GLOBELICS
WORKING PAPER SERIES
THE GLOBAL NETWORK FOR ECONOMICS OF LEARNING, INNOVATION, AND COMPETENCE BUILDING SYSTEM

Do Technological Capabilities foster small young firm growth? The Brazilian Case

Maria Molina-Domene and
Franco Malerba

Working Paper

No. 2018-03

ISBN: 978-87-92923-29-5

Do Technological Capabilities foster small young firm growth? The Brazilian Case

Maria Molina-Domene * and Franco Malerba **

*CEP, London School of Economics, London
**CRIOS, Bocconi University, Milan

Abstract

This paper studies the role of technological capabilities (TCs) on small young firm growth. Distinguishing three types of technological capabilities - projects, execution and external learning- and looking at the complementarities among them, we provide empirical evidence on Brazilian small young firms. The econometric analysis employs three waves of Pintec surveys. Results show that project design capabilities are a major factor in the growth for small young Brazilian firms if combined with an appropriate level of external learning. As an extension, we delve into sectors (machinery, food processing, chemicals, and electronics) and find relevant differences across them.

Keywords: *small young firms, technological capabilities, firm, Brazil*

Acknowledgements

We are indebted to the Instituto Brasileiro de Geografia e Estatistica (IBGE) for providing access to the data. Martin Bell provided inspiration and support in early stages of the research. We wish to thank Jörn-Steffen Pischke, Marcelo Matos, and the participants at seminars at SPRU and the Department of Statistics at LSE and at the Globelics Conferences at Addis Ababa and Cuba for comments and suggestions; Bruno Oliveira de Araújo, Ricardo Cavalcante, and Eric Jardim Cavalcante of IPEA for their fundamental support and great collaboration; and Alexandre Pessôa Brandão, Carlos Lessa, and Luis Carlos Pinto of the IBGE staff.

1. Introduction

How crucial are technological capabilities for small, young firms in emerging countries? Given small young firms within these countries, typically do not undertake formal R&D, which are the relevant technological capabilities (TCs) needed to grow? Do different TCs matter across different industries? This paper offers empirical answers to these questions, investigating the role TCs play in firm's path to growth.

Small, young firms can bring new visions, technologies, and skills to the economic system and can help to transform the productive structure. Their growth may foster the overall economic development of a country and provide the domestic industrial structure with new domestic or international leaders. Since Schumpeter (1934), literature[1] suggests that small young firms can be important sources of innovation and change.

We contribute to this theoretical debate by focusing on small young firm's internal efforts and capability development that enable them to grow. Being young, the distinctive feature of these firms is that they do not possess huge amounts of previous information about the environment. Therefore, young firm's challenge is to early build technological capabilities and dynamically adapt to the environment (Stam and Wennberg, 2009; Sapienza et al., 2005; Winter, 2003; Helfat and Peteraf, 2003; Dosi, 2001; Teece et al. 1997). Being small, these firms are more prone to growth but have more chances or facing bankruptcy and failure. Combining both aspects may place small young firms in difficulties and these firms can struggle even more within emerging countries[2].

[1] See Nelson and Winter (1982); Acs and Audretsch (1990); Audretsch, (1995), among others.
[2] Kim (1980) for instance highlights industrial technology develops in stages within emerging countries.

Growth can be achieved individually (organically) or through integration (e.g. acquisitions as part of a value chain). Strategies to grow range from diversification to market penetration, achievable thanks to technological sophistication, market positioning, new product introduction, etc. In terms of internal drivers of the growth of small young firms[3], entrepreneurship, management and innovation (i.e. besides simple imitation) appear fundamental (Davidsson et al., 2010).

To the best of our knowledge, the literature has not covered yet the role of TCs in small young firm growth. Neither in advanced, nor in emerging economies[4]. We argue TCs, related to tacit and informal knowledge rather than to formal R&D projects (Foray, 2004; Nelson, 2008) are core for small young firms in emerging countries. We follow Teece[5] (2007, p.1319) and argue that 'to sense and shape opportunities and threats, to seize opportunities, and to maintain competitiveness through enhancing, combining, protecting, and, when necessary, reconfiguring the business enterprise's intangible and tangible assets', small young firms previously master TCs.

As in Bell and Pavitt (1993), we define technological capabilities as the resources and abilities needed to generate and manage technical change, including skills, knowledge and experience, and institutional structure and linkages. We follow Lall (2000, 1992) in distinguishing different capabilities types or dimensions (projects, execution and linkages

---

[3] Kotha et al. (2011) moderation arguments suggest that there are relative advantages of young versus older firms from entry into new technological niches.

[4] Seminal contributions suggest technological capabilities are key factors for economic development and catching up. Works by Nelson and Winter (1982), Katz (1976 and 1987), Lall (1987 and 1992), Bell and Pavitt (1993), Kim (1997), Amsden and Hikino (1994), Nelson and Pack (1999), Lee and Lim (2001), Mathews (2002), Figueiredo (2001 and 2003), Amsden and Chu (2003), Lee (2011) argue TCs are particularly relevant for firms in emerging countries. TCs are associated with various aspects of the resource endowment of firms in developing countries (Fransman 1985, Dahlman et al. 1987, Kaplinsky 1990, Hobday 1995, Mathews, 1996 and Lee, 2013).

[5] In a more strict sense, dynamic capabilities in general refer to capacity to reconfigure its capabilities to adapt to a changing environment (Teece, 2012). A relatively long time or a changing context would be the ideal scenario for them.

capabilities), which can be exerted at different levels of complexity. In addition, we examine whether there are complementarities among TCs—that is, if they are interdependent in a manner that causes them to reinforce one another within the firm—or if instead they act as substitutes.

Our empirical analysis focuses on a large sample of small, young Brazilian firms in the period 2003–2008, surveyed during three consecutive rounds of the Brazilian Innovation Survey (2003–2008). Brazil is an ideal[6] setting for this inquiry because it has experienced rapid growth in the last decades and additionally it has a preponderance of small domestic firms operating alongside a large number of multinational subsidiaries (Costa and Robles Reis de Queiros, 2002). Additionally, as in most of the emerging countries, the role of informal, tacit knowledge in mastering technologies and in innovation seems substantial[7].

Firstly, we consider the entire sample of small, young Brazilian firms. Secondly, we look for differences across four industries (machinery and equipment, food, chemicals, and electronics), which we retain relevant examples of different sectoral systems (Malerba, 2002).

We derive our results using various econometric specifications based on quantile and OLS regressions. At the general level, our findings indicate that project capabilities matter for growth when complemented by appropriate external learning. Linkages capabilities, which allow firms to build links with external actors, appear relevant for firms early in the life cycle. Then, focusing on the four industries, we show that the positive relationship between project capabilities, linkages capabilities, and growth is true only in three of the four industries—machinery and equipment, chemicals, and electronics—with some caveats regarding results with

[6] The Brazilian case is interesting. It expanded beyond agricultural commodities and low value-added manufacturing to a wide range of sectors, including food, biotechnology, information and communications technology (ICT) and software that serve mainly domestic and regional markets (Goedhuys and Veugelers, 2012).
[7] Brazil spends only about 1% of its GDP in R&D, and most of these expenditures come from the public sector (Lugones and Suarez, 2007).

firm fixed effects. We do not find evidence that TCs play a role in the growth of small, young firms in the food industry.

The structure of this paper is as follows. Section 2 briefly examines the literature on growth and TCs in firms. Section 3 describes the database, the variables, and the methodology we used to measure growth in our sample of small, young Brazilian firms. Section 4 presents our empirical results. Section 5 discusses our findings and offers some concluding remarks.

2. The Conceptual Framework

2.1. Firm growth

From a broad perspective, firm's ability to grow depends on internal and external factors[8]. At internal level, there is some consensus that capabilities, innovation and management play a crucial role on growth. Looking what externally conditions growth, more product market competition has a positive effect on growth and too much imitation is growth-reducing (Aghion and Howitt, 1992). Instead, the adoption of new technologies, a heavy regulatory burden, low quality institutions, severe financial constraints, and macroeconomic uncertainty can hamper growth[9] (Goedhuys and Veugelers, 2012).

Irrespective of the size, some firms grow faster than others and in a persistent way, driven by human capital, strategy, human resource management, innovation and capabilities (Barbero et al., 2011; Demir et al., 2017[10]). Intuitively, larger firms may have better chances of increasing its size in absolute terms, even if large and small firms should have the same proportionate rate of

[8] Firm growth rates can follow different patterns. On the one hand, some findings suggest that growth rates follow a random walk (Geroski, 2000). On the other hand, some authors find regularities such as fat tails (Bottazzi and Secchi, 2006) and autocorrelation patterns, in which growth is not just a final outcome, but is also an input that provides firms with the means for more expansion (Coad, 2010).

