



ARTIGOS

O EFEITO DA INOVAÇÃO NO DESEMPENHO FINANCEIRO E NA INTENSIDADE DE EXPORTAÇÃO DE FIRMAS DE PAÍSES EMERGENTES

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RESUMO

Qual o impacto da inovação no desempenho financeiro e na intensidade de exportação de firmas de países emergentes? Estudos da área encontraram resultados contraditórios sobre o efeito da inovação no desempenho das firmas. A minoria destes estudos operacionalizou investigações com dados históricos provenientes de diversos países, especialmente em se tratando de países emergentes. Este artigo contribui com a evidenciação do efeito da atividade de inovação em firmas de países emergentes no seu desempenho financeiro e na intensidade de exportação. Esta contribuição é atingida pela realização de uma survey multinacional que conta com dados de cinco anos (2008-2012) de 140 firmas do Brasil, Rússia, Índia e China com atividade predominantemente baseada em manufatura. Os resultados contrastam-se com a literatura encontrada, apresentando forte correlação positiva entre as variáveis principais de estudo. Com base nos resultados estatísticos destacados, discutem-se as similaridades e peculiaridades deste estudo em relação aos demais bem como implicações gerenciais e teóricas desta pesquisa.

Palavras Chave: Inovação, desempenho financeiro, intensidade de exportação.

ABSTRACT

What impact does innovation have on the financial performance and export intensity of firms in emerging countries? Studies of this subject have found contradictory results with regard to the effect of innovation on firm performance. Only a minority of these studies have operationalized their investigations using historical data from a range of different countries and fewer still have focused on emerging countries. This article contributes to the debate by reporting the effects of innovation activity by firms from emerging countries on their financial performance and export intensity. This contribution is the result of an analysis of five years' data (2008-2012) from a multinational survey conducted with 140 predominantly manufacturing firms from Brazil, Russia, India, and China. In contrast with the prevailing literature, the results reveal strong positive correlations between the principal study variables. With reference to the statistical results, this paper discusses the similarities and peculiarities of the study with relation to others and the implications of the findings for management and theory.

Keywords: Innovation, financial performance, export intensity.

INTRODUCTION

The capacity to generate innovation is a strategic capability that is key for all firms that aim to create and accrue value with the objective of achieving and sustaining competitive advantages (BAREGHEH, ROWLEY, and SAMBROOK, 2009). By combining their resources and competencies, firms attempt to create innovations that will increase sales and profitability, if possible over the long term (ARCHIBUGI and PIANTA, 1996). However, competition with other firms, whether new entrants or incumbents, often redistributes value between firms. The principal vector of this redistribution is also innovation, whether disruptive or incremental.

Thus, firms that compete via innovation have a better chance of rising above competitors in their market, in the same way that, at the other end of the market concentration spectrum, firms that hold monopolies tend to maintain their dominant positions for longer periods when they do so by means of innovation. As such, the organizational processes that are linked with innovation, and with technological and economic changes can be said to be fundamental to

understanding firm performance and market structures (SCHUMPETER, 1934).

The most recent research into this subject analyzes both developed and emerging countries, but there is no consensus in the literature on the effect of innovation on financial performance. There are studies reporting positive effects (SUN, GU and WU, 2017; EZZI, JARBOUI, 2016; XIE, HUO, QI et al., 2016; LIN and CHEN 2007; TERZIOVSKI, 2010), negative effects (MAHLICH, 2010; CHOI and LEE, 2008), and even no effect (BRITO, BRITO, and MORGANTI, 2009). Terra, Barbosa, and Bouzada (2015) state that the literature is inconclusive because of the diversity of the variables used to measure the relationship between innovation and financial performance. In response to these conflicting results, Mahlich (2010) proposes incorporating variables on these firms' foreign performance to understand the effects of institutional characteristics of each country on firm performance. Furthermore, recent internationalization literature has begun to consider the role of innovation in inducing competition among firms in international markets (CASTAÑO, MÉNDEZ and GALINDO, 2016; MONREAL-PÉREZ, ARAGÓN-SÁNCHEZ and SÁNCHEZ-MARÍN, 2012), especially with relation to

firms from emerging countries (EZZI, JARBOUI, 2016; XIE, HUO, QI et al., 2016; MATHEWS, 2006). The relationship between innovation and internationalization and its impacts on performance has become a central theme in the literature (RAMAMURTI, 2016).

This article contributes to this debate by reporting the effect of innovation on the financial and export performance of firms from emerging countries. The relationship is investigated using a database of 5 years (2008-2012) of survey data from 140 firms from Brazil, Russia, India, and China. The dependent variables used in the study were financial performance measured using return on assets (ROA), return on equity (ROE) and return on sales (ROS) and export intensity expressed as exports as a percentage of total sales. The independent variable is innovation (measured by the numbers of domestic and international patents). Additionally, control variables such as firm size, firm age, educational level of CEO, and export propensity were included, to maximize explanatory power.

The results indicate that there are positive and statistically significant associations between innovation and financial performance and between innovation and

export intensity ($p > 0.01$), even when variables to control firm, industry, and country characteristics, and the year of data are included. The study's principal hypotheses are therefore supported by the data.

Our results agree with the results generally reported by studies of this subject. The paper also discusses certain similarities and differences between this study and others. We argue that previous research that has operationalized similar variables has not analyzed data from such a wide range of countries as those studied here.

