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Sailing through stormy waters in Argentina. A study on innovations during crisis times

Javier Papa

Friedrich-Schiller University Jena / Max Planck Institute of Economics
Graduate College (DFG) "The Economics of Innovative Change"
javier.papa@uni-jena.de

Viktor Slavtchev

Halle Institute for Economic Research (IWH)
Structural Change
Viktor.Slavtchev@iwh-halle.de

Abstract

Over the past years there has been growing evidence that shows the emergence of successful domestic firms from developing countries (Dunning et al 1997, Chudnovsky et al 1999, Amsden 2001). However, there is still a gap in the literature on latecomers? catch up as most of these studies are fundamentally contextualized in thriving and growing economies with mild-to-strong institutional support (Asian Tigers, BRICs). So far, little attention has been paid to the case of successful latecomer firms coming out of declining and crisis-ridden economies. In this sense, Argentina sets a particular context of analysis as the country has suffered a considerable decline in its industrial base and technological capability, within turbulent economic conditions (Schvarzer 2000; Katz 2006). As a result, we should not expect the emergence of successful firms from such a harsh environment. Drawing on the latecomer firm theory (Gerschenkron 1962, Hobday 1995, Mathews & Cho 2000, Hobday 2003, Mathews 2006), we use micro-data from the 2nd Innovation Survey of Argentina (INDEC, 2003) to analyse empirically how and why latecomer firms might be able to survive, grow, and succeed when facing adverse conditions like the last economic crisis of Argentina (1998-2001). The econometric results of this paper (via OLS methods) indicate that the introduction of organizational innovations, alongside product and process innovations, turned out to have a positive impact on firms? performance in the economic downturn. These empirical findings highlight the importance of flexibility and capacity of adaption during crisis times, with implications for (corporate) policy of latecomer firms.

Sailing through stormy waters in Argentina:

A study on innovations during crisis times

I. Introduction

According to theory and received wisdom, developing countries are usually importers of high-technology goods (Rosenberg 1976, Bell & Pavitt 1993), which are produced by the most advanced firms in the developed world. However, over the past years there has been growing evidence that shows the emergence of successful domestic firms from developing countries, at least in low-to-medium-tech manufacturing sectors (Dunning et al 1997, Chudnovsky et al 1999, Amsden 2001). Even so, there is still a gap in the literature on latecomers' catch up as most of these studies are fundamentally contextualized in thriving and growing economies with mild-to-strong institutional support (e.g. Asian Tigers, BRICs). So far, little attention has been paid to the case of successful latecomer firms coming out of declining and crisis-ridden economies. In this sense, Argentina sets a particular context of analysis as the country has suffered a considerable decline in its industrial base and technological capability, within turbulent economic conditions (Schvarzer 2000; Katz 2006). As a result, we should not expect the emergence of internationally successful latecomer firms from such a harsh environment. However, some firms apparently survived, grew, and caught up during the last economic crisis of Argentina (Papa 2011).

Therefore, the general objective of this study is to investigate how and why latecomer firms might be able to survive, grow, and succeed when facing adverse economic conditions.

The empirical literature on East Asian catch-up (Hobday 1995, Mathews & Cho 2000, Hobday 2003, Mathews 2006) suggests that latecomer firms followed different strategies to catch-up with global competitors. In addition to technical innovations such as product and process, many latecomer firms also relied heavily on non-technical innovations such as inter-organizational

links with global suppliers and customers (Mathews & Cho 2000; Mathews 2006) as well as intra-organizational and marketing innovations to upgrade along the value chain (Hobday 1995, Hobday 2006). In the case of Argentina, Papa (2011) conducted a case study on a successful latecomer firm that, given the technology gap in terms of product and process innovations, caught up with global competitors via marketing and organizational innovations, as a response to a new business strategy in time of crisis.

Based on that empirical evidence, the specific objective of this paper is to investigate to what extent other latecomer firms also fared well during the last economic crisis of Argentina, due to the introduction of organizational and marketing innovations -alongside product and process innovations.

The dataset used in this study is the 2nd Innovation Survey of Argentina (INDEC, 2003) as conducted by the National Statistics Office for the period 1998-2001, which coincides with one of the most severe economic crises of the country. The survey contains information on more than 100 variables for a sample of 1,688 manufacturing firms, which is largely representative of the industrial sector in Argentina as a whole.

We specify a standard Cobb-Douglas output (sales) function in order to account for the main drivers of firms' growth (labour and capital) with particular emphasis in the total factor productivity components (different types of innovations). The empirical strategy we use to test the model above consists of OLS regression analysis with cross-sectional data. Nonetheless, we also make use of those variables for which we have time variation in the data, between 1998 and 2001, in order to mitigate potential endogeneity problems.

The structure of this paper is organized as follows. The next section contains the conceptual framework that underpins the main ideas used in this research on catch-up, latecomer firms, and non-technological innovation. Section III briefly depicts the main features of the dataset in question and displays some descriptive statistics. In section IV we sketch the model specification and describe the main variables to be used. In section V we pose some data limitations and explain the estimation strategy to overcome them. Then, section VI presents the econometric analysis and empirical findings of this study. Finally, in section VII, we draw the conclusions of this paper and discuss some tentative implications for (corporate) policy and further research.