[9] Strategic management literature (Oriani and Sobrero, 2008) introduce industry-level moderators, for instance to moderate the effect of uncertainty on the value of R&D, the degree of technology cumulativeness, etc. This type of analysis goes beyond the scope of this paper.

[10] The authors provide a systematic review of the drivers of high-growth firms.

growth[11]. In parallel, small firms may be able to grow faster than large ones[12]. Unlike established firms, moderately innovative strategies seem the most appropriate strategy for small young firm that aim to grow.

In this paper, we focus on what drives the growth of small young firms within an emerging country. We argue this is interesting because these firms may differ from large firms in their resources, abilities[13] and competitive behavior, having obvious consequences for growth. We extend Eisenhardt and Schoonhoven (1990) and acknowledge emerging markets are a difficult environment for young firms[14].

There are different modes in which small firms grow[15]: organic, acquisition-based or through international expansion[16]. We concentrate on the former aspect and in particular, on TCs, because we predict they are paramount for firm growth. TCs, as the other factors of organic growth, need purposeful planning and specific allocation of resources. Furthermore, growing by acquisition or through international expansion can produce better results if firms have previously developed their own TCs, particularly within emerging countries. We expand on this aspect in the following paragraphs.

---

[11] The Gibrat's Law of proportionate effect predicts a proportionate change in the size of the firm. Hart and Prais (1956) illustrate this fact and find that the probability of proportionate change in size varies inversely with the magnitude of the change. In parallel, focusing on employment, Hall (1987) weakly rejects the Gibrat's Law for the smaller firms in a sample of around 1,800 US firms in 1976 and Dunne and Hughes (1994) confirms that the Gibrat's Law does not hold for the smaller firms in a sample of around 2,000 UK companies.
[12] For instance, Dosi (2007) shows that this is true on average, and only when considering small surviving firms.
[13] Davidsson (1991) develops a model based on three determinants of growth: ability, need and opportunity.
[14] Nichter and Goldmark (2009) highlight that the vast majority of small firms in developing countries never expand, due to individual entrepreneur characteristics, firm characteristics, relational and contextual factors. Some studies in developing countries just pay attention to the relationship between entrepreneurial attributes, firm characteristics and growth (Bigsten and Gebreeyesus, 2007; Goedhuys and Sleuwaegen, 2010); while studies in advanced countries explore the impact of factors such as age, size, and survival on growth (such as ; Phillips and Kirchhoff, 1989; Audretsch, 1995; Bartelsman et al., 2005; Coad, 2009; Coad, 2010).
[15] Davidsson et al. (2010) provide a comprehensive survey of the empirical literature on small firm growth.
[16] Gilbert et al. (2006) address different growth dilemmas in relation to the "how" decision of internal versus external growth and the "where" decision of domestic versus international growth.

Firm's age also plays a role (Autio et al, 2000). Firms need to overcome the initial hurdles (i.e. the liability of the newness). Once they get past the first critical period, they may be able to grow fast (Mata, 1994). There is evidence that growth decreases for different phases of the business cycle, holding the firm size constant (Evans, 1987). A plausible explanation is that young companies are more dynamic but also more volatile in their growth experience than old companies (Dunne and Hughes, 1994).

If young firms innovate[17], they may able to grow faster, but this may entail additional uncertainty for young firms[18] and higher risks of disappearing in the early years subsequent to their birth. We believe, size and youth (i.e. lack of experience) taken together, can make growth even more challenging[19]. If new firms are born small, with imperfect knowledge about their true efficiency levels and limited resources, their first time in the market can be more crucial (Jovanovic, 1982).

2.2. Technological capabilities as drivers of growth

The underpinning intuition is that having TCs, small young firms are better prepared to grow. In line with the resource-based view of the firm, companies need capabilities (i.e. built on resources), to be competitive (Barney, 2001). The first step is the ability to absorb and make effective use of knowledge and technologies (i.e. absorptive capabilities, as coined by Cohen and Levinthal, 1990). Exhibiting project capabilities (often not formalized) helps execution

[17] Innovators are an active area of empirical and theoretical research (Schneider and Veugelers, 2010; Veugelers, 2009) because of their role in technological change and industrial evolution (Malerba and Orsenigo, 1999). Interestingly, the type of innovations (major or incremental) does not affect growth. Instead, what matters for growth is firms' ability to develop innovations with significant commercial applications and social value (Schneider and Veugelers, 2010). Additionally, if firms operate in 'seedbed' industries they can achieve faster-than-average employment growth (Beesley and Hamilton, 1984).

[18] The first area of uncertainty is achieving an appropriate production process and scale for the innovative product; the second is successfully marketing an innovative product (Audretsch, 1995). Uncertainty may also be higher with regard to financial constraints, both internal and external (Schneider and Veugelers, 2010). Furthermore, it may take a long time for a firm to convert increases in economically valuable knowledge (Coad and Rao, 2008) into successful manufacturing procedures and a viable production process.

[19] Audretsch (1995) find that the growth of young firms negatively correlates with firm size.

capabilities, broadly associated with knowledge about how to carry on production changes and develop organizational routines. This internal knowledge prepares firms for linkages capabilities or fruitful exchanges of information and collaboration (e.g. networks, alliances, etc. at national or international level), to obtain external technology necessary to feed the knowledge base of firms[20].

Given we look at small young firms within emerging markets, our hypothesis is that TCs are key drivers of growth. Having TCs, firms can go beyond cloning, imitation, or pure transfer of technologies from advanced countries. TCs, exerted at different levels of complexity (Figueiredo, 2008), may highlight indigenous processes of learning and technological activities that are not included in the traditional concept of R&D (i.e. an activity conducted by specialized units or centers belonging to a company). The various types of technological capabilities may exhibit different degrees of complementarity[21] and may imply interactions with external sources of knowledge[22].

As an extension, we consider the sectoral[23] context in which capabilities can exert their influence on the growth of small young firms. For instance, rapidly growing firms are frequent in industries and regions that are more dynamic. Sectoral differences[24] may affect the type of

[20] Small young firms differ from multinationals exchange of knowledge. In a case study of a Chinese construction firms, Rui et al. (2016) suggest emerging market multinationals tend to focus on their reliance on foreign firms for learning and capability upgrading.

[21] This implies that the implementation of one activity pays off more if the complementary activity is present, too (i.e. complementarity can be formally expressed via supermodularity, see Topkis, 1998; Schmiedeberg, 2008).

[22] Firms in developing countries accumulate TCs in the context of global value chains, in which learning and capability development lead firms to upgrade in various ways (Hobday 1995; Gereffi and Sturgeon, 2005; Morrison et al. 2008).

[23] Capabilities operate in systems of various types (Nelson, 2008): they can be national (Lundvall, 2007), sectoral (Malerba and Nelson, 2011), and regional (Cooke, 2001).

[24] The literature on innovation systems has pointed out that each sector has a specific knowledge base, set of actors, networks, and institutional setting (Malerba and Orsenigo, 1999; Malerba, 2002). These differences may greatly affect the type of actors involved in production and the market structure of industries, both in advanced countries (Mowery and Nelson, 1999; Malerba, 2004; Castellacci, 2008) and in developing countries (Malerba and Mani, 2009).

technological capabilities that flourish within firms and should be relevant for growth. To account for these differences, we consider four industries with different knowledge bases, actors, networks, and institutions: *machinery and equipment, chemicals, food, and electronics*.

3. Database, Variables, and Methodology

3.1. Data description

Our empirical analysis examines the growth of firms in the period 2003–2008. Our data come from the Brazilian Innovation Surveys (Pesquisa de Inovação Tecnólogica, hereafter called 'Pintec') for 2003 (11,337 firms), 2005 (13,575 firms), and 2008 (14,355 firms)[25]. Only industrial firms in Brazil with more than 10 employees are included in the surveys, therefore our analysis include all but the smallest of young firms.

Table 1 reports descriptive statistics about the number of firms by size (measured as the number of permanent employees), by absolute values of sales and sales growth, and by percentages of sales growth, based on the Pintec website[26]. IBGE does not allow providing statistics and plots of our sample of firms due its confidentiality policy.

From Table 1 it is apparent that the highest deflated sales growth rates across the three intervals (2003–2005, 2005–2008, and 2003–2008) belonged to the smallest and largest firms. Interestingly, in the period 2003–2008 the growth rate of sales was 98.82% on average.

Our analysis considers firms that were present in all three waves of the survey. We define small, young firms as those whose age was less than 15 years in 2008 and whose number of

[25] The Pintec surveys conducted by the Instituto Brasileiro de Geografia e Estatistica (IBGE) according to the Oslo Manual 3rd Edition and the Community Innovation Survey (CIS III), are administered only to industrial firms with more than 10 employees, which means that the smallest manufacturing plants are omitted from the analysis.