LITERATURE AND HYPOTHESES

Innovation is considered an important source of competitive advantage that can enable a firm to maintain a market-leading position (FAGERBERG, MOWERY and NELSON, 2006; HELFAT and PETERAF, 2003). However, there are also several examples of new entrant firms that have supplanted competitors through introduction of innovations (PLA-BARBER and ALEGRE, 2007). This dynamic varies depending on a range of variables such as firm size, industry, and home country.

Increasingly, researchers have been investigating this subject to better understand variations in the relationship

between innovation and firm performance. One indication of this is the fact that the term innovation occurs in the titles of four times more social sciences articles than in the 1960s (FAGERBERG, MOWERY and NELSON, 2006). As globalization has intensified and research into innovation has expanded (FLEURY and FLEURY, 2011), a growing number of studies relating innovation to performance are analyzing firms from emerging countries. Some of the most recent research in the area has suggested that features of firm internationalization could be useful for understanding this relationship (MAHLICH, 2010).

The next two subsections consist of reviews of the literature on the relationships between innovation and financial performance and between innovation and export intensity and present the study hypotheses.

INNOVATION AND FINANCIAL PERFORMANCE

The majority of studies that have conducted empirical investigations of the relationships between innovation and features of firm performance have reported negative relationships (MAHLICH, 2010; CHOI and LEE, 2008). However, it is not uncommon to find studies that have detected positive

relationships (LIN and CHEN 2007; TERZIOVSKI, 2010), or have detected no effect (BRITO, BRITO and MORGANTI, 2009). The most important aspects of studies that have related innovation and performance are detailed in the following paragraphs.

Recently, Mahlich (2010) researched Japanese pharmaceutical companies, analyzing 10 years' data (1987-1998). The analysis considered the institutional changes that occurred as barriers to the Japanese market were lifted and it was deregulated, in conjunction with a government policy to cut drug prices. The authors believed that the effect of this combination of factors would be to weaken the correlation between R&D intensity, patent intensity, and performance, particularly when the policy was more severe. To test this hypothesis, the authors used the performance metric "profit over assets" and the innovation metric "patents". They found that patents did not have a significant relationship with performance, but at certain times when the price policy was applied in a more severe manner, there was a negative correlation. They suggested including variables to reflect export sales performance in future research into the relationship between innovation and performance.

Brito, Brito, and Morganti (2009) conducted an analysis of the subject in Brazil using data from a Brazilian Government survey of technological innovation. They attempted to test the relationship between innovation and performance using two performance measures: growth and profitability. The innovation construct was operationalized using a set of fifteen variables including the proportion of spending allocated to R&D for a variety of purposes, the proportion of spending allocated to process acquisition, adoption, and innovation, and to educational and training of personal involved in innovation, among other indicators. The final study sample comprised 62 Brazilian companies. They conducted three regressions, of which only one that took growth in revenue as the dependent variable achieved a high explanatory power and was statistically significant. Thus, in the sample analyzed, these measures of innovation did not explain variations in profitability, although they did help in understanding growth in company revenue.

Choi and Lee (2008) investigated Chinese and Korean firms with high technological intensity (micro-electronics, pharmaceuticals, and communications companies) using 4 years' panel data (2000-2003). They analyzed two measures of

innovation (intensity of patents and of R&D) and two performance measures (sales growth and ROA). In general, the results for correlations between variables were not significant. The authors demonstrated that R&D intensity did not have a direct impact on financial performance, whereas patents had a greater influence. They therefore suggested that patents intensity is more appropriate than R&D investment for explaining the variation in firms' financial performance.

Lin and Chen (2007) found positive but weak relationships between innovation and performance in a study over 800 manufacturing and services companies from Taiwan. They used variables to operationalize the different innovation types typically found in the literature (radical, incremental, administrative, and market innovation, etc.) and used traditional variables to measure performance (ROE, ROA, and ROI). The control variables used included size, age, source of R&D, and international investment. Their results also demonstrated that firms that internationalized through investment exhibited better performance and were compelled to be more innovative because they had entered international markets.

One of the most accepted definitions of innovation, by Baregheh, Rowley, and Sambrook (2009, p. 1334), is the “multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace.” Archibugi and Pianta (1996) agree with this definition and advocate using patents as a measure of innovation, while acknowledging that patents offer advantages and disadvantages, in common with all indicators. They list as advantages the fact that patents are a direct result of innovation activity and technological change, that patenting an innovation demands investment and time, which makes it a rare activity, that patents are measurable in almost all countries and for long periods of time, and patent records are public-access information. Among the disadvantages, they point out that not all innovations are patented, often because they are similar to something that already exists or because the firm uses its own methods of protection, such as industrial secrets, and there is also a possibility that firms will only attempt to patent their products in their domestic markets and not internationally. Finally, it should be borne in mind that each patent office has its own characteristics.

In this study we used three metrics to measure firm financial performance: ROA, ROE, and ROS and the numbers of domestic and international patents held by the firm to measure innovation.

The first study hypothesis is as follows:

H1: Innovation has a positive effect on the financial performance of firms from emerging economies.

INNOVATION AND EXPORT INTENSITY

The classical theories of internationalization were developed during the 1960s and 1970s, when academic studies of innovation were still rare (FAGERBERG, MOWERY and NELSON, 2006). The relationship between internationalization theories and innovation was consolidated as the process of globalization intensified.