II. Conceptual framework

The literature that relates innovation and crisis started with Schumpeter (1934), who believed that economic recessions had a positive effect on development as they induce firms to become more innovative in order to enhance their productivity. On one hand, Schumpeter's countercyclical view on innovation would be supported by Mensch (1979) and Kleinknecht (1987) who argued that, during economic recession, firms would relocate their resources from production to innovation activities due to the related opportunity costs. On the other hand, Stiglitz (1993) and Hall (2002) would contest Schumpeter's viewpoint by arguing that, during economic downturns, firms actually would cut back on their investments in innovation due to credit rationing and limited internal funding. In the light of the recent economic crisis 2008/2009, Archibugi et al (2012) found that most of UK-based firms reduce their investment in innovation, while a group of persistent innovators and growing new firms, instead, increased their share of innovation expenditures. In any case, most of the discussion goes around the impact of economic crisis on the innovative performance of firms in developed countries. However, in this study we are particularly interested in the other side of the coin or, simply put, the impact of innovations to overcome economic downturns¹. This is particularly relevant for the business performance (and survival) of latecomer firms operating in crises-ridden developing countries.

Latecomer firms approach

In a pioneering work on industrial innovation, Freeman & Soete (1997: pp. 265-266) assert that firms' innovation activities are historically circumscribed to world market and technological possibilities and their performance depends upon the capacity of adaptation to such rapidly changing external environments. The authors conclude that, upon the base of firms' resources, history, management style and luck, the range of innovation strategies to be adopted could be as followed:

(i) Offensive strategy. The aim is to be ahead of competitors in the introduction of new products by means of technical leadership as well as market leadership. This is commonly found in advanced firms from developed countries.

¹ Stiglitz (1993) theoretically demonstrated that the nexus between economic fluctuations and innovation goes in both directions.

(ii) Defensive strategy. The purpose is not to incur the heavy risks of being the first to innovate but to profit from leaders' mistakes and from later open-up of markets by introducing minor improvement leading to product differentiation.

(iii) Traditional and opportunistic strategies. These strategies are followed in less developed markets either by firms that do not face any challenge to innovate with the exception of design changes (traditional strategies) or by individual entrepreneurs that identify new niche markets (opportunistic strategies).

(iv) Dependant and imitative strategies. Dependant firms are generally capital-intensive small firms acting as satellite, subordinate or sub-contractors of stronger firms by supplying specific components or a variety of services. Occasionally, they may have the chance of upgrading into specialized-knowledge products/services and turning into offensive innovator as it occurred in South Korea (Hobday, Rush & Bessant 2004). Imitative firms are basically concerned with following the leaders in established technologies either by licensing innovators' patents or acquiring 'know-how'.

However, Freeman & Soete assume a developed country context with functioning markets and access to technology. In a developing country the enterprising imitator may aspire to become a defensive innovator and benefit from non-innovative advantages such as captive markets, geographical locations, political privileges, lower labour costs, plant investment costs, energy supplies or materials costs. Nonetheless, if the dependant or imitative strategies are oriented towards catching-up, in Gerschenkronian² terms, then it may be possible for this group of firms to turn their backwardness into a competitive advantage. This leads us to introduce the concept of 'latecomer firms'.

Mathews (2006: pp. 1-2) proposes extending the usage of 'latecomers' coined by Gerschenkron (1962) to the case of firms. Referring to the advantages, the author states "latecomer firms, like latecomer countries, are able to exploit their late arrival to tap into advanced technologies, rather than having to replicate the entire previous technological trajectory. They can accelerate their uptake and learning efforts utilising various forms of collaborative processes and state agencies to assist with the process, and bypassing some of the organisational inertia that hold back their more established competitors." The author also emphasizes the opportunities of latecomer firms to link

² Gerschenkron (1962)

with global value chains via inter-organizational innovations (e.g.: outsourcing, subcontracting, licensing)

With regard to the disadvantages, Hobday (1995: p. 1172) defines a latecomer firm as “a manufacturing company (existing or potential) which faces two sets of competitive disadvantages in attempting to compete in export markets”. The first one is a technological constraint. Based in a developing country, a latecomer firm is dislocated from the most important world sources of science, technology and R&D as well as engineering and technical skills. Moreover, the surrounding industrial, technological and educational (universities, technical institutions) infrastructures and networks are poorly developed or equipped. The second set of disadvantages concerns the access to international markets and sophisticated users. Once again, the author argues that a latecomer firm is dislocated from the mainstream global markets it wishes to supply which are basically located in developed countries. As a consequence, the firm must contend with supplying underdeveloped, small local markets and unsophisticated customers.

Drawing upon the experience of electronics in East Asia, Hobday (1995) examined the innovation strategies in these countries to understand the learning mechanisms, channels of technology and links between technology and global market entry that led some latecomer firms to catch-up and even overtake traditional leaders. The author found that successful firms took advantage of the global production network by technologically upgrading from subcontracting & OEM (original equipment manufacture) to ODM (own-design manufacture) and eventually to OBM (own-brand manufacture), which also required a strong development of both organizational and marketing capabilities.

To sum up, both Hobday and Mathews agree on the fact that successful latecomer firms are likely to overcome their technological disadvantage (in terms of product and process innovations) by pursuing business strategies that supplement the former ones with non-technological innovations oriented towards marketing and organizational (both inter- and intra-firm) change.

Particularly to the case of Argentina, Papa (2011) conducted an in-depth case study on a successful latecomer firm that, given the technology gap, caught up with global competitors via non-technological innovations, as response to a new business strategy in times of crisis (e.g. downstream integration of manufacturing and service activities). The main empirical findings of that study show that the seamless steel pipe manufacturer Tenaris introduced a number of marketing and organizational changes that enabled the firm to quickly adapt to the adverse economic conditions in Argentina. At the same time, these non-technological innovations

complemented with the existing technological assets so as to pave the way of differentiation from global competitors in sophisticated export markets. With regards to marketing innovations, Tenaris got access to global markets in the early 1980s thanks to the opening up of several commercial offices abroad, which led the company to bypass intermediate sales agents and establish direct contact with its customers. For example, this enterprise was so successful that in 1997 the Japanese Corporation NKK formed a strategic alliance with Tenaris to make use of its cutting-edge commercial network, in exchange of NKK's technological knowledge. With respect to organizational innovations, *Tenaris'* marketing endeavor came along with several organizational changes as the firm had been gradually enhancing the commercial network with technical and service support centers. In 2001, the new customer-oriented business strategy of the firm brought about a major organizational change that allowed the downstream integration of customised products with high-tech services to produce and deliver the so-called 'integrated solutions' (Gann & Salter 2000, Galbraith 2002, Davies 2004). In so doing, this latecomer firm was able to catch up with global competitors and become a world-leading provider of integrated solutions to the oil and gas industry.