[26] Pintec website: www.pintec.ibge.gov.br

employees was more than 10 and less than 150[27]. Our population therefore consists of 786 firms.[28] Among these, the numbers of firms operating in our four focal industries are 97 in machinery and equipment, 78 in food, 48 in chemicals, and 55 in electronics. Our unit of observation is the firm, which we define as an entity that can perform different economic activities operating at different geographic locations.

3.2. Methodology

Our empirical analysis focuses on firm growth from 2000[29] to 2008. Growth is calculated for the firms present in all three waves of the survey. It is defined as:

$$Growth = \ln(\frac{St'}{St}) \qquad \text{(I)}$$

where *S* is firm sales, *t*' is 2008 and *t* is 2000. Our first caveat regards growth due to mergers and acquisitions: as no information is available on mergers and acquisitions, there is no way to distinguish between internal growth and growth due to these processes.

Our basic specification includes standard least squares and quantile regressions. Standard least squares regression techniques provide estimates that calculate the average effect of the independent variables on the 'average firm' and may hide important features of the underlying relationship (Coad and Rao, 2008). Instead, quantile regressions segment the sample into subsets defined according to the conditioning covariates (Koenker and Hallock, 2001). They provide an equally convenient method for estimating models for conditional quantile functions

[27] In line with the IDB's Classification of SMEs stated in "Comparative Analysis. SME Models Supported by IDB: The Case of Brazil. IDB, 2013".
[28] Because in all surveys there are losses from the original sample, the rate of loss is estimated and varies with the reference year. Firms' distribution by rate of loss is made in proportion to the samples size of the eligible and non-eligible strata (Junqueira Lustosa, 2011). These losses do not affect the validity of our study. We show in Appendix C (available upon request) that the distribution of TC1 (project capabilities) for small and young (S&Y) firms is similar for firms in the original samples and for firms present in the three waves.
[29] The 2000 survey is used only as a baseline for our calculations.

(i.e. the correspondent quantile coefficients can be interpreted as the partial derivative of the conditional quantile of *growth* with respect to particular regressors [30]), appropriate for highlighting changes in ways not revealed by an examination of averages.

Applying quantile regressions allows us to delve into the features of the conditional distribution of growth [31] in terms of confounding factors and interaction terms, just as with conventional regressions[32] (Angrist and Pischke, 2009). Furthermore, quantile regression models could be the best linear approximation to the conditional quantile function using a weighted means squared error loss function. Assuming integrability, the conditional quantile function solves the following problem (Angrist et al. 2006):

$$Q_\tau(Y|X) \in \arg\min_{q(X)} E[\rho_\tau (Y - q(X))].$$

at a quantile τ where $\rho_\tau(\mu) = (\tau - 1(\mu \leq 0))\mu$ and the minimum is over the set of measurable functions of X.

Then, our linear regression model[33] for firm growth takes the following form:

$$Growth_{i,t} = \alpha + (\beta_1 X_1 + \cdots + \beta_{1k} X_k) + \varepsilon_{i,t} \quad \text{(II)}$$

[30] The θ_{th} regression quantile with $0<\theta<1$ is defined as any solution to the minimization problem (Koenker and Basset, 1978):

$$\min_{b \in R}[\sum_{t \in \{t: y_{t \geq b}\}} \theta|y_t - b| + \sum_{t \in \{t: y_{t<b}\}} (1 - \theta|y_t - b|)]$$

considering that *{Xt: t = 1,…., T}* is a sequence of (row*) K-vectors* of TCs which are drivers of growth, and $\{Y_t: t = 1, \ldots, T\}$ is a random sample on the regression process $U_t = Y_t - X_{tb.}$

[31] We measure growth in terms of sales (i.e. not in the number of employees, etc.) to make the most of the quantile regressions machinery.

[32] A caveat could be that quantiles are not smooth functions of data, and thus the standard linearization might fail. In any case, we would expect that the estimates are still asymptotically normal, as shown by Rao and Wu (1988), for the case of smooth functions of population totals.

[33] We fit a model for conditional quantiles. As the survey conveys a weighting variable meant to adjust for sampling differences, we use it to help determine the importance the quantile regression minimand gives to points in the support of Xi for a given distribution of Xi, and we use it as a substitute for the linear approximation with weighting function proposed by Angrist et al. (2006).

where $X_1 \ldots . X_k$ is a vector of measured explanatory variables for the i_{th} firm and $\beta_1 \ldots . \beta_k$ is the vector of unknown regression parameters to be estimated.

To uncover omitted variable bias, potential reverse causality, and measurement error (typically occurring in observational studies) our empirical strategy is to control for unobserved confounding factors such as unobserved individual firm heterogeneity (correlated with the explanatory variables) by allowing $\varepsilon_{i,\,t}$ to include a firm-specific fixed effect (F_j). In this way, we reduce the omitted variable bias that comes from idiosyncratic unobserved firm characteristics that affect growth rates (such as labor force productivity, effective management, etc.). Subject-specific random intercepts are included to account for within-subject dependence in the context of longitudinal surveys (Geraci and Bottai, 2014).[34]

To check for Brazilian contextual shocks during the eight-year period we include year dummy variables. Time invariant omitted variable bias may not be obvious: it is likely that these unobserved firm characteristics correlate with the explanatory variables in equation (II). Ideally, we should get a linear, additive form to solve the problem of unobserved confounders by using panel data[35].

We include 'good controls' (Angrist and Pischke, 2009) in our model to help capture the effects of TCs on the growth rate. We avoid 'bad controls' (such as access to financial resources), as they could be an outcome of our regressor of interest and would generate selection

[34] The approach relies on the link between the minimization of weighted absolute deviations, typically used in quantile regression, and the maximization of a Laplace likelihood. The stronger constraint of a joint quantile specification is replaced by the weaker stochastic ordering of the asymmetric Laplace. Indeed, the use of L1 penalties in fixed-effect models is convenient and apt to be solved via linear programming algorithms (Geraci and Bottai, 2014).

[35] Working with panel data with no instruments we need a set of more restrictive assumptions; therefore, we avoid overly strong claims when interpreting fixed effects (Angrist and Pischke, 2009).

bias (i.e. we would have included this variable if access to financial help was randomly assigned to small and young innovative firms, which as far as we understand is not the case).

As sectoral systems play a fundamental role in firm performance, we control for another source of confounders by including a predetermined sectoral dummy. Specific regional contexts are similarly fundamental; therefore, we include regional dummies.

Timing also matters. For instance, we would avoid including R&D and innovation if we were to consider a longer span of time, as these variables may have been determined in part by growth. Including such variables could eventually promote reverse causality in the long term.

Finally, working with survey data typically presents limits in terms of how the data correspond to the true value (e.g. misunderstanding the questions, not having the information necessary to provide an answer, not having a standardized measure to respond, etc.). Furthermore, not all questions posed to firms in these surveys are about objective facts (i.e. subjectivity may be present); making it possible that our coefficients are affected by attenuation bias. We expect that working across many answers and many firms may minimizes these potential errors.

We test for complementarities between TCs by introducing interaction terms between them. We work with three multiplicative terms (which represent potential ways of combining capabilities in pairs), to encompass potential complementarities. We therefore estimate our model by including the capabilities' main effect plus these three interaction terms.

A second specification of our analysis includes firm fixed effects, which allow us to account for within-firm dependence in the context of longitudinal data. The raw quantiles might largely capture permanent differences between firm growth rates, while quantile fixed effects[36] are assumed to be purely location-shift effects. Within this context, therefore, the target of the analysis is the conditional mean of the response. We fit the model using Linear Quantile Mixed Models (LQMM)[37] (Geraci and Bottai, 2014) to control for quantile fixed effects[38].

From an initial population of 3.463 firms, we built a database of 786 of small and young firms, which are present in the three waves of survey. Average yearly growth rate for these young and small firms was 24%. In the four sectors growth rates are 33% in Machinery and Equipment (97 firms), 26% in Chemicals (48 firms), 24% in Food (78 firms), and 15% in Electronics (55 firms).

3.3. Variables

3.3.1 Dependent Variable

Our dependent variable firm growth and is computed taking differences of logs of growth in total sales between 2003 and 2008. This growth analysis is applied first to all young and small firms and then to firms in the selected sectors.