From a wider perspective, Vernon’s (1966) product lifecycle theory suggests that there is a positive relationship between innovation and exportation. Along the same lines, in their theory of firm internationalization, Buckley and Casson (1976) claimed that firms will conduct internally those activities that the market performs less efficiently. From this perspective, innovation is intrinsically focused on operational costs and processes.

Innovation can also be discussed within a behavioral context, according to the model proposed by the Uppsala school (JOHANSON and VAHLNE, 1977). This theory states that managers internationalize the firm's activities gradually, starting with irregular export sales and culminating in establishment of a production subsidiary. As such, management allocate resources and commit to foreign markets in stages. Innovation may enable some firms to accelerate this process and still internationalize in a competitive and successful manner (PLA-BARBER and ALEGRE, 2007). Finally, Dunning (1988) refers to the relationship between innovation and internationalization when he suggests that firms internationalize to seek new resources, markets, new sources of efficiency, or intangible assets.

Mathews (2006) makes the clearest and most recent reference to innovation in the classical literature on internationalization. In his study of large multinationals from Asia, "Dragon multinationals", he attempts to explain how firms from peripheral countries have been able to compete with multinationals firms that were consolidated in the market. He argues that there are factors that were not taken into account in earlier approaches and which are responsible

for firms' international expansion, proposing a model based on the well-known three Ls: linkage, leverage and learning. Mathews claims that interaction between the three Ls, enabled these Asian firms to accumulate knowledge and accelerate their internationalization. From this perspective, innovation emerges from the organizations' capacity to learn from their global interactions – which are sources of knowledge external to the firm (SAENZ, REVILLA and KNOPPEN, 2014).

The innovation literature also refers to innovation capability - mechanisms that enable a firm to innovate in ways that are relevant to its performance. For example, Guan and Ma (2003) assessed seven dimensions of innovation capability (learning, research and development, manufacturing, marketing, organizational, resource allocating, and strategy planning) and three firm characteristics (domestic market share, size, and productivity growth rate) as determinants of the export performance of 213 Chinese firms. According to their statistical results, manufacturing was the only element of innovation capability which could not be defined as a determinant of export performance. In contrast, of the three firm characteristics, only productivity

growth rate exhibited a positive effect on export performance.

Gorodnichenko, Svejnar, and Terrell (2010) discuss the context of opportunities and challenges created by globalization for firms in emerging countries, in which innovation is a route to improving competitive position. Using data from 27 economies in emerging markets and panel data, the authors estimated the effects of foreign competition and of relationships with foreign firms on innovation by domestic firms. Their results revealed a positive relationship between foreign competition and innovations, providing support for the theory that globalization contributed to development of innovations in these firms.

Márquez-Ramos and Martínez-Zarzoso (2010) investigated the effect of technological innovation on international trade by looking at the different levels of firm absorptive capacity. Their results indicated that technological innovation had a non-linear positive effect on firms' export performance, demonstrating a threshold before innovations affect exports. In short, they show that firms cannot only consider acquisition and assimilation of innovation capabilities, but also transformation and exploitation once a minimum level of

potential absorptive capacity has been reached.

In the context of developing countries, innovations represent an important mechanism of competitiveness for firms accessing new markets. Firms develop innovations through essential competencies combined with characteristics of the institutional environment. According to Fleury, Fleury, and Borini (2013), the integration of firm competencies, institutional context, and innovations forms a group of factors that determine the international expansion of Brazilian firms.

Studies have claimed that selling innovative products brings firms into the internationalization process (TAVASSOLI, 2013). However, most studies relating innovation with export performance use samples of firms from developed countries. Furthermore, studies indicate asymmetries in the relationship between innovations and export performance, finding positive linear relationships (TAVASSOLI, 2013; HWANG, HWANG, and DONG, 2015), negative linear relationships (DENG, GUO, ZHANG et al., 2014) and even no effect (MAIS, CARVALHO and AMAL, 2014).

Based on the empirical studies described above, and primarily on the conceptual

model proposed by Mathews (2006), in which firms from emerging economies can compete in international markets with multinationals from developed countries by means of innovations, the second study hypothesis is stated as follows:

H2: Innovation has a positive effect on the export intensity of firms from emerging economies.

METHODOLOGICAL PROCEDURES

This study is based on a survey and is of an explanatory character. The questionnaire was produced in four languages (English, Portuguese, Chinese, and Russian) and validated by native speakers. It was made available to the firms involved on the Survey Monkey platform. Respondents were executive directors or managers and had access to strategic information on their firms.

DATA AND SAMPLE

Manufacturing firms from emerging markets were selected to test the hypotheses proposed, because this economic activity is seen as the sector that most increases its

share of exports when a country's public policies provide incentives for creativity and innovation (DIPIETRO and ANORUO, 2006). Food and drinks companies were excluded from the sample selection in advance because they are part of the primary goods sector, which could be a limiting factor on innovation. The original questionnaire comprises 44 questions designed to collect a wide range of information on each firm to provide data on each of the variables for innovation, financial performance, and exports, and also some control variables, all of which are specified in Table 1.