Although based on an exploratory case study, these empirical findings constitute the main motivation of this paper so as to investigate to what extent organizational and marketing innovations, along with technological innovations, may help latecomer firms to endure and overcome adverse economic conditions, like the last economic crisis in Argentina.

Non-technological innovations

The seminal work of Schumpeter (1934) on economic development distinguished five categories of innovations driving economic change. On one hand, (i) the introduction of new products and (ii) new processes might be referred as to technological innovations. On the other hand, (iii) the opening of new markets, (iv) the development of new sources of supply, and (v) the creation of new forms of organization, are somehow related to the idea of non-technological innovations. Later, scholars would come back again to Schumpeter's core ideas by pointing out that the management of different types of resources -including organizational and marketing capabilities- is a key driver of firm growth, according to the resource-based theory of the firm (Penrose 1959) and the evolutionary economic theory (Nelson & Winter 1982, Teece 1988). Moreover, the strand of literature on innovation management (Kelly & Kranzburg 1978, Tidd et al 2009)

highlights the idea of bringing together R&D engineers and managers to better understand the co-evolutionary process of organization, technology, and markets underpinning firms' performance. In spite of all these theoretical contributions, the empirical research on organizational and marketing innovations only started to flourish in recent years (Schmidt & Rammer 2007, Baranano 2003, Boer & During 2001, Evangelista & Vezzani 2010, Polder et al 2010). This is mainly due to the methodological challenges posed by their measurement through large-scale surveys (Armbruster et al 2008). Curiously, the first attempt to measure non-technological innovations at large scale did not stem from developed. In the year 2001 the Bogota Manual set the guidelines on how to carry out innovation surveys in developing countries. The authors pointed that the Oslo Manual had proposed so far a rather narrow approach towards innovation by excluding key factors such as organizational change, training, quality management, use of ICTs, and the like. Under these concerns, the Oslo Manual was revised in 2005 to include a separate appendix on measurement of innovation in developing countries. In line with the Bogota Manual, the 3rd edition of the Oslo Manual (OECD, 2005, p.46), now uses a broader definition of innovation as “the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, *workplace organizational or external relations*”. More precisely, the Bogota Manual (2001, p. 30) suggested developing countries to collect data on non-technological innovations based on the following definitions:

Organizational innovation: changes in the way the firm is organized and managed; changes in the organization and management of the production process; incorporation of significantly modified organizational structures; and implementation of new or substantially modified strategic corporate orientations.

Marketing innovation: marketing of new products; new methods of product delivery; changes in packaging; new distributions channels; and new customer services.

Despite some recent improvements towards the measurement of organizational and marketing innovations and the increasing availability of micro-data from innovation surveys, empirical research about the determinants, interactions and effects of non-technological innovations is a topic that still remains somewhat under-explored in developing countries. Apart from the work of Alvarez, Benavente, and Crespi (2010) about the impact of economic crisis on the organizational change of Chilean firms, we are not aware of any other firm-level empirical research that deals directly with the relationship between non-technological innovations and firm performance in

crisis-ridden developing countries. For the case of Argentina, Chudnovsky, Lopez, and Pupato (2006) conducted the first micro-econometric study on the determinants of innovative inputs and outputs and their impacts on firm's performance, although the authors focused exclusively on product and process innovations (in line with the studies for industrialized countries).

Nonetheless, there seem to be a number of reasons to believe that non-tech innovations are likely to have a strong impact on the firms' performance of developing countries, viz: (i) the dislocation of latecomer firms from the world sources of scientific, technical and R&D knowledge might induce them to re-address their efforts towards less-technical forms of innovation; (ii) organizational and marketing innovations tend to be less costly than product and process innovations, which usually require infrastructure support, and that is a reason why latecomer firms that face financial constraints might find them more attractive; and (iii) organizational flexibility and capacity of adaptation (Freeman & Soete, 1997) are likely to be highly-valued characteristics that a latecomer firms might wish to attain, when facing crisis-ridden environment with changing institutional settings (e.g. macroeconomic instability)

III. Data sources, limitations and descriptive statistics

This study is based on data stemming from the 2nd Innovation Survey of Argentina (INDEC, 2003) as conducted by the National Statistics Office for the period 1998-2001, which coincides with a deep and long-standing economic downturn in Argentina.

The innovation survey has been designed in accordance with the methodological guidelines of both the Oslo and Bogota Manuals and thus contains information on a large number of variables covering a broad range of topics, namely: (a) basic characteristics about the firm surveyed; (b) firms' economic performance; (c) employment and organization of work processes; (d) innovation activities; (e) environmental activities; (f) funding of innovation activities; (g) sources of information for innovation activities; (h) human resources related to innovation; (i) innovations achieved; (j) hindering factors to innovation; (k) links with the national innovation system; (l) information and communication technologies (TICs); and (m) technology balance of payments.