3.3.2 Independent Variables

3.3.2.1 Regressors of interest. To characterize TCs, we build on the classification proposed by Lall (1992), broadly indicative but not necessarily sequential in time. We characterize them as reflecting different levels of knowledge related to the preparation, execution, and external organization of future projects[39] that can potentially foster growth. We

[36] Unfortunately, because we do not have a large time dimension we cannot relax parallel trends by allowing for firm-specific trends. However, we use this method as a specification check on our baseline specification.
[37] The fixed effects can be interpreted as a weighted average approximation of the population quantiles they target. LQMM considers a block bootstrap to assess the uncertainty in conditional quantile estimates.
[38] The number of quadrature nodes was set to 9, while the estimation control parameters include 10,000 iterations. Bootstrapped standard errors based on 50 replications are calculated throughout.
[39] Firms perform activities that allows them to build capabilities. We develop a simple summary measure of technological capabilities by ranking the technical functions performed by firms. The approach is to highlight the various technical functions performed by firms and to award a score for each activity based on the assessed level of

compute TCs indexes by first giving a score to each activity based on a firm's level of competence in that activity[40] (for more on this see Molina and Pietrobelli, 2012). Summing these scores gives an overall score for each type of technological capability. For better comparison between enterprises, we divide the original grading by the maximum grade. These new variables then range from 0 to 1. We build three types of TCs:

(TC1) *Project capabilities* (capabilities in project design and preparation) relate to the importance of projects and technical procedures necessary to implement product or process innovations. They refer to projects, preliminary activities, and other technical preparatory activities for innovations in processes and in products and include changes in quality controls at preliminary stages. Following the survey's methodology, each technical activity is graded in four levels (high, medium, low, and not relevant) to represent the importance given to these activities.

(TC2) *Execution capabilities* (capabilities in project execution and investment) refers to technical functions related to training for developing innovation (four levels: high, medium, low, and not relevant); the implementation of quality certification (two levels: yes or no); and the acquisition of new equipment (four levels: high, medium, low, and not relevant). These capabilities should facilitate growth, in the following way:

- Training employees creates technological and absorptive capabilities (e.g. better trained employees are more able to incorporate know-how, to manipulate new equipment and machinery, to identify the need of more technology from external sources, etc.);

competence in that activity. An overall capability score for a firm is obtained by taking an average of the scores for the different technical functions (Gonsen, 1998; Romijn 1997; Wignaraja, 2002 and 2008; Molina and Pietrobelli, 2012. See more on this in the next Section.

[40] We work with categorical variables except for R&D expenditures. Firms provide a score for each activity based on their evaluation of their level of competence in that activity.

- Quality certification relates to the accomplishment of the production process in a standardized way (with formal systems for quality control based on final inspection);
- Purchasing new equipment reflects the incorporation of new technologies embodied in physical equipment.

(TC3) *Linkages capabilities* (learning from external sources) considers the importance of technology transfers and know-how for fostering innovation (four levels: high, medium, low, and not relevant). It includes transfers of technology through licenses, patents, etc. (again at four levels) and external sources of information such as clients, suppliers, competitors, universities, etc., considered important for the innovative process (also at four levels). It aims to reflect firms' continuous need for, and efforts toward, generating adequate linkages to absorb knowledge from external sources.

3.3.2.2 Controls. *Sectors* is a set of dummy variables controlling for sectoral differences (CNAe)[41], included when examining all industrial sectors together and omitted when we check for inter-sector differences. The four sectors examined in the paper are machinery and equipment (CNAe 28 and 29), food processing (CNAe 15, excluding 15.9), chemicals (CNAe 24, excluding 24.5), and electronics (CNAe 30 and 32, excluding 32.1). These sectors provide a picture of the manufacturing industry and represent a different spectrum of knowledge bases, structures, and dynamics (see for example the discussion in Malerba (2004), Malerba and Mani (2009), and Pavitt (1984)). In the Pavitt (1984) classification, these sectors belong to scale intensive (machinery and equipment), traditional (food-processing), science-based (chemicals), and a combination of science-based and specialized supplier (electronics).

[41] For more information on Brazilian classification of industries according to CNAe codes see http://www.ibge.gov.br/home/estatistica/economia/classificacoes/cnae_subclasses

Innovation is the output of innovative activities.[42] It is a binary variable that takes value one if firms introduce at least one new product to the Brazilian market during a three-year period (including the year of the survey) or if firms introduce or improve one new process, one new product, or both; it is zero otherwise. We believe that introducing innovations will not have an instantaneous effect on growth (i.e. reverse causality should not be present at this stage).

R&D expenditures reflects the decision to perform in-house formal R&D activities and/or contract it externally. We explicitly exclude them from the TCs. Pintec define them as basic and applied research and include those systematic tasks aiming to increase knowledge and to use knowledge for new or improved products and processes. As with innovation, we do not expect R&D expenditures to have an immediate effect on our regressors of interest (which would have made this variable a bad control).

Regions[43] reflects the five country regions into which the survey divides responding firms: North, Northeast, South, Southeast and Central-West. We include dummies to control for predetermined differences created by contextual regional conditions.

Domestic represents the domestic nature of a young and small firm's capital. It is a dummy variable, which takes the value one if a firm's capital is completely Brazilian; it is zero otherwise.

Age, size, and year are predetermined features that could help us to solve for selection bias.

3.3.2.3 Interaction terms. We allow for three dimensions of complementarity using the following interaction terms:

---

[43] While the focus on regional systems (Suzigan et al. 2007, Pires et al. 2013 and Cravos et al., 2015) is not one of the main objectives of the present analysis, our findings confirm its relevance. This opens interesting questions for future research, as discussed in the Conclusions.

TC1–TC2. The firm remains rather closed to use external knowledge, opting instead to design and execute projects internally. This could be the case when external knowledge is not available or when firms are not able to tap into and/or use it.

TC2–TC3. The firm avoids internally designing projects and focuses instead on executing and connecting, also using external sources of knowledge. This would be plausible in cases where firms need to produce immediate positive results.

TC1–TC3. The firm focuses on project and relies on external knowledge. This seems a reasonable option for a young and small firm.

A brief summary of the independent variables common to both rounds of analysis (entire population and sector-specific) is presented in Appendix A (available upon request .

4. Empirical Results

Our empirical model is:

$$Growth_{i,t} = \alpha + \beta_1 X_i + \beta_2 Controls_i + \beta_3 Inter_i + \varepsilon_{i,t} \qquad \text{(III)},$$

which includes the variables described in Section 3.3 and heteroskedastic robust standard errors. We use conditional quantiles to measure the spread of the growth rate distribution changes from 2003 to 2008 conditional on covariates, and quantify the sampling uncertainty in estimates of these approximations using the sampling weight as defined above.

The first column of Table 2 shows the role of each technological capability (TC) in our basic specification (OLS point estimations). None of our regressors of interest are significant. Columns 3, 5, 7, 9, and 11 of Table 2 present the results of quantiles regressions, showing the differential effect of the TCs' covariate on various quantiles in the conditional distribution. Most of the coefficients on TC3 are significant across quantiles (i.e. excluding the estimates for the 10^{th} quantile)[44].

Even columns of Table 2 include the results for our specification with interaction terms for the analysis of complementarity among TCs. For instance, we can be interested in the effect of ΔGrowth/ΔTC1 = β1 + β2TC3 (where β1 is the coefficient for TC1 and β2 is the coefficient for the interaction term TC1–TC3). Considering firms in the 25^{th} quantile, the coefficient on TC1 is negative but it supposedly measures the effect when TC3 = 0 which does not seem relevant in this case[45].

Instead, by plugging in interesting values of TC1–TC3 we obtain the partial effect. At the mean TC3 (0.68) the effect of TC1 on growth is –1.976 + 3.014 * 0.68 = 0.074 (around 40% standard deviation of TC1–TC3), indicating that a TC1–TC3 complementarity has a positive effect on firm growth. This seems plausible given the systemic nature of technological knowledge and the importance of combining design capability with the right absorptive capacity necessary to interact with other firms and to establish appropriate links with external actors. The effect of complementarities between TC1 and TC3 differs at different points of the distribution of firm growth, conditional on observables: at an average level of TC3, TC1 has a positive effect on growth, and the estimates on TC1–TC3 increase sharply in the upper quantile.

In Table 2 the quantile regression results provide evidence of the heterogeneous effects of TCs on firm growth, but they do not pin down whether a given firm growth is systematically

---

[44] We observe that quantile coefficients differ across quantiles: the TC1 effect seems negative at the lowest conditional quantiles and positive and significant for the higher quantiles, while the opposite happens for TC2. It therefore seems that TCs are more relevant in the central quantiles (e.g. the coefficients related to capabilities are statistically significant there, while this is not the case for the extreme quantiles 10th and 90th). However, this is probably due to sampling variation, as we observe higher standard errors at the extreme quantiles than at the middle ones.

[45] We provide more details about the statistical significance of TCs and interaction terms in Appendix D (available upon request). For instance, the p-value for the F-test of the joint hypothesis (i.e. no firm in the sample exhibits TC3 = 0), Ho: TC1=0, TC1–3=0, is 0.035 (significant at the 3.5% level), allowing us to reject Ho.

higher or lower over time. To provide evidence on the effects of TCs on the growth of the same firm, in Table 3 we present firm fixed-effects estimates.

It becomes apparent that a TC1–TC3 complementarity has stronger effect on firm growth, after controlling for firm fixed effects[46]. This suggests that firms are heterogeneous: some firms have systematically higher growth with a change in TCs while others have systematically lower growth. This is indicative of the idiosyncratic nature of firms, especially in the bottom quantile of the distribution of growth. As expected, whether a firm grows is positively related to exerting complementarity TC1–TC3: this means keeping projects internal and outsourcing technology transfers and know-how (except in the top quantile).