Table 1 – Specification of variables

Group	Variable	Operational definition	Availability of data	Type	Measure	Coding of binary and discrete variables
Primary study variables	ROA	Return on assets	Annual	Discrete	0.1,2,...11	-100~-81%=0, -80~-61%=1,...81~100%=11
	ROE	Return on equity	Annual	Discrete	0.1,2,...11	-100~-81%=0, -80~-61%=1,...81~100%=11
	ROS	Return on sales	Annual	Discrete	0.1,2,...11	-100~-81%=0, -80~-61%=1,...81~100%=11
	PATINT	Number of international patents	Annual	Continuous	No limits	-
	PATINT2	Number of international patents squared				
	PATDOM	Number of domestic patents	Annual	Continuous	No limits	-
	PATDOM2	Number of domestic patents squared				
Firm level control variables	EXPORT	Exports as percentage of total sales	Annual	Discrete	0.1,2,...10	0%=0.1~10%=1, 11~20%=2,...91~100%=10
	FIRMSIZE	Number of employees	Fixed	Continuous	No limits	-
	FORPAR	Foreign shareholder	Fixed	Binary	0.1	No=0, Yes=1
	FIRMAGE	Year firm founded	Fixed	Continuous	No limits	-
	GOVPAR	Government shareholder	Fixed	Binary	0.1	No=0, Yes=1
	CEOEDU	CEO's educational level	Annual	Categorical	0, 1, 2, 3	0=No degree, 1=bachelor's degree, 2=masters, 3=doctorate
	EMPEDU	Percentage of employees with degree	Annual	Discrete	0.1,2,...10	0%=0.1~10%=1, 11~20%=2,...91~100%=10
	XDIFIC	Assessment of difficulty of competing in international market compared to domestic	Fixed	Binary	0.1	0=domestic market is more difficult, 1= international market is more difficult
	XYEAR	Year first exported	Fixed	Continuous	No limits	-
XINTER	Level of interest in export markets	Fixed	Categorical	0.1,2,3	Very negative=0, Negative=1, Positive=2 Very positive=3	
XPROF	Assessment of profitability of international market compared to domestic	Fixed	Binary	0.1	0=domestic market is more difficult, 1= international market is more difficult	
Binary country control variables	BRAZIL	Brazilian firm	Fixed	Binary	0.1	No=0, Yes=1
	RUSSIA	Russian firm	Fixed	Binary	0.1	No=0, Yes=1
	INDIA	Indian firm	Fixed	Binary	0.1	No=0, Yes=1
	CHINA	Chinese firm	Fixed	Binary	0.1	No=0, Yes=1
Binary year control variables	YR2008	Year 2008	Fixed	Binary	0.1	No=0, Yes=1
	YR2009	Year 2009	Fixed	Binary	0.1	No=0, Yes=1
	YR2010	Year 2010	Fixed	Binary	0.1	No=0, Yes=1
	YR2011	Year 2011	Fixed	Binary	0.1	No=0, Yes=1
	YR2012	Year 2012	Fixed	Binary	0.1	No=0, Yes=1
Industry control variables	AERO	Aerospace industry	Fixed	Binary	0.1	No=0, Yes=1
	AUTO	Automotive industry	Fixed	Binary	0.1	No=0, Yes=1
	CHEM	Chemicals industry	Fixed	Binary	0.1	No=0, Yes=1

Binary industry control variables	ELECTR	Electrical and electronics industry	Fixed	Binary	0.1	No=0, Yes=1
	CONGOOD	Consumer goods industry	Fixed	Binary	0.1	No=0, Yes=1
	MACH	Machinery industry	Fixed	Binary	0.1	No=0, Yes=1
	METAL	Metalworking industry	Fixed	Binary	0.1	No=0, Yes=1
	PHARM	Pharmaceutical industry	Fixed	Binary	0.1	No=0, Yes=1
	SHIP	Shipbuilding industry	Fixed	Binary	0.1	No=0, Yes=1
	ETC	Other industries	Fixed	Binary	0.1	No=0, Yes=1

Source: Research data (2015).

A total of 7,842 firms were contacted and invited to take part in the survey. The list of company e-mails was obtained from the EMIS database (www.emis.com), searching for the four emerging economies Brazil, Russia, India, and China. A total of 140 firms responded and were included in the sample; 12 Brazilian, 40 Russian, 55 Indian, and 33

Chinese firms, with an overall response rate of 1.7%. The original response rate was 5.3%, with 420 replies, but 280 of these did not complete the survey and were excluded. The time period covered is 5 years, from 2008 to 2012, making a total of 700 observations. Table 2 contains a descriptive analysis of the study variables.

Table 2 – Descriptive statistics for study variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
ROA	700	6.453	2.001	0	11
ROE	700	6.321	2.133	0	11
ROS	700	6.609	2.008	0	11
EXPORT	700	3.551	2.729	0	10
PATINT	700	8.267	33.398	0	500
PATINT2	700	1182.159	11949.380	0	250000
PATDOM	700	16.071	48.898	0	535
PATDOM2	700	2645.863	18335.110	0	286225
FIRMSIZE	700	2607.657	11037.230	10	125000
FIRMAGE	700	24.086	21.592	6	155
FORPAR	700	0.407	0.492	0	1
GOVPAR	700	0.257	0.437	0	1
CEOEDU	700	1.841	0.767	0	3
EMPEDU	700	4.310	2.542	0	10
XDIFIC	700	0.679	0.467	0	1
XYEAR	700	13.279	13.557	0	88
XINTER	700	2.364	0.689	0	3
XPROF	700	0.629	0.484	0	1
BRAZIL	700	0.086	0.280	0	1
RUSSIA	700	0.286	0.452	0	1
INDIA	700	0.393	0.489	0	1
CHINA	700	0.236	0.425	0	1
YR2008	700	0.200	0.400	0	1
YR2009	700	0.200	0.400	0	1
YR2010	700	0.200	0.400	0	1
YR2011	700	0.200	0.400	0	1
YR2012	700	0.200	0.400	0	1
AERO	700	0.014	0.119	0	1
AUTO	700	0.121	0.327	0	1
CHEM	700	0.129	0.335	0	1
ELECTR	700	0.193	0.395	0	1
CONGOOD	700	0.214	0.411	0	1
MACH	700	0.179	0.383	0	1
METAL	700	0.079	0.269	0	1
PHARM	700	0.021	0.145	0	1
SHIP	700	0.007	0.084	0	1
ETC	700	0.043	0.203	0	1

Source: Research data (2015).