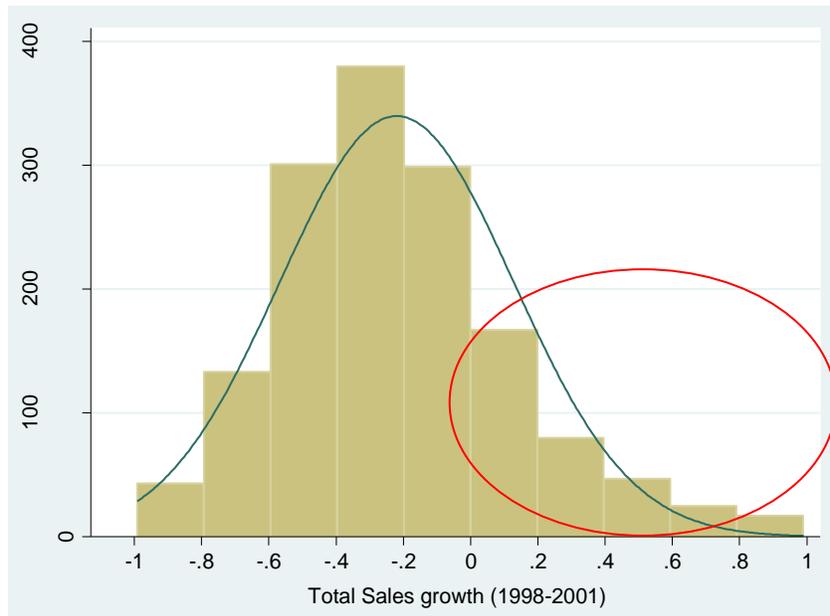
The sample was randomly drawn from the Input-Output Matrix survey of 1997 in order to be representative of the Argentinean manufacturing sector as a whole, at the beginning of the period covered (1998). The sample size is comprised of 1,688 firms that finally answered the questionnaire, out of 2,229 firms that were asked to do so originally. Therefore, the response rate

was 76%, which is relatively high in comparison with the low 25%-30% usually achieved by CIS in developed countries. In addition to that, an important feature of this survey is that, contrary to the European CIS, both innovators and non-innovators are asked to answer the full questionnaire avoiding, this way, some selectivity problems (see Crepon et al 1998).

The period under study (1998-2001) was concurrent with one of the deepest and longest economic downturns that Argentina has experienced since the Great Depression of the 1930s. After a period of relatively stable GDP growth (1991-1998), the Argentinean economy entered into a phase of long stagnation that ended up towards the end of 2001 with a deep financial, economic and social crisis, mainly due to the failure of so-called Convertibility Plan (see Schvarzer 2002). Indeed, between 1998 and 2001, the country's GDP saw a cumulative fall of nearly 20 percentage points, the unemployment rate climbed up to 20% of the economically active population, and poverty reached the alarming levels of around 50% of Argentina's population. Under these circumstances, the industrial sector was the worst hit economic activity with an average drop of 22 % (EMI, INDEC). As expected, the manufacturing firms that make up the current innovation survey also reported negative values for most of their performance indicators. Even though, most of the business indicators of firms recorded a sharp decline in both absolute and relative terms, the economic performance varied largely across different types of firms. For instance, large firms outperformed medium and small firms as much as foreign firms did with domestic firms, although all of them equally saw a negative performance towards the end of 2001. Figure 1 illustrates that most of the firms recorded a negative growth in total sales, ranging from -20% to -40%, between 1998 and 2001. Nonetheless, the circled area indicates a bunch of nearly 300 firms (roughly 20% of the sample size) that saw a positive growth in sales, in spite of the economic crisis.

Drawing on the conceptual framework presented above, we believe that the differential performance of these firms might be due to the introduction innovations, particularly in the case of organizational and marketing improvements.

Figure 1. Distribution of firms by their total sales growth, 1998-2001



Source: Own elaboration based on the Innovation Survey (INDEC, 2003)

Table 1 below shows some indicators of firm performance by type of innovation (either pursued or achieved) during the last economic crisis. In the first set of columns we observe that the total sales of all firms sampled fell by 22.8 % -on average-, between 1998 and 2001. Total sales of firms that did not achieve any innovation (output) dropped by more than 30%, while firms that achieved at least one innovation saw their sales falling by 18.3%, for the same period of time. Going down along the table we can find the innovation strategies of our interest. The decline in total sales of those firms that achieved, at least one, process (-15.7%) or product (-17.3%) innovation was slightly lower than that of organizational (18.1%) and marketing (19.8%) innovators,³ during the economic crisis. The similar pattern can be seen in terms of labor productivity (total sales per employee), although the decline rate is lower than in sales due to the simultaneous reduction of employment levels, between the same period 1998-2001.

Table 1 also shows the performance of firms by type of innovation strategy pursued or innovative behavior⁴ during the last economic crisis in Argentina. Like in the case of innovators, innovative firms (1,023) outnumbered non-innovative ones (408) in the sample and fared much better both in terms of total sales and labor productivity, between 1998 and 2001. With regards to the different types of innovative behavior, the pattern is quite similar to that of innovators and non-

³ For operational purposes, innovators are used as an output measure to define those firms that achieve innovations in the period 1998-2001, regardless if the innovation was pursued in the present or the past (see RICYT, 2001)

⁴ For operational purposes, innovative will be used as an input innovation measure to characterize those firms that pursued innovations in the period 1998-2001, regardless the output or results.

innovators, although firms that made efforts towards organizational innovations seemed to show a slightly better performance than others.