It is also interesting to examine the complementarities between TC1 and TC2. We observe significant but negative coefficients on the interaction term TC1–TC2 (in particular for the 75^{th} quantile[47] in the regressions without fixed effects (Table 2), and across all the quantiles with fixed effects (Table 3). However, computing partial effects at the mean TC1 for the 25^{th} quantile in Table 2, the effect of TC2 on growth is positive and equal: 1.155 + (-0.986) * 0.45 = 0.711[48]. However the partial effect at the mean TC2 (within the 25^{th} quantile) is negative: –1.976 + (–0.986) * 0.35 = –2.32. Therefore, only at specific levels are TC1 and TC2 complementary for growth. An explanation for this could be that the burden of investing in projects can only be superseded if strong execution capabilities are developed within the firm. This effect is stronger after controlling for firm fixed effects and for firms in the bottom quantile of growth.

---

[46] Considering firms in the 25th quantile, at the mean TC1 the effect of TC3 on growth is –1.67 + 3.443 * 0.68 = 0.671.

[47] Testing the joint significance of both coefficients TC1 and the interaction TC1–2 for the median and 75^{th} quantile regressions, we are able to reject the null hypothesis that they are significant at the 5% and 1% significant level, respectively (p-values of 0.0210 and 0.000).

[48] From Table 3 computing partial effects at the mean TC1 for the 25th quantile, the effect of TC2 on growth is positive and lower (0.133) and the partial effect at the mean TC2 is negative and higher (-1.784), when controlling for firm fixed effects.

These findings indicate that, all else equal, project capabilities (namely investing in preliminary activities and other technical preparatory activities) reinforce other capabilities and foster growth, but at different strengths for firms in different quantiles of the distribution. The complementarity between TC1–TC2 (project and execution) does not always seem significant in this context. This may suggest that these TCs can sometimes act more as substitutes than complements (i.e. once a firm acquires its own internal TCs it no longer seeks them from external sources).

Concerning the *sectoral analysis*, the differential effects of the TCs covariate on the full distribution are significant (with alternate signs) in some quantiles and in some sectors. We observe higher standard errors at the extreme quantiles than at the middle ones[49], probably due to sampling variation, as Tables 5 through 8 provides results for the four selected sectors using firm fixed effects. Sector results without fixed effects are listed in the Appendix B, Tables 4B–7B (available upon request).

For *machinery and equipment* (Table 4 and Table 4B), we find evidence that TC1 and TC3 are statistically significant and negative in the bottom quantiles, and that TC2 is significant and positive across the quantiles (Table 4). Similar to the results for the whole sample, in this case we cannot simply assume that TC2 is positively and significantly related to growth (e.g. the 75th quantile in Table 4B in Appendix B and across all the quantiles when controlling for firm fixed effects in Table 4).

[49] Results for the basic specification for the four selected sectors (OLS and quantile regressions) are available upon request.

If we evaluate complementarities between TC2–TC3 (75th quantile), the partial effect at the mean TC2 (e.g. within the 75th quantile) is negative and statistically significant[50]. This means that external learning capabilities (TC3) and execution capabilities (TC2) act as substitutes for small and young firms in the machinery and equipment sector. Proceeding in a similar fashion we find complementarities between TC1 and TC3. The partial effect at the mean TC3 (e.g. within the 75th quantile) is positive and statistically significant[51]. The effect of complementarities between TC1 and TC3 after controlling for firm fixed effects is still positive, but lower (1.78).

This highlights that, conditional on observables, firms in this sector do not grow if they only design and execute projects internally (at least at an early stage). TC1 fosters growth if it is coupled with external links and knowledge. This suggests that if firms in the machinery and equipment sector want to grow, they need to interact with external sources of knowledge (e.g. cooperate with networks of clients, suppliers, and other strategic partners), an insight that is consistent with the observations of several case studies.[52]

In the *food* sector (Table 5 and Table 5B), our first specification without fixed effects (Table 5B) shows that TCs are only significant for the 25th quantile, with no significant coefficients for the OLS and the rest of the quantiles. Considering complementarities between TC2–TC3 (25th quantile), the partial effect at the mean TC2 is statistically significant[53].

[50] The p-value for the F-test of the joint hypothesis, Ho: TC2=0, TC2–3=0, is almost zero): –1.927 – 27.17 * 0.356 = –11.60 and becomes higher when controlling for fixed effects (–9.75).

[51] The p-value for the F-test of the joint hypothesis, Ho: TC1=0, TC1–3=0, is almost zero): –15.698 – 27.697 * 0.663 = 2.665 they are highly significant and positive.

[52] Analyses done for Brazil support this result. For example, Kaminski et al. (2008) highlight the importance of the involvement of clients and suppliers in long-term, solid relationships with small- and medium-sized firms in São Paolo. Interactions with clients and suppliers generate innovative solutions and strengthen the productive chain in which the firm is inserted.

[53] The p-value for the F-test of the joint hypothesis, Ho: TC2=0, TC2–3=0, is almost zero) and positive: 6.487 – 1.731 * 0.668 = 7.643.

This is not the case for TC1–TC3: evaluating at the mean TC1 and TC3 we obtained significant and negative values (–1.344 and –0.568 respectively), suggesting that projects (TC1) and linkages (TC3) could be substitute capabilities for firms in the food sector.

Given these results, we could conclude that, conditional on observables, firms in this sector do not grow if they concentrate on developing projects internally, but they do grow if they combine execution capabilities (TC2) with appropriate linkages to external knowledge (TC3). Nevertheless, after controlling for firm fixed effects, none of our regressors of interest are statistically significant and TCs do not appear to be a driver for growth.[54] The literature on Brazil's food sector shows that firms looking to boost innovative and complementary assets need to identify the most useful technology strategy and evaluate their own technological possibilities and constraints.[55] Our findings implicitly indicate that, in this sector, firms at an early stage of their life have problems and difficulties in developing the appropriate strategies and assets.

As far as the *chemical* sector is concerned (Table 6 and Table 6B), our results suggest that TCs may spur growth in most quantiles[56]. Results become lower when controlling for firm fixed effects (3.398), and this could be due to attenuation bias. Given the level of technological sophistication and high competition in this sector, as confirmed in the literature[57], firms need external knowledge for complementing project seems appropriate. Also project and execution to benefit from complementarities. Indeed the partial effect of TC1–TC2 evaluated at the mean of

[54] A caveat is that, although fixed effects control for a certain type of omitted variable, they may be subject to attenuation bias (e.g. due to measurement error) or may have lost 'good variation' while removing the bad variation (Angrist and Pischke, 2009).
[55] See the empirical evidence in Cabral and Traill (2001).
[56] For instance, in our first specification (Table 6B) the partial effect of TC1–TC3 at the mean TC1 (e.g. within the 25th quantile) is positive (¬–2.522 + 12.396 * 0.518 = 4.179) and statistically significant (the p-value for the F-test of the joint hypothesis, Ho: TC1=0, TC1–3=0, is almost zero).
[57] For Brazil, one can think of the case of the successful implementation of ethanol, which can be partially attributed to innovation in the sector (de Freitas and Kaneko, 2012).

TC1 remains significant (e.g., for the 75th quantile) and positive (11.542), and smaller with fixed effects (4.05).

Within the *electronics* sector (see Table 7B), the results of our first specifications are statistically significant in terms of TCs[58]. Our regressors of interest lose significance after controlling for firm fixed effects (Table 7); that is, after controlling for the unobserved individual effects of each firm in the electronics sector, TCs do not appear to be a driver for growth. Once again, we confirm the importance of allowing for between-firm differences, because ignoring them could convey misleading results due to confounders. Empirical analysis on this sector in Brazil suggests that, in order to be competitive, firms should focus on a series of dimensions such as cost reduction and the introduction of better products, which may not necessarily be related to TCs in the early stages of firm's life.[59]

5. Conclusions

This paper has examined the role of TCs for small young firm growth. Based on theoretical arguments from prior studies (technological capabilities, dynamic capabilities, resource-based view), we provided empirical evidence that TCs and their complementarities foster the growth of small young firms in Brazil.

This entailed extending previous empirical research that looked at age, size, or innovativeness, as drivers for small and young firm growth. Our empirical contribution was twofold: (a) we investigated the role of TCs as drivers of growth for firms, which are both, small and young (b) we focused on this type of firms within an emerging country such as Brazil.

[58] In terms of partial effects, the magnitude of TC1–TC3 at the mean TC1 (e.g. within the 75th quantile) is positive (–2.36 + 10.787 * 0.7 = 5.191) and statistically significant (the p-value for the F-test of the joint hypothesis, Ho: TC1=0, TC1–3=0, is almost zero).
[59] Ariffin and Figueiredo (2007) provide empirical evidence on these aspects for electronics firms in Manaus.