VARIABLES AND CONSTRUCTS

To supplement the specification of variables shown in Table 1, conceptual definitions of the constructs and the variables used to operationalize them are given below.

- Financial performance comprises the variables: (i) ROA - return on assets; (ii) ROE - return on equity; and, (iii) ROS - return on sales, as used by previous studies in the literature (LIN; CHEN, 2007; CHOI; LEE, 2008).

- Export intensity: exports as a proportion of total sales. This is one of the most widely used objective measures of firms' capability to do business in markets that are more developed technologically (PLA-BERGER; ALEGRE, 2007; TAVASSOLI, 2013).

The independent variable is innovation, operationalized as follows:

- Innovation: the principal variable is the number of patents registered internationally and domestically registered patents as a secondary metric, as used by Archibugi and Pianta (1996).

Control variables used in the test of Hypothesis 1 were firm size; firm age; international shareholders; government shareholders; educational level of principal

CEO; proportion of employees with degrees; home country of firm; year; and industry. Additionally, the test of Hypothesis 2 also used measures of export propensity. Table 3 lists correlations between variables. As can be observed from this table, there were no problems of multicollinearity, since the only variables with strong and significant correlations are equivalent measures from the same constructs (ex: ROA-ROE, ROE-ROS, and PATINT-PATDOM).

Table 3 – Table of correlations between variables

	ROA	ROE	ROS	EXPOR T	PATIN T	PATDO M	FIRMSI ZE	FIRMA GE	FORPA R	GOVPA R	CEOED U	EMPED U	XDIFIC	XYEA R	XINT ER	XPR OF
ROA	1															
ROE	0.768*	1														
ROS	0.701*	0.635*	1													
EXPORT	0.408*	0.359*	0.319*	1												
PATINT	0.221*	0.224*	0.223*	0.264*	1											
PATDOM	0.064	0.103*	0.081*	0.177*	0.569*	1										
FIRMSIZE	0.115*	0.083*	0.053	0.053	0.007	0.039	1									
FIRMAGE	0.067	0.122*	0.093*	0.019	-0.034	0.114*	0.031	1								
FORPAR	0.045	0.001	-0.015	0.410*	0.169*	0.153*	0.162*	0.089*	1							
GOVPAR	-0.053	-0.079*	0.044	0.123*	0.055	0.097*	0.001	0.168*	0.277*	1						
CEOEDU	0.040	0.047	0.120*	0.194*	0.134*	0.156*	0.104*	0.153*	0.106*	0.130*	1					
EMPEDU	0.261*	0.278*	0.282*	0.368*	0.221*	0.137*	-0.003	0.075*	0.171*	0.174*	0.258*	1				
XDIFIC	0.119*	0.142*	0.129*	0.020	0.097*	0.048	0.053	0.145*	-0.052	0.020	0.188*	0.097*	1			
XYEAR	0.052	0.080*	0.075*	0.197*	0.027	0.148*	0.078*	0.793*	0.136*	0.129*	0.224*	0.088*	0.142*	1		
XINTER	0.072	0.026	0.068	0.416*	0.072	0.093*	0.057	0.101*	0.321*	0.068	0.106*	0.086*	0.119*	0.176*	1	
XPROF	0.033	0.020	0.034	0.199*	-0.058	0.053	0.012	-0.070	0.035	0.046	0.118*	-0.102*	0.040	-0.080*	0.363*	1

Source: Research data (2015).

Dummy variables (country, year, and industry) not shown to save space.

** p<0.01, * p<0.05

EMPIRICAL STRATEGY

Two equations were estimated to test the hypotheses presented in the previous section. The first equation tests the hypothesis of an association between innovation and financial performance:

$$\text{Financial Performance}_i = \beta_0 + B_1 \text{Innovation}_i + \text{Controls} + \text{Dummies} + \varepsilon \quad [1]$$

This equation comprises nine models, as shown in Table 4. The equation is made up of the following variables: Innovation_i is innovation by firm i , measured by the number of international patents; $\text{Financial performance}_i$ is the firm's financial performance measured by ROA, ROE, and ROS; Controls are the control variables mentioned above that differentiate between firms; the variables Dummies are the factors country, industry, and year, and ε is random error. The models were estimated a second time, with domestic patents as the dependent variable, to test for similarities in the relationships with financial performance.

The second equation tests Hypothesis 2, which relates innovation to export intensity:

$$\text{Exports}_i = \delta_0 + \delta_1 \text{Innovation}_i + \text{Controls} + \text{Dummies} + \vartheta \quad [2]$$

This equation comprises four models, where Exports_i represents the export intensity of

firm i , measured by exports as a proportion of total sales, Innovation_i is once more tested using number of international patents and are the error terms. The control variables are the same as in equation 1, with the addition of variables for export propensity. These models were also estimated again with domestic patents as the dependent variable, to test for similarities in the relationships with export intensity.