Table 1. Firms Performance by Type of Innovation Strategy, 1998-2001

Means, Standard Deviations, and no of observations reported

Innovation Strategies	Obs.	Total Sales		Employment		Labor Productivity	
		Mean (% change)	Std. Dev.	Mean (% change)	Std. Dev.	Mean (% change)	Std. Dev.
All firms	1.431	-22,8	33,6	-7,6	27,0	-14,8	32,6
Output							
Non-Innovator (none innovation achieved)	503	-31,1	33,3	-12,3	25,9	-19,8	34,5
Innovator (any innovation achieved)	928	-18,3	32,9	-5,0	27,2	-12,0	31,2
Product innovator	703	-17,3	32,8	-4,0	26,7	-11,8	31,1
Process innovator	720	-15,7	33,2	-3,9	27,2	-10,5	30,9
Organizational innovator	543	-18,1	32,2	-5,4	25,9	-12,0	29,9
Marketing innovator	415	-19,8	30,5	-4,0	26,9	-14,6	29,8
Input							
Non-Innovative (none innovation pursued)	408	-32,8	33,6	-12,9	25,7	-21,6	34,4
Innovative (any innovation pursued)	1.023	-18,8	32,7	-5,5	27,2	-12,0	31,5
Product innovative	864	-17,8	33,3	-4,8	27,3	-11,8	31,2
Process innovative	889	-17,4	33,1	-4,4	27,2	-11,8	30,9
Organizational innovative	835	-17,5	33,1	-5,6	26,8	-10,6	31,7
Marketing innovative	690	-18,4	33,0	-5,9	26,4	-11,4	31,8

Source: Own elaboration based on the Innovation Survey, INDEC (2003)

Notes: Outlying observations have been excluded

IV. Model specification

In order to address the research questions of this paper, we need to specify a model that account for the relationship among the above-described variables. For analytical purposes, we assume here that such a model follows a simple Cobb-Douglas⁵ sales function⁶ (S) with two inputs, labor (L) and capital (K), and a total factor productivity component (A) that summarizes all other influences on S, including different types of innovations. Therefore, the logarithmic form of the equation to be estimated can be written as follows:

$$\Delta S_{i\Delta t} = \beta \Delta L_{i\Delta t} + \alpha \Delta K_{i\Delta t} + A_{iT} + W_{it-1} + \varepsilon_i$$

⁵ Cobb & Douglas (1928). See also Katz, J. (1969) for the usefulness and limitations of Cobb-Douglas production functions to the Argentine case.

⁶ The use of a production function (quantity) to explain sales (price times quantity) implies that prices are constant. This assumption is not quite unrealistic as the inflation rate in Argentina was relatively stable during the period under analysis (1998-2001)

where ΔS is the change in total sales of firm (i) between 1998 and 2001 (Δt); ΔL is the change in total employment for firm i during the same period Δt ; ΔK is the change in capital stock or investment in 1998 (t_{-1}). The total factor productivity component A of firm i can be broken down by type of innovation achieved / pursued⁷ (product, process, organizational and marketing), during the whole period 1998-2001 (T). The additional component W_{it-1} represents the usual control variables (size, ownership, industry) that account for the initial conditions of firm i in the period 1998 (t_{-1}). According to the literature reviewed, we also include in W_{it-1} those variables that are likely to have an impact on the sales function -or productivity function- such as skilled labor (Crepon et al, 1998; Caroli & Van Reenen 2001; Chudnovsky et al, 2006), export intensity (Clerides 1998; Baldwin & Gu, 2004; Crespi et al, 2008) and links with the innovation system (Arza & Lopez, 2011). As usual, α and β indicate the output (sales) elasticities of capital and labor, respectively, and ε_i represents the unobserved disturbance term of the equation.

A simple algebraic transformation of the above-defined sales equation allows us to estimate a (labor) productivity function as well.

Table 2 shows a short description of all the variables that are included in the four models to be estimated, following the questionnaire of the Innovation Survey (INDEC, 2003)

Table 2. Variables description

Variable	Type of data	Short description
Dependant variables:		
Total Sales	Continuous	Growth rate of domestic sales plus exports between 1998 and 2001 (in log)
Labor Productivity	Ratio	Growth rate of total sales -per employee- between 1998 and 2001 (in log)
Explanatory variables:		
Investment in capital goods	Continuous	Expenditure in capital goods investments in 1998 (in log)
Investment in capital goods (intensity)	Ratio	Expenditure in capital goods investments over total sales in 1998 (in log)
Other investments	Continuous	Expenditure in other investments in 1998 (in log)
Other investments (intensity)	Ratio	Expenditure in other investments over total sales in 1998 (in log)

⁷ We specify two models herein, depending on innovation is measured as an output (achieved) or as an input (pursued)

Total employment	Continuous	Growth rate of total employment between 1998 and 2001 (in log)
Foreign capital	Percentage	Percentage of foreign capital share (in log)
Group	Dummy	Is the firm part of an economic group? (Yes equals to one)
Exports (intensity)	Ratio	Share of exports over total sales in 1998 (in log)
Product innovation (output)	Dummy	Has the firm achieved product innovations in the period 1998-2001?
Process innovation (output)	Dummy	Has the firm achieved process innovations in the period 1998-2001?
Organizational innovation (output)	Dummy	Has the firm achieved organizational innovations in the period 1998-2001?
Marketing innovation (output)	Dummy	Has the firm achieved marketing innovations in the period 1998-2001?
Product innovation (input)	Dummy	Has the firm pursued any innovation activity oriented towards product innovation in the period 1998-2001?
Process innovation (input)	Dummy	Has the firm pursued any innovation activity oriented towards process innovation in the period 1998-2001?
Organizational innovation (input)	Dummy	Has the firm pursued any innovation activity oriented towards organizational innovation in the period 1998-2001?
Marketing innovation (input)	Dummy	Has the firm pursued any innovation activity oriented towards marketing innovation in the period 1998-2001?
Links with the NIS	Count (0-12)	What is the intensity of the national and international links the firm has established (if any) with the different institutions of the National Innovation System (NIS), during the period 1998-2001?
Skilled labour	Ratio	Share of professionals over total employment in 1998
Industry	Dummy	21 variables by ISIC sector classification at 2-digit level

Source: Own elaboration based on the Innovation Survey (INDEC, 2003)

Based on the model specification we have defined so far, we can operationalize the research questions of this paper by formulating the following hypotheses:

H1: Technological innovations (product and process) have a positive impact on firm performance (sales and productivity) during crisis time, as suggested in the literature.