We found that project design, technical preparatory activities, and quality controls at early stages (what we called project capabilities, or TC1) are fundamental for growth *when they are not undertaken in isolation*. Instead, project capabilities need to be complemented with training, quality certification and the acquisition of new machinery (what we called execution capabilities, or TC2) or with appropriate transfers of technology through licenses and patents and interactions with clients, suppliers, universities, etc. (what we called linkages capabilities, or TC3).

For our econometric analysis, we run OLS and quantiles regressions. Most of the OLS results were statistically insignificant. Instead, differences emerged when analyzing quantile distributions. In addition, we found complementarities between the three types of TCs (project capabilities, execution capabilities, and linkages capabilities). We obtained statistically significant results when evaluating the partial effect of each capability on growth at the mean value of another capability.

The key assumption at this stage was that the most important omitted variable bias is firm-invariant; that is, our estimates of the impact of TCs on growth are conditional on covariates such as innovation, R&D, being domestic, etc. Our second specification included firm fixed effects, allowing us to control for unobserved, idiosyncratic characteristics across firms (i.e. fixed differences between firms). Including fixed effects, results became stronger for the sample that included all sectors.

We also found that in some cases TCs behave more as substitutes than complements. We attempted to pin down the idiosyncratic nature of these relationships (with the corresponding caveats) by capturing all unobserved firm constant factors that affect growth. After making the pertinent caveats about the results obtained using fixed effects, our findings uncovered that firm heterogeneity matters for growth.

We have considered, and analyzed first a whole sample of young and small Brazilian firms and then firms in four sectors: machinery and equipment, food processing, chemicals, and electronics. Our other notable finding is that the role of technological capabilities varies across industries.

For instance, and execution and linkages capabilities behave as substitutes or are irrelevant at different quantiles of the growth distribution within the machinery and equipment sector. This empirical evidence is intuitive and confirmed in case studies. Less obvious was the result that the complementarity between project and linkages capabilities has a negative effect on growth for firms in the food sector (at least at an early stage in the life cycle this seems not a winning strategy for growth). Within the chemical sector, firms behave in a manner consistent with our analysis for all firms. We found that firms within the electronics sector were similar to the machinery and equipment sector: complementarities between project and linkages capabilities helped growth.

Our results provided empirical confirmation to pioneering contributions, which look at capabilities as drivers of growth. We found that TCs matter for small young Brazilian's growth. Future research could aim focusing on whether these capabilities change over the course of the life of a young firm and are still effective for growth.

Given we found evidence that linkages with external actors are relevant for growth, another fruitful avenue for research would be to incorporate information about whether specific local networks and institutions and policies setting can facilitate small young firm growth.

The above discussion also implicitly points to the limitations of the present study. This is a pioneering study, particularly for an emerging economy. In addition to addressing our earlier caveats and remarks about studies that use longitudinal data on firms, future research needs to expand the number of firms examined in each sector and ideally to consider a longer span of time.

References

Acs, Z., and D. Audretsch. 1990. *Innovation and Small Firms.* Cambridge, MA: MIT Press.

Aghion P., C. Harris, P. Howitt and J. Vickers. 2001. Competition, Imitation and Growth with Step-by-Step Innovation. Review of Economic Studies (68), 467-492.

Amsden, A.H., and W. Chu. 2003. *Beyond Late Development: Taiwan's Upgrading Policies.* Cambridge, MA: MIT Press.

Amsden, A.H., and T. Hikino. 1994. "Project execution capability, organizational know-how and conglomerate corporate growth in late industrialization". *Industrial and Corporate Change* 3(1), 111-147.

Angrist, J.D., V. Chernozhukov, and I. Fernandez-Val. 2006. "Quantile regression under misspecification, with an application to the U.S. wage structure". *Econometrica* 74(2), 539-563.

Angrist, J.D., and J.S.Pischke. 2009. *Mostly Harmless Econometrics: An Empiricist's Companion.* Princeton, New Jersey: Princeton University Press.

Ariffin, N., and P.N. Figueiredo. 2007. "Internationalization of innovative capabilities: Counter-evidence from the electronics industry in Malaysia and Brazil". *Oxford Development Studies* 32 (4), 559-583.

Audretsch, D. 1995. *Innovation and Industry Evolution.* Boston, MA: MIT Press.

Autio, E., H. Sapienza and J. Almeida. 2000. "Effects of Age at Entry, Knowledge Intensity, and Imitability on International Growth". Academy of Management Journal 43(5), 909-924.

Barbero, J.L., Casillas, J.C., and H.D. Feldman. 2011. "Managerial capabilities and paths to growth as determinants of high-growth small and medium-sized enterprises". *International Small Business Journal* 29(6) 671-694.

Barney, J.B. 2001. "Resource-based theories of competitive advantage: A ten-year restrospective on the resource-based view". *Journal of Management* 27 (6) 643–650.

Bartelsman, E., S. Scarpetta, and F. Schivardi. 2005. "Comparative analysis of firm demographics and survival: Evidence from micro-level sources in OECD countries". *Industrial and Corporate Change* 14(3), 365-391.

Bell, M., and K. Pavitt. 1993. "Technological accumulation and industrial growth: Contrasts between developed and developing countries". *Industrial and Corporate Change* 2(2), 157-209.

Beesley, M.E., and R.T. Hamilton. 1984. "Small firms' seedbed role and the concept of turbulence". *The Journal of Industrial Economics* 33(2), 217-231.

Bigsten, A., and M. Gebreeyesus. 2007. "The small, the young, and the productive: Determinants of manufacturing firm growth in Ethiopia". *Economic Development and Cultural Change* 55 (4), 813-840.

Bottazzi, G., and A. Secchi. 2006. "Explaining the distribution of firms' growth rates". *Rand Journal of Economics* 37(2), 235-256.

Cabral, J.E.O., and B. Traill. 2001. “Determinants of a firm’s likelihood to innovate and intensity of innovation in the Brazilian food industry”. *Journal on Chain and Network Science* 1(1), 33-48.

Castellacci, F. 2008. “Technological paradigms, regimes and trajectories: Manufacturing and service industries in a new taxonomy of sectoral patterns of innovation”. *Research Policy* 37(6/7), 978-994.

Coad, A. 2009. *The Growth of Firms: A Survey of Theories and Empirical Evidence* (New Perspectives on the Modern Corporation Series). Cheltenham, UK: Edward Elgar Publishing Limited.

Coad, A. 2010. “Exploring the processes of firm growth: Evidence from a vector auto-regression”. *Industrial Corporate Change* 19(6), 1677-1703.

Coad, A., and R. Rao. 2008. “Innovation and firm growth in high tech sectors: A Quantile Regression Approach”. *Research Policy* 37(4), 633-648.

Cohen, W., and Levinthal D. 1990. “Absorptive capacity: A new perspective on learning and innovation”. *Administrative Science Quarterly* 35(1), 128-152.

Cooke, P. 2001. “Regional innovation systems, clusters and the knowledge economy”. *Industrial and Corporate Change* 10(4), 945-74.

Costa, I., and S. Robles Reis de Queiros. 2002. “Foreign direct investments and technological capabilities in Brazilian industry”. *Research Policy* 31(8/9), 1431-443.

Cravo ,T.A., B. Becker, and A. Gourlay. 2015. “Regional growth and SMEs in Brazil: A spatial panel approach”. *Regional Studies* 49(12), 1995-2016.

Davidsson, P. 1991. “Continued entrepreneurship: Ability, need, and opportunity as determinants of small firm growth”. Journal of Business Venturing 6(6), 405-429.

Davidsson, P., L. Achtenhagen and L.Naldi. 2010. “Small Firms Growth”. Entrepreneurship 6(2), 69-166.

Dahlman, C., B. Ross-Larsen, and L.E. Westphal. 1987. “Managing technological development: lessons from the newly industrializing countries”. *World Development* 6(15), 759-75.

De Freitas, L.C., and S. Kaneko. 2012. “Is there a causal relation between ethanol innovation and the market characteristics of fuels in Brazil?” *Ecological Economics* 74, 161-168.

Demir, R., K. Wennberg, and A. McKelvie. 2017. "The strategic management of high-growth firms: a review and theoretical conceptualization." Long Range Planning 50(4), 431-456.

Dosi, G. 2007. “Statistical regularities in the evolution of industries: A guide through some evidence and challenges for the theory”. In *Perspectives on Innovation*, edited by Malerba F., and S. Brusoni. 153-186. Cambridge, UK: Cambridge University Press.

Dosi G. Nelson R. Winter S. 2001. *The nature and dynamics of organizational capabilities.* Oxford, UK: Oxford University Press.

Dunne, P., and A. Hughes. 1994. “Age, size, growth, and survival: UK companies in the 1980s”. *The Journal of Industrial Economics* 42(2), 115-139.

