). Learning by Exporting: New Insights from Examining Firm Innovation. *Journal of Economics & Management Strategy*, *14*(2), 431-460. https://doi.org/10.1111/j.1530-9134.2005.00047.x

Santi, C., & Santoleri, P. (2017). Exploring the link between innovation and growth in Chilean firms. *Small Business Economics*, *49*(2), 445-467. https://doi.org/10.1007/s11187-016-9836-4

Schmeiser, K. N. (2012). Learning to export: Export growth and the destination decision of firms. *Journal of International Economics*, *87*(1), 89-97. https://doi.org/10.1016/j.jinteco.2011.11.006

Silva, A., Afonso, O., & Africano, A. (2010). Do Portuguese manufacturing firms learn by exporting? *Universidade do Porto, Faculdade de Economia do Porto, FEP Working Papers*.

Silva, A., Afonso, O., & Africano, A. P. (2012). Learning-by-Exporting: What We Know and What We Would Like to Know. *The International Trade Journal*, *26*(3), 255-288. https://doi.org/10.1080/08853908.2012.682022

Silvente, F. R., & Giménez, J. C. (2007). Information Spillovers and the Choice of Export Destination: A Multinomial Logit Analysis of Spanish Young SMEs. *Small Business Economics*, *28*(1), 69-86. https://doi.org/10.1007/s11187-005-7324-3

Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*(6), 285-305. https://doi.org/10.1016/0048-7333(86)90027-2

Van Beveren, I., & Vandenbussche, H. (2010). Product and process innovation and firms' decision to export. *Journal of Economic Policy Reform*, *13*(1), 3-24. https://doi.org/10.1080/17487870903546267

Venturini, F. (2015). The modern drivers of productivity. *Research Policy*, *44*(2), 357-369.

https://doi.org/10.1016/j.respol.2014.10.011

Vernon, R. (1966). International Investment and International Trade in the Product Cycle. *The Quarterly Journal of Economics*, *80*(2), 190-207. https://doi.org/10.2307/1880689

Wagner, J. (2007). Exports and Productivity: A Survey of the Evidence from Firm-level Data. *World Economy*, *30*(1), 60-82. https://doi.org/10.1111/j.1467-9701.2007.00872.x

Wagner, J. (2008). Exports, Imports, and Productivity at the Firm Level. An International Perspective: Introduction by Guest Editors. *Review of World Economics / Weltwirtschaftliches Archiv*, *144*(4), 591-595.

Appendix

Table 1: Variable specifications.

Variable	Descripción
Innovation	Takes the value 1 if the firm innovated during the period considered. 0 in other case.
Product Innovation	Takes the value 1 if the firm innovated at least in product during the period considered. 0 in other case.
Process Innovation	Takes the value 1 if the firm innovated at least in process or in organization during the period considered. 0 in other case.
Export status	Define the export condition of the firm in both time periods, 2010-2012 and 2013-2015. It is a dummy variable that takes the value 1 if part of the income of the firm came from overseas during the period considered and 0 in other case.
Export to developed country	Define the export condition to developed countries. It is a dummy variable that takes the value 1 if one of the three main destinations of international sales reported by the firm is a developed country and 0 in other case.
Export to developing country	Define the export condition to developing countries. It is a dummy variable that takes the value 1 if the three main destinations of international sales reported by the firm are developing countries and 0 in other case.
Age	Years of the firm in 2015.
Human capital	Defined as the ratio of employees with university education to total workers.
R+D	Defined as a dummy variable that takes the value 1 if the firm invested in R+D in the period considered. 0 in other case.
Sales per Worker	Defined as the ratio between sales over employment in the initial period.
LnWorkers	Defined as the natural logarithm of the number of employees at the firm in the initial period. It is a proxy variable for firm size.
Foreign capital	It is a dummy variable that takes the value 1 if the firm owns foreign capital participation and 0 in other case.
Sector	It is a dummy variable that takes the value 1 if the firm is a manufacturing firm and 0 if it is a service firm.

Source: Authors definitions of variables