H2: Non-technological innovations (organizational and marketing) have a positive impact on firm performance (sales and productivity) in crisis time, as suggested in this study.

V. Data limitations and estimation strategy

In order to test empirically the hypotheses stated above we have to find out the estimation strategy that best fits into the information contained in the innovation survey at hand. However, it is of utmost importance to discuss first some data limitations which we are dealing with, viz:

Reduced time variation in the available data. Although we have access to the full dataset of the 2nd innovation survey in Argentina for the recession period of 1998-2001, we are not able to collect further information from other innovation surveys covering either ex-ante (1992-1996) or ex-post (2002-2004) growth and recovery periods, respectively. Hence, the limited time variation of the available data poses some restrictions to the very definition of “catching-up”, which always entails long time series and -technological or market- benchmarks to reach out. That is the reason why we have to rely on a rather narrow definition and analyze the performance of those latecomer firms that overcame their technological and market disadvantages (Hobday 1995) as necessary, but not sufficient, condition to catch up.

Limited number of time-varying variables. In addition to the temporal limitation on the available data, the innovation survey in question contains a reduced number of time-varying variables. Only information about firms’ performance, employment, and innovation expenditures is available for two years (1998 & 2001), while the rest of the variables are dummies that indicate different observed characteristics of the firm, for the period 1998-2001 as a whole. This data limitation brings about important consequences for the estimation strategy as it impedes the use of panel data techniques to control for unobserved characteristics of the firm. Nonetheless, we try to maximize as much as possible the time variation available in the dataset as we explain later on.

Broad definition of non-technological innovations. In accordance with the Bogota Manual, the innovation survey in question also uses a rather broad output variable for both organizational and marketing innovations. Therefore, we cannot identify the specific components of marketing or organizational change that are actually driving each type of innovation. Armbruster et al (2008) suggest that the different elements of organizational change might be related with different business strategies of the firm. Therefore, one potential solution to narrow down the scope of such a broad definition is to analyze the impact of non-technological innovations on different dependent variables which, in turn, are related to different business strategies. For example, if organizational innovations have a stronger impact on labour productivity than on sales, then they are likely to be referred to just-in-time, supply chain management, and teamwork concepts. Conversely, if organizational innovations have a stronger impact on sales than on labour

productivity, then they are likely to be related with quality audits /certifications (ISO), decentralization of planning, and customer-oriented structure concepts.

Given these data limitations on time variation, panel data techniques that control for unobserved characteristics of the firm cannot be implemented in the empirical testing of the models. Instead, we use ordinary least square (OLS) methods for cross-section estimation while trying to mitigate any potential bias arising from other sources of endogeneity in the following ways, viz:

(a) Control variables W_{it-1} like investments; export intensity; and skilled labor were estimated at the beginning of the period (1998), as if they were “initial conditions”. The idea behind is to reduce any simultaneity problem with the dependent variables that were estimated as growth rates in the period 1998-2001.

(b) Dummy variables by type of innovation either achieved (output) or pursued (input) during the whole period 1998-2001 might suffer from some simultaneity problem with the growth rate 2001/1998 of the dependent variable if and only if the former took place in the year 2001. Since the odds for that to happen are 1 to 3 (because innovations could have taken place in 1998, 1999, 2000, or 2001) then the chances for any endogeneity problem here are somewhat reduced.

Finally, we estimate OLS regressions that are robust in two ways. On one hand, we allow heteroskedasticity in the estimation and thus robust standard errors are produced. On the other hand, outlying observations with growth rates in sales and productivity larger than 100 per cent have been excluded from the analysis as they are most likely to be the result of typing errors in the survey.

VI. Econometric analysis and empirical findings

The regression analysis of this paper entails the estimation of four models. On one side, total sales (I) and labor productivity (II) equations with innovation being measured as an output (achievement). On the other side, total sales (III) and labor productivity (IV) equations with innovation being measured as an input (efforts). The other explanatory and control variables remain the same for each model.

As Table 3 illustrates, the sharp reduction in employment levels due to the crisis led to a negative growth in sales, though it increased the labour productivity of firms, as expected. We found that changes in total employment are highly significant and positively correlated with the variation in total sales, between 1998 and 2001. Moreover, the estimated elasticity of labor to sales (β) indicates diminishing marginal returns as a 1% increase in labor would lead to approximately

0.49% increase in total sales (Model I), which is broadly in line with the existing literature on production functions (Cobb & Douglas 1928; Katz 1969).

Table 3. Determinants of Firms' Growth in Sales and Productivity, 1998-2001
OLS regression coefficients and robust standard errors reported