The Pooled Ordinary Least Squares (OLS) data analysis technique was chosen to evaluate the relationships between constructs (WOOLDRIDGE, 2002).

ANALYSIS AND DISCUSSION OF RESULTS

This section presents the main research findings, the hypothesis test results, and their relationships with prior literature. The results are dealt with sequentially, by Hypothesis.

Table 4 lists the results of estimating regression equation 1 to test Hypothesis 1. As can be observed from the results of the estimations of all of the models, innovation measured by number of international patents (PATINT) had a statistically significant positive association ($p < 0.01$) with all of the

financial performance measures for the firms – ROA, ROE, and ROS.

The dependent variable domestic patents (PATDOM) is included as a test of robustness, and in common with international patents it revealed a positive relationship between innovation and financial performance – ROA, ROE, and ROS. However, this relationship is weaker (loading, p-value, and R^2) than for the main estimation using international patents. These results indicate that innovation has a positive influence on financial performance of firms, as reported by studies by Lin and Chen (2007), and Terziovski (2010). These results provide empirical support for Hypothesis 1.

Comparison between the results for the primary and secondary estimations reveals that international patents have a stronger and more significant association with financial performance than domestic patents. We see this finding as expected, considering the three factors discussed by Archibugi and Pianta (1996). First, it can be stated that domestic patents have a smaller financial effect, since their reach is limited to the firm's home market. The protection provided by international patents is greater and allows firms to target more markets with greater demand. It can also be assumed that

the technological level of domestic patents is lower than patents registered with international offices. In addition to the fact that the process is cheaper and is generally easier, patenting a product with a national office reveals that the firm's strategy is focused on its home market and it is not seeking a position as technological leader of its sector in a foreign or global setting. Finally, when a firm patents a product at an international office, it can be deduced that it is expecting high returns from the product and that it is supported by major investment in resources and capabilities, attempting to achieve a configuration that competitors will find difficult to imitate.

Table 4 – Results for Equation 1 with International Patents

Variables	ROA			ROE			ROS		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
PATINT	0.013*** (0.001)	0.011*** (0.001)	0.011*** (0.002)	0.014*** (0.002)	0.012*** (0.002)	0.013*** (0.002)	0.013*** (0.002)	0.011*** (0.001)	0.010*** (0.002)
FIRMSIZE		2.21e-05*** (3.01e-06)	2.45e-05*** (3.30e-06)		1.82e-05*** (3.04e-06)	1.99e-05*** (3.63e-06)		1.21e-05*** (2.63e-06)	1.49e-05*** (3.08e-06)
FIRIMAGE		0.008*** (0.002)	0.006* (0.003)		0.014*** (0.002)	0.014*** (0.003)		0.008*** (0.002)	0.008*** (0.003)
FORPAR		-0.082 (0.157)	-0.303* (0.170)		-0.265* (0.159)	-0.492*** (0.175)		-0.453*** (0.155)	-0.718*** (0.177)
GOVPAR		-0.497*** (0.187)	-0.389** (0.185)		-0.674*** (0.187)	-0.632*** (0.188)		0.0199 (0.180)	0.179 (0.189)
CEOEDU		-0.158 (0.104)	-0.146 (0.104)		-0.163 (0.109)	-0.156 (0.112)		0.0547 (0.094)	0.058 (0.099)
EMPEDU		0.198*** (0.031)	0.184*** (0.033)		0.229*** (0.033)	0.208*** (0.037)		0.195*** (0.031)	0.188*** (0.033)
Country control	No	No	Yes	No	No	Yes	No	No	Yes
Year control	No	No	Yes	No	No	Yes	No	No	Yes
Industry control	No	No	Yes	No	No	Yes	No	No	Yes
Constant	6.343*** (0.076)	5.693*** (0.196)	7.728*** (0.458)	6.203*** (0.081)	5.389*** (0.219)	6.790*** (0.456)	6.498*** (0.0758)	5.508*** (0.201)	5.674*** (0.574)
Observations	700	700	700	700	700	700	700	700	700
R²	0.049	0.130	0.207	0.051	0.154	0.220	0.050	0.128	0.196

Source: Research data (2015).
Standard error of robustness in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Conceptually, innovation is a process that transforms ideas into new or improved products, services, or processes to improve performance (BAREGHEH, ROWLEY, and SAMBROOK, 2009). Just as in studies in developed countries (TERZIOVSKI, 2010), in this study, innovations were found to be determinants of the financial performance of firms from emerging countries.

Additionally, the control variables firm size (FIRMSIZE), time firm has been in business (FIRMAGE), and educational level of employees (EMPEDU) also had positive and statistically significant associations with firm financial performance in all equation 1 models. In other words, the larger the firm, the more experience it has acquired since its founding, and the greater the percentage of employees educated to degree level, the better the firm's performance. This confirms what is found in literature on the relationships between these constructs (STOREY, KEASEY, WYNARCZYK et al., 1987).

In contrast, government shareholders (GOVPAR) and foreign shareholders (FORPAR) were negatively associated with financial performance. These control variables exhibited the same behavior irrespective of the variable used to measure innovation (domestic or international patents), with the

exception of government shareholders, which did not reach statistical significance for inferences in the domestic patents models. This evidence confirms studies reporting that ownership structure has a negative impact on performance, especially government involvement (BOARDMAN and VINING, 1989).