Eisenhardt K.M. and C.B. Schoonhoven. 1990. "Organizational Growth: Linking Founding Team, Strategy, Environment, and Growth Among U.S. Semiconductor Ventures, 1978-1988". *Administrative Science Quarterly* 35 (3), 504-529

Evans, D.S. 1987. "Tests of alternative theories of firm growth". *The Journal of Political Economy* 95(4), 657-674.

Figueiredo, P.N. 2001. *Technological Learning and Competitive Performance*. Edward Elgar: Cheltenham, UK.

Figueiredo, P.N. 2003. "Learning, capability accumulation and firms differences: Evidence from latecomer steel". *Industrial and Corporate Change* 12(3), 607-643.

Figueiredo, P.N. 2008. "Industrial policy changes and firm-level technological capability development: Evidence from Northern Brazil". *World Development* 36(1), 55-88.

Foray, D., 2004. *The Economics of Knowledge.* Cambridge, MA: MIT Press.

Fransman, M., 1985. "Conceptualising technical change in the third world in the 1980s: An interpretive survey". *The Journal of Development Studies* 21(4), 572-652.

Geraci, M., and M. Bottai. 2014. "Linear quantile mixed models". *Statistics and Computing* 24(3), 46–479.

Gereffi, G., J. Humphrey, and T. Sturgeon. 2005. "The Governance of Global Value Chains". *Review of International Political Economy* 12(1), 78-10.

Geroski, P.A. 2000. "The growth of firms in theory and practice". In *Competence, Governance, and Entrepreneurship*, edited by N. Foss and V. Mahnke, 168-186. Oxford: Oxford University Press.

Gilbert, B. A., P.P. McDougall, and D. B. Audretsch. 2006. "New venture growth: A review and extension." Journal of management 32(6), 926-950.

Goedhuys, M., and L. Sleuwaegen. 2010. "High-growth entrepreneurial firms in Africa: A quantile regression approach". *Small Business Economics* 34(1), 31-51.

Goedhuys, M., and R. Veugelers. 2012. "Innovation strategies process and product innovations and growth: Firm-level evidence from Brazil". *Structural Change and Economic Dynamics* 23 (4), 516-529.

Gonsen, R. 1998. *Technological Capabilities in Developing Countries: Industrial Biotechnology in Mexico*. London: Macmillan Press.

Hall, B.H. 1987. "The relationship between firm size and firm growth in the U.S. manufacturing sector". *The Journal of Industrial Economics* 35(4), 583-606.

Hart, P.E., and S.J. Prais. 1956. "The analysis of business concentration: A statistical approach". *Journal of the Royal Statistical Society, Series A* 119(2), 150-191.

Helfat, C. E., Peteraf, M. 2003. "The dynamic resource-based view: Capability lifecycles". *Strategic Management Journal*, 24(10), 997-1010.

Hobday, M. 1995. *Innovation in East Asia: The Challenge to Japan.* Aldershot, England: Edward Elgar.

Jovanovic, B. 1982. "Selection and the evolution of industry". *Econometrica* 50(3), 649–670.

Junqueira Lustosa, M.C. 2011. *Technological Innovation in Brazil. Data Report.* https://www.naurocampos.net/pnbr/papers/Lustosa_data_description.pdf.

Kaplinsky, R. 1990. *The Economics of Small: Appropriate Technology in a Changing World.* London: Intermediate Technology Publications.

Kaminski, P.C., A.C. Oliveira, and T.M. Lopes. 2008. "Knowledge transfer in product development processes: A case study in small and medium enterprises (SMEs) of the metal-mechanic sector from São Paulo, Brazil". *Technovation* 28 (1/2), 29-36.

Katz, J. 1976. *Importación de Tecnología, Aprendizaje e Industrialización Dependiente*. México; Fondo de Cultura Económica.

Katz, J. ed. 1987 *Technology Generation in Latin American Manufacturing Industries.* London: Macmillan Press.

Kim, L. 1980. "Stages of development of industrial technology in a developing country: A model". *Research Policy* 9 (3), 254-277.

Kim, L. 1997. *Imitation to Innovation: The Dynamics of Korea's Technological Learning.* Boston, MA: Harvard Business School Press.

Koenker, R., and G. Basset. 1978. "Regression quantiles". *Econometrica* 46(1), 33-50.

Koenker, R., and K.F. Hallock. 2001. "Quantile regression". *Journal of Economic Perspectives.* 15(4), 143-156.

Kotha, R., Y. Zheng, and G. George. 2011. "Entry into new niches: the effects of firm age and the expansion of technological capabilities on innovative output and impact". Strategic Management Journal 32(9), 1011-1024.

Lall, S. 1987. *Learning to Industrialize: The Acquisition of Technological Capability by India.* London: Macmillan.

Lall, S. 1992. "Technological capabilities in industrialization". *World Development* 20(2), 165-186.

Lall, S. 2000. "The Technological Structure and Performance of Developing Country Manufactured Exports, 1985-98". *Oxford Development Studies* 28(3), 337-369.

Lee, K. 2011. "Making a technological catch-up: Barriers and opportunities". *Asian Journal of Technology Innovation* 13(2), 97-131.

Lee, K. 2013. *Schumpeterian Analysis of Economic Catch-up: Knowledge, Path-creation, and the Middle-Income Trap.* London: Cambridge University Press.

Lee, K., and C. Lim. 2001. "Technological regimes, catching up, and leapfrogging: Findings from the Korean industries". *Research Policy* 30(3), 459-483.

Lundvall, B.A. 2007. "National innovation systems—Analytical concept and development tools". *Industry and Innovation* 14(1), 95-119.

Lugones, G., and D. Suarez. 2007. "National innovation systems in Brazil and Argentina: Key variables and available evidence". In *Technological Innovation in Brazilian and Argentine Firms*, edited by DeNegri, J., and L.M. Turchi, 147-176. Brasilia: IPEA.

Malerba, F. 2002. “Sectoral systems of innovation and production”. *Research Policy* 31(2), 247-264.

Malerba, F. 2004. *Sectoral Systems of Innovation.* Cambridge, UK: Cambridge University Press.

Malerba, F., and L. Orsenigo. 1999. “Technological entry, exit, and survival: An empirical analysis of patent data”. *Research Policy* 28(6), 643-660.

Malerba, F., and S. Mani. 2009. *Sectoral Systems of Innovation and Production in Developing Countries.* Cheltenham, UK: Edward Elgar Publishing.

Malerba, F., and R. Nelson. 2011. “Learning and catching up in different sectoral systems: Evidence from six industries”. *Industrial and Corporate Change* 20(6), 1645-1675.

Mata, J. 1994. “Firm growth during infancy”. *Small Business Economics* 6(1), 27-39.

Mathews, J.A. 1996. “High technology industrialization in East Asia”. *Journal of Industry Studies*, 3(2), 1-77.

Mathews, J.A. 2002. “Competitive advantages of the latecomer firm: A Resource-based account of industrial catch-up strategies”. *Asia Pacific Journal of Management* 19(4), 467-488.

Molina, M.A., and C. Pietrobelli. 2012. “Drivers of technological capabilities in developing countries: An econometric analysis of Argentina, Brazil and Chile”. *Structural Change and Economic Dynamics* 23(4), 504-515.

Morrison, A., C. Pietrobelli, and R. Rabellotti. 2008. “Global value chains and technological capabilities: A framework to study learning and innovation in developing countries”. *Oxford Development Studies* 36(1), 39-58.

Mowery, D., and R. Nelson, eds. 1999. *Sources of Industrial Leadership.* Cambridge, UK: Cambridge University Press.

Nelson, R. 2008. “Economic development from the perspective of evolutionary economic theory”. *Oxford Development Studies* 36(1), 9-21.

Nelson, R., and S. Winter. 1982. *An Evolutionary Theory of Economic Change*. Cambridge, MA: Belknap Press.

Nelson, R., and H. Pack. 1999. “The Asian miracle and modern growth theory”. *The Economic Journal* 109, 416-436.

Nichter S. and L. Goldmark. 2009. “Small Firm Growth in Developing Countries”. World Development 37(9), 1453-1464.

Oriani R, and M. Sobrero. 2008. “Uncertainty and the Market Valuation of R&D within a Real Options Logic”. *Strategic Management Journal* 29(4), 343–361.

Pesquisa Industrial de Inovação Tecnologica (Pintec), 2000, 2003, 2005 and 2008. Processo 03605.000364/2009-15. Instituto Brasileiro de Geografia e Estatistica, Rio de Janeiro.

Phillips, B.D., and B.A. Kirchhoff. 1989. “Formation, growth, and survival: Small firms’ dynamics in the U.S. economy”. *Small Business Economics* 1(1), 65–74.