Dependent variables (growth rates 1998-2001)	Total Sales	Labor Productivity	Total Sales	Labor Productivity
	(I)	(II)	(III)	(IV)
Investment in capital goods	.0051175 *** (.001586)		.0054005 *** (.001618)	
Investment in capital goods (intensity)		.0217834 *** (.006612)		.0230599 *** (.006743)
Other investments	-.0018063 (.001358)		-.0018014 (.001358)	
Other investments (intensity)		-.0028399 (.0078471)		-.0034104 (.0078625)
Total employment (change)	.4940690 *** (.058900)	-.3215201 *** (.064544)	.4990524 *** (.058715)	-.318391 *** (.064134)
Foreign capital (%)	.00901365 *** (.0030007)	.00987987 *** (.002917)	.0084796 *** (.003013)	.00931334 *** (.0029536)
Export (intensity)	-.0060900 (.005388)	-.00557495 (.0052462)	-.0050117 (.005437)	-.00459567 (.00531634)
Product innovation achieved (output)	.05655283 * (.0307446)	.06212409 ** (.0302299)		
Process innovation achieved (output)	.10763028 *** (.0309594)	.1159091 *** (.029995)		
Organizational innovation achieved (output)	.04593568 (.0307584)	.03196979 (.0292957)		
Marketing innovation achieved (output)	-.07777315 ** (.0346009)	-.0864074 ** (.0337848)		
Product innovation efforts (input)			.02886002 (.0362563)	.03723002 (.0359947)
Process innovation efforts (input)			.0149102 (.037159)	.02922181 (.0355679)
Organizational innovation efforts (input)			.13460593 *** (.0364372)	.09442781 *** (.033939)
Marketing innovation efforts (input)			-.03300886 (.0317161)	-.01302618 (.030666)
Number of firms	1396	1390	1396	1390
R ²	.2798	.1410	.2785	.1355

Source: Own elaboration based on the Innovation Survey, INDEC (2003)

Note 1: Estimation includes 21 industry dummies (not reported)

Note 2: Estimation includes heteroskedasticity-corrected standard errors

Note 3: Statistical significances at 10% (*); 5% (**); and 1% (***)

Likewise, we found that changes in the stock of capital goods are highly significant and positively correlated with the variation in total sales, for the same period of time. However, the estimated elasticity of capital to sales (α) indicates a much lower diminishing marginal return at 0.005% for each 1% increase of investment in capital goods. Most likely this is due to the fact

that firms have been massively re-stocking capital in the previous period. For example, imports of capital goods increased by more than 70%, between 1992 and 1996. That is the reason why any marginal drop in the capital stock did not have a strong impact on turnover growth.

Overall, the sales elasticities of both labor and capital indicate decreasing returns to scale for the sample of nearly 1,400 manufacturing firms. These results emphasize the importance of reading and interpreting the estimated coefficients within the specific phase of the business cycle, in this case during the last economic downturn in Argentina.

Investment in other items (e.g. consumption and intermediate goods) had no significant impact on total sales. Surprisingly, we did not find significant results either for some firm characteristics -or initial conditions in 1998- such as export intensity, networking intensity, skilled labor, and being part of a group (not reported in the table). Nonetheless, firms with larger share of foreign capital were more likely to perform better in total sales than those with lower shares. However, the fact the dummy variable “being part of a group” is not statistically significant allows us to argue that multinational corporations did not have a differential performance as compared to independent firms. The industry dummies analysis (not reported in Table 3) indicates that only manufacturer of basic metals⁸ and fabricated metal products⁹ showed a slightly better performance in sales and productivity, out of 21 industrial sectors analyzed.

We also found similar results in the estimation of the labor productivity equation (Model II). Changes in total employment are highly significant though negatively correlated with the growth of labor productivity, as expected. The impact of investments in capital goods is also highly significant and positively correlated with labor productivity growth, with a coefficient value larger than that of Model I. This might be due to fact that in Model II we are measuring capital intensity (over sales) rather than absolute growth in capital goods.

More importantly, the middle part of Table 3 illustrates the impact of different types of innovation achievements (output) on total sales (Model I) and labor productivity (Model II). As proposed in our first hypothesis (H1), the introduction of both product and process innovations have a significant and positive impact on firm performance. The impact of process innovations on total sales (0.10) and labor productivity (0.12) is twice as much higher that of product innovations on total sales (0.5) and labor productivity (0.6) of the firm. However, the empirical findings of our research showed mixed results so as to fully confirm the second hypothesis of this paper. The

⁸ Corresponding to code 27, ISIC Rev. 3

⁹ Corresponding to code 28, ISIC Rev. 3

introduction of organizational innovations has a positive impact on firm performance, though it not statistically significant. Unexpectedly, the introduction of marketing innovations turned out to be highly significant though negatively correlated with the growth in sales and productivity of the firm. This might be due to some sort of reverse causality phenomenon during the economic downturn. For instance, a drop in total sales in 2001 might have led firms to introduce more marketing innovations in the same year, rather than during the economic peak in 1998. Longer time series that also cover economic upturns periods are needed in order to validate these findings on the role of marketing innovations.

Nevertheless, when the four types of innovations are measured as inputs or efforts, rather than outputs or achievements, their impact on firm performance turned out to be quite different (Models III and IV). Product, process and marketing innovations cease to have effects on firm performance. Instead, firm's efforts oriented towards organizational innovation become highly significant and the associated coefficient is positively correlated with total sales (0.13) and labor productivity (0.09) growth. The somehow contrasting results of models I and II, on one hand, and III and IV, on the other hand, might be explained by a number of methodological reasons on measuring different types of innovations. First, technological innovations are likely to be riskier than non-technological ones and thus not all innovation efforts oriented towards product and process innovations (Models III and IV) necessarily have a direct impact on firm performance. Second, organizational innovations such as new business practices, workplace restructuring, external relations and the like, can hardly be measured or quantified as an output or achievements by questionnaire respondents. They usually generate changes and improvements along the way and within rather long period of time. Therefore, it should not be surprising that organizational innovations have a positive impact on firm performance when they are measured as effort (input) rather than results (output). As Kimberly (1981) suggests, it is important to distinguish two stages of innovation, namely (i) as a discrete item like in the case of product, process, and to some extent, marketing innovations; and (b) as a process aimed at improving business processes and structure like in the case of organizational innovations.