Table 5 – Results for Equation 1 with Domestic Patents

Variables	ROA			ROE			ROS		
	Model 2.1	Model 2.2	Model 2.3	Model 2.4	Model 2.5	Model 2.6	Model 2.7	Model 2.8	Model 2.9
PATDOM	0.003** (0.001)	0.001 (0.001)	0.002* (0.001)	0.003** (0.001)	0.001 (0.001)	0.002* (0.001)	0.003** (0.001)	0.001 (0.001)	0.002* (0.001)
FIRMSIZE		1.13e-05*** (0.000)	1.35e-05*** (0.000)		1.13e-05*** (0.000)	1.35e-05*** (0.000)		1.13e-05*** (0.000)	1.35e-05*** (0.000)
FIRIMAGE		0.006** (0.003)	0.007** (0.003)		0.006** (0.003)	0.007** (0.003)		0.006** (0.003)	0.007** (0.003)
FORPAR		-0.363** (0.157)	-0.605*** (0.179)		-0.363** (0.157)	-0.605*** (0.179)		-0.363** (0.157)	-0.605*** (0.179)
GOVPAR		0.002 (0.183)	0.191 (0.192)		0.002 (0.183)	0.191 (0.192)		0.002 (0.183)	0.191 (0.192)
CEOEDU		0.086 (0.096)	0.084 (0.102)		0.086 (0.096)	0.084 (0.102)		0.086 (0.096)	0.084 (0.102)
EMPEDU		0.219*** (0.031)	0.202*** (0.033)		0.219*** (0.031)	0.202*** (0.033)		0.219*** (0.031)	0.202*** (0.033)
Country control	No	No	Yes	No	No	Yes	No	No	Yes
Year control	No	No	Yes	No	No	Yes	No	No	Yes
Industry control	No	No	Yes	No	No	Yes	No	No	Yes
Constant	6.555*** (0.078)	5.420*** (0.200)	5.563*** (0.587)	6.555*** (0.078)	5.420*** (0.200)	5.563*** (0.587)	6.555*** (0.078)	5.420*** (0.200)	5.563*** (0.587)
Observations	700	700	700	700	700	700	700	700	700
R²	0.007	0.098	0.172	0.007	0.098	0.172	0.007	0.098	0.172

Source: Research data (2015).
Standard error of robustness in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6 lists results of tests of Hypothesis 2. Four models were estimated with different combinations of control variables. According

to the results, innovation (PATINT) has a strong and positive association with firm export intensity (EXPORT) ($p < 0.01$).

Table 6 – Results for Equation 2 with International Patents

Variables	EXPORT			
	Model 3.1	Model 3.2	Model 3.3	Model 3.4
PATINT	0.021*** (0.003)	0.011*** (0.001)	0.011*** (0.001)	0.009*** (0.001)
FIRMSIZE		-2.51e-06 (4.35e-06)	-4.29e-06 (4.85e-06)	-9.44e-06** (4.57e-06)
FIRIMAGE		-0.003 (0.003)	-0.036*** (0.005)	-0.039*** (0.005)
FORPAR		1.922*** (0.206)	1.347*** (0.203)	1.269*** (0.207)
GOVPAR		-0.200 (0.208)	-0.135 (0.195)	-0.096 (0.174)
CEOEDU		0.286*** (0.109)	0.063 (0.114)	0.078 (0.108)
EMPEDU		0.285*** (0.037)	0.313*** (0.037)	0.306*** (0.037)
XDIFIC			-0.300 (0.196)	-0.131 (0.193)
XYEAR			0.069*** (0.009)	0.065*** (0.009)
XINTER			0.874*** (0.122)	0.568*** (0.138)
XPROF			0.885*** (0.176)	0.737*** (0.182)
Country control	No	No	No	Yes
Year control	No	No	No	Yes
Industry control	No	No	No	Yes
Constant	3.373*** (0.104)	1.079*** (0.225)	-0.897*** (0.288)	1.676** (0.678)
Observations	700	700	700	700
R²	0.070	0.286	0.426	0.520

Source: Research data (2015).

Standard error of robustness in parentheses.

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7 lists results for models with domestic patents (PATDOM), showing that the relationships are slightly weaker than for international patents, but are in the same direction, for the dependent variable and the control variables, which had strong associations. This result, in which innovation has a more significant positive relationship

with export intensity when measured by international patents than when measured by domestic patents, can be interpreted in the context of similar motives to those described above in relation to the different results for relationships with performance. Moreover, DiPietro and Anoruo (2006) showed that degree of innovation on the international level explained around 32% of

variation in export performance in the countries they analyzed.

These empirical results indicate that innovations by firms from emerging countries contribute to their export performance, in agreement with studies by Pla-Barber and Alegre (2007), Monreal-Pérez, Aragón-Sánchez, and Sánchez-Marín (2012), Tavassoli (2013), and Hwang, Hwang and Dong (2015).

Research conducted in developed countries led Tavassoli (2013) to state that selling innovative products contributes to the internationalization process and that firms in developing countries are driven to improve their export performance by innovations. These findings can be explained by firms' capacity to absorb external knowledge and learn from their global interactions (MATHEWS, 2006; SÁENZ, REVILLA and KNOPPEN, 2014). Furthermore, Fleury, Fleury, and Borini (2013) conducted research into Brazilian firms and suggested that innovations are driven by a combination of firm competencies and the institutional context.

In view of the results observed and their support in the literature, it can be concluded that Hypothesis 2 is supported both theoretically and empirically.