Summarizing, once the empirical model is properly accounted for capital, labor and other control variables, we found enough evidence to confirm that product and process innovations have a positive impact on latecomer firms' performance in crisis time. Thus we can confirm the first hypothesis of this paper. However, we found mixed results so as to confirm the second

hypothesis. On one hand, marketing innovations seem to be negatively correlated with firms' performance, at least, during the last economic downturn in Argentina. On the other hand, organizational innovations seem to have positive effect on firms' performance only when measured as innovation efforts (input) rather than as an achievement (output).

VII. Conclusions and implications

The main motivation of this paper was to address the research question on how and why latecomer firms might be able to survive, grow, and succeed when facing adverse economic conditions in developing countries. Based on the empirical evidence gathered in a case study on latecomer firms in Argentina (Papa 2011), we narrowed down the scope of the question above and aimed at investigating the extent to which organizational and marketing innovations, along with technological innovations, might have helped latecomer firms to endure and overcome the economic crisis of 1998-2001 in Argentina. We drew on the latecomer firm theory (Gerschenkron 1962, Hobday 1995, Mathews & Cho 2000, Hobday 2003, Mathews 2006) in order to support the argument that firms from developing countries follow different competitive strategies that might not be uniquely related to product and process innovations but rather to non-technological innovations such as organizational and marketing. Then, we reviewed the literature on technological and non-technological innovations and pointed out the relatively lack of empirical research on the latter, mainly due to methodological issues and micro-data availability. In order to attain some degree of generalization in our results, we use data from the 2nd Innovation Survey in Argentina (INDEC, 2003) that covers the period 1998-2001 characterized by the deepest and longest-standing economic crisis of the country in contemporary times. The sample of 1,688 manufacturing firms is largely representative of the industrial sector in Argentina. We specify a Cobb-Douglas output (sales) function in order to account for the econometric relationship between sales and productivity, on the one hand, and labor, capital, and innovations –among other variables-, on the other hand. Given some data limitations on time variation we had to rely on OLS regression analysis, which showed the following empirical results, namely.

With regards to the role of technological innovations, we could successfully test the first hypothesis of this paper. The introduction of product and process innovation turned out to have a positive impact on firms' performance, although the significance and magnitude of the latter one doubles that of the former one. This might be indicating that in crisis time latecomer firms tend to

prioritize the sales of cheaper goods (via process innovations) rather than the sales of new – usually costly- goods (via product innovations). These findings sharply contrast with that obtained by Archibugi et al (2012) for the 2008 economic crisis in developed countries. The present study showed that exploitative strategies (new processes) prevailed over explorative strategies (new products) during the last economic crisis in a developing country like Argentina. With regard to the role of non-technological innovations, we found mixed results when testing the second hypothesis of this study.

In the case of marketing innovations, we found a possible case of retro-causality by which the drop in total sales could have led to an increase in the marketing innovations of the firm, rather than vice versa.

In the case of organizational innovations, the introduction of new business strategies, routines and procedures, quality management systems, and the like, turned out to have no effect on firms' performance. However, when these activities are measured as inputs or efforts oriented toward organizational change, they have effectively a positive impact on firms' performance. The increasing restocking of capital (via acquisition of new machinery) along with the sharp reduction in employment levels during the 1990s in Argentina have probably led many firms to address their innovation efforts towards organizational change, in line with the new productive structure (Schvarzer 2000, Katz 2006). Yet, firms were not able to report whether the goals of this ongoing process of organizational restructuring have been achieved finally or not, mainly due to measurement difficulties. If this turns out to be the case, then latecomer firms that pursued organizational innovation fared better than those that did not. This might be reflecting the importance of capacity of adaptation (Freeman & Soete 1997) for latecomer firms facing unstable and changing environments like the last economic crisis in Argentina. These findings would also go in line with the preference for flexibility found among economic agents of crisis-ridden countries like Argentina (Fanelli & Frenkel 1995). Indeed, since the econometric results showed that organizational innovations have a stronger impact on total sales (0.13) than on labour productivity (0.09), then they are likely to be related with organizational concepts like quality audits /certifications (ISO), decentralization of planning, and customer-oriented structures which are aimed at improving companies' flexibility.

Finally, we reckon that the empirical findings of this paper could have some implications for policy and further research.

In terms of policy implications, we should be somewhat cautious about deriving recommendations for other developing countries, even if facing similar adverse conditions, simply because each country has their own specific set of resources, capacities and strategies to deal with their economic development (Gerschenkron 1962, Hobday 2003). Moreover, policy-makers in developing countries usually might not have the resources, capacity and/or willingness to tackle appropriate policies because they could be part of the wider problem of underdevelopment (Papa 2011). Nonetheless, we believe that the empirical findings of this paper might have more implications for the (corporate) policy of latecomer firms. Hence, managers should aim at fostering not only the introduction of product and process innovations (e.g. through the acquisition of technology) but also the organizational change required to cope with turbulent economic environments. For example, (i) replacing the traditional, centralized, tayloristic type of organizational structure by more decentralized, product- or customer-oriented organization aims at improving the company's flexibility; or (ii) implementing just-in-time and supply chain management concepts aims at increasing productivity (Armbruster et al 2008, pp 650).

In terms of implications for further research, the regression analysis of this study has shown that organizational innovations should be measured as an input rather than an output. This way, the methodology of future studies should be able to fully capture the effect of all the innovation efforts oriented towards organizational change that the firm makes along the way, regardless their results. The measurement of organizational innovations as an output seems to be misleading as respondent might find difficult to quantify in a questionnaire the degree of accomplishment of an ongoing process. Having said that, we acknowledge that further research is needed along the following lines, namely: (i) analysis of longer time series that also cover economic upturns periods in order to confirm whether or not the results found during economic downturn also hold for different phases of the business cycle; (ii) complementarities analysis among different types of innovations (product, process, organizational, and marketing) in order to test which innovation mix further enhances firm performance along different phases of the economic cycle of firms.

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