In addition to the principal association, these regressions also merit discussion with relation to the control variables. Of note in equation 2 are the positive relationships with high statistical significance ($p < 0.01$) when there is a foreign shareholder (FORPAR) and with the percentage of employees with higher education (EMPEDU). Assuming that entering foreign markets demands an international network (GORODNICHENKO, SVEJNAR and TERRELL, 2010), having foreign shareholders could offer benefits in terms of acquiring a network and for overcoming possible barriers to international markets (WIGNARAJA, 2008). Additionally, a high proportion of employees who have graduated from universities also implies a greater likelihood of harmonious communications with potential importers and successful market research to meet diversified demand and serve more sophisticated foreign customers, which should lead to better export performance (WIGNARAJA, 2008).

Table 7 – Results for Equation 2 with Domestic Patents

Variables	EXPORT			
	Model 4.1	Model 4.2	Model 4.3	Model 4.4
PATDOM	0.009*** (0.002)	0.004*** (0.001)	0.002** (0.001)	0.001 (0.001)
FIRMSIZE		-3.39e-06 (4.14e-06)	-5.32e-06 (4.65e-06)	-1.09e-05** (4.44e-06)
FIRMAGE		-0.005* (0.003)	-0.039*** (0.005)	-0.042*** (0.005)
FORPAR		1.980*** (0.206)	1.424*** (0.204)	1.380*** (0.207)
GOVPAR		-0.225 (0.209)	-0.149 (0.197)	-0.0798 (0.179)
CEOEDU		0.299*** (0.110)	0.0861 (0.114)	0.108 (0.109)
EMPEDU		0.305*** (0.0375)	0.332*** (0.037)	0.317*** (0.037)
XDIFIC			-0.234 (0.198)	-0.094 (0.194)
XYEAR			0.070*** (0.009)	0.068*** (0.010)
XINTER			0.886*** (0.124)	0.538*** (0.138)
XPROF			0.813*** (0.179)	0.688*** (0.182)
Country control	No	No	No	Yes
Year control	No	No	No	Yes
Industry control	No	No	No	Yes
Constant	3.393***	1.027***	-0.978***	1.720**
	-0.108	-0.225	-0.293	-0.681
Observations	700	700	700	700
R²	0.031	0.275	0.411	0.509

Source: Research data (2015).

Standard error of robustness in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

FINAL COMMENTS

The varying characteristics of studies conducted to try to understand the relationships between innovation, financial performance, and export intensity (GUAN and MA, 2003) mean that there is no consensus on these relationships in the literature. This uncertainty and the relevance of innovation to practice and academia (FAGERBERG, MOWERY and NELSON, 2006) motivated us to conduct this study to evaluate the effect of innovation on the financial performance and export intensity of firms in emerging countries.

The study has provided evidence to answer the question: Can firms in emerging countries benefit from innovation or is it more profitable to adopt strategies based on copying their competitors?

In contrast to previous studies using samples from developed countries or few emerging countries, our results show that firms from emerging countries that innovate on the domestic level, and even more so those that innovate internationally, at a superior technological level to that of their competitors, can achieve elevated returns and increase the intensity with which they export their products to foreign countries.

Since there is no way of regulating competition from foreign firms in their home markets, it is left to domestic firms to seek innovation in the foreign setting so that they can compete internationally. In the case of export intensity, this is even more valid, since there firms compete with little support from their home countries in what is practically a free market (DÜR, 2010).

Hypotheses developed from the existing literature were tested using regression (pooled OLS) with data from a very wide-ranging survey, different from those that existed previously. The study is based on data from manufacturing firms from the four major emerging countries, Brazil, Russia, India, and China. The results demonstrate positive association between innovation and the financial performance and export intensity of firms from emerging countries. In addition to innovation, we also found that firm size, firm age, and the educational level of employees have positive relationships with financial performance. Additionally, foreign shareholders and the educational level of employees have strong associations with export performance.

The measures used in this study also contribute to the debate on innovation metrics. We have demonstrated that

multinational studies using internationally registered patents as metric have greater power to explain financial performance and export intensity than a domestic measure.

However, there are also limitations. Testing hypotheses empirically with survey data from firms from the BRICs could limit generalization of these results to open economies, smaller economies, and non-manufacturing firms. Another limitation is linked to the dataset examined, in which some control variables do not change over time. This is why statistical regression techniques commonly used to treat panel data with fixed or random effects are not applicable.

This study has implications for public policy formulation, for academia, and for business. The existence of positive associations between the principal study variables in firms from emerging countries provides public authorities with more evidence for allocating increased resources to aid firms to innovate, grow, and internationalize, thereby guaranteeing the entry of foreign capital (DIPIETRO and ANORUO, 2006).

Initially, imitation strategies may be more effective, but over the long term, innovation becomes crucial to achieving superior performance, internationalization, and

technological development. The literature on strategy and innovation and the international business literature are furnished with new evidence on the determinants of superior performance and the sources of competitive advantages (FAGERBERG, MOWERY and NELSON, 2006; HELFAT and PETERAF, 2003, MATHEWS, 2006). Finally, business managers aiming to improve financial performance can focus their efforts on innovation in the international environment. Exporting may not be their initial objective because of the many barriers to and risks involved in export activity, but in the current globalized market, not exporting means restricting markets and growth.

Although positive linear effects were detected between the constructs investigated in this study, Márquez-Ramos and Martínez-Zarzoso (2010) have suggested nonlinear analyses of the effect of innovations on exports. Future studies could test whether the relationships between innovation and performance variables could be understood in ways that are not linear.

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