Pires, J.C., T. Cravo, S. Lodato, and C. Pizac. 2013. “Industrial clusters and economic performance in Brazil”. IBD Working Paper Series 475, Inter-American Development Bank, Washington.

Rao, J.N.K., and C.F.J. Wu. 1988. "Resampling inference with complex survey data". *Journal American Statistics Association* 83(401), 231-241.

Romijn, H. 1997. "Acquisition of technological capabilities in development: A quantitative case study of Pakistan's capital goods sector". *World Development* 25(3), 359-377.

Rui, H., A. Cuervo-Cazurra and C. Annique Un. 2016. Learning-by-doing in emerging market multinationals: Integration, trial and error, repetition, and extension. *Journal of World Business* 51, 686–699.

Sapienza H., E. Autio, G. George and S.A. Zahra. 2005. "A Capabilities Perspective on the Effects of Early Internationalization on Firm Survival and Growth". *The Academy of Management Review* 31(4), 914-933.

Schneider, C., and R. Veugelers. 2010. "On young highly innovative companies: Why they matter and how (not) to policy support them". *Industrial and Corporate Change* 19(4), 969-1007.

Schumpeter, J. 1934. *The Theory of Economic Development.* Cambridge, MA: Harvard University Press.

Schmiedeberg C. 2008. "Complementarities of innovation activities: An empirical analysis of the German manufacturing sector". *Research Policy* 37(9), 1492-1503.

Stam E. and K. Wennberg. 2009. "The roles of R&D in new firm growth". *Small Business Economics* 33(1), 77-89.

Suzigan, W., J. Furtado, and R. Garcia. 2007. "Designing policies for local production systems: A methodology based on evidence from Brazil". http://www.anpec.org.br/encontro2005/artigos/A05A129.pdf

Teece, D.J., G. Pisano and A. Shuen. 1997. "Dynamic capabilities and strategic management". *Strategic Management Journal,* 18(7), 509-533.

Teece, D. J. 2007. "Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance". *Strategic Management Journal*, 28(13), 1319-1350.

Teece, D. J. 2012. "Dynamic Capabilities: Routines versus Entrepreneurial Action". *Journal of Management Studies* 49 (8), 1395-1401.

Topkis, D.M. 1998. *Supermodularity and Complementarity*. Princeton, New Jersey: Princeton University Press.

Veugelers, R. 2009. A lifeline for Europe's young radical innovators. Bruegel Policy Brief 1, Bruegel, Belgium.

Wignaraja, G. 2002. "Firm size, technological capabilities, and market-oriented policies in Mauritius". *Oxford Development Studies* 30(1), 87-104.

Wignaraja, G. 2008. "Foreign ownership, technological capabilities, and clothing exports in Sri Lanka". *Journal of Asian Economics* 19(1), 29-39.

Winter, S. G. 2003. "Understanding dynamic capabilities". *Strategic Management Journal*, 24, 991–5.

TABLE 1. Descriptive Statistics of Sales and Growth by Firm Size (Entire Population)

Number of employees	Total	10 to 29	30 to 49	50 to 99	100 to 249	250 to 499	> 500
2003 Number of firms	20.598	11.916	3.051	2.413	1.656	650	912
Sales 2003	953.705,43	39.174,35	28.472,80	54.914,20	105.090,68	107.263,84	618.789,56
2005 Number of firms	21.905	12.037	2.664	2.837	2.300	981	1.086
Sales 2005	1.217.445,46	52.276,66	33.537,11	62.568,27	117197,80	124.559,54	827.306,07
2008 Number of firms	33.034	20.093	4.576	3995	2.288	880	1.202
Sales 2008	1.896.136,04	75.253,63	53.112,36	97.101,95	171.460,57	183.308,55	1.315.898,97
% 2003-2005 Sales Growth	27.65%	33.45%	17.79%	13.94%	11.52%	16.12%	33.70%
% 2005-2008 Sales Growth	55.75%	43.95%	58.37%	55.19%	46.30%	47.17%	59.06%
% 2003-2008 Sales Growth	98.82%	92.10%	86.54%	76.82%	63.15%	70.90%	112.66%

Notes: All sales are expressed in R$ (1000) and deflated with the appropriate Consumption Price Index (Índice Nacional de Preços ao Consumidor Amplo, IPCA - IBGE), base 2003.
Source: Authors' elaboration based on Pintec (Pesquisa de Inovação Tecnólogica) 2003, 2005, and 2008 IBGE website.

TABLE 2. OLS and QR (10%, 25%, 50%, 75%, and 90% quantiles) - S&Y - All Sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	OLS	OLS	0.10 Q	0.10 Q	0.25 Q	0.25 Q	0.50 Q	0.50 Q	0.75 Q	0.75 Q	0.90 Q	0.90 Q
Project Capab.	0.172	-1.661	-0.569	-1.572	-0.220	-1.976**	-0.220*	-0.978*	0.180	-0.732	1.298**	-0.423
	-0.289	-1.267	-0.304	-1.417	-0.195	-0.297	-0.126	-0.572	-0.271	-1.120	-0.542	-2.146
Execution Capab.	0.070	1.223	0.163	-2.500	0.233	1.155	0.202*	0.588	-0.107	1.221	-0.280	3.726
	-0.255	-1.471	-0.268	-1.645	-0.172	-0.919	-0.111	-0.664	-0.238	-1.301	-0.476	-2.492
Ext.Learn. Capab.	-0.339	-1.851***	-0.550	-1.200*	-0.119	-1.099***	-0.173	-0.749***	0.287	-0.941*	-0.275	-2.118*
	-0.268	-0.648	-0.283	-0.725	-0.181	-0.147	-0.118	-0.292	-0.252	-0.573	-0.504	-1.097
Project_Execut	---	-2.1*	---	2.018	---	-0.986***	---	-0.783*	---	-3.125***	---	-5.847**
	---	-1.295	---	-1.448	---	-0.809	---	-0.584	---	-1.145	---	-2.194
Execut_Ext Learn.	---	-0.700	---	2.225	---	-0.761	---	-0.312	---	-0.345	---	-2.368
	---	-1.672	---	-1.870	---	-1.045	---	-0.754	---	-1.479	---	-2.832
Project_Ext Learn.	---	4.08**	---	0.190	---	3.014**	---	1.727***	---	3.394**	---	6.288*
	---	-1.912	---	-2.138	---	-1.194	---	-0.862	---	-1.690	---	-3.237

Source: Authors' elaboration based on Pintec 2000, 2003, 2005, and 2008.
*Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. Observations: 786. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 768.*

TABLE 3. Fixed Effects - OLS and QR (10%, 25%, 50%, 75%, and 90% quantiles) - S&Y - All Sectors

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	0.10 Q	0.25 Q	0.50 Q	0.75 Q	0.90 Q
Project Capab.	-1.279	-0.564	-1.524	-1.076	-1.365	-0.519
	(0.768)	(0.994)	(0.827)	(0.79)	(1.009)	(1.596)
Execution Capab.	1.844	0.451	0.884	1.233	0.544	1.073
	(1.021)	(1.314)	(0.98)	(0.993)	(1.061)	(1.379)
Ext.Learn. Capab.	-1.877**	-2.144**	-1.67**	-1.103**	-1.801**	-1.984**
	(0.415)	(0.688)	(0.502)	(0.397)	(0.49)	(0.674)
Project_Execut	-3.038**	-2.219*	-1.668*	-1.912**	-1.583*	-3.233*
	(0.852)	(0.867)	(0.592)	(0.684)	(0.962)	(1.186)
Execut_Ext Learn.	-0.788	0.560	-0.373	-0.379	-0.250	-0.165
	(1.171)	(1.424)	(1.068)	(1.061)	(1.068)	(1.442)
Project_Ext Learn.	3.951**	2.955*	3.443**	2.644*	3.647**	3.82*
	(1.151)	(1.474)	(1.260)	(1.221)	(1.324)	(1.973)

Source: Authors' elaboration based on Pintec 2000, 2003, 2005, and 2008.
*Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 768.*

TABLE 4.: Fixed Effects - OLS and QR (10%, 25%, 50%, 75% and 90% quantiles) S&Y - Machinery and Equipment Sector

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	0.10 Q	0.25 Q	0.50 Q	0.75 Q	0.90 Q
Project Capab.	-3.419	-16.116***	-12.968***	-13.975***	-14.542***	-16.018***
	(2.960)	(2.795)	(2.639)	(2.813)	(2.879)	(3.018)
Execution Capab.	5.266	19.016***	17.387***	16.486***	17.862***	15.885***
	(2.416)	(3.891)	(3.775)	(3.807)	(3.923)	(4.101)
Ext.Learn. Capab.	-0.659	-3.371**	-3.555**	-2.563*	-2.390	-2.468
	(1.672)	(1.462)	(1.392)	(1.382)	(1.601)	(2.046)
Project_Execut	-0.637	-6.412***	-5.970**	-4.917***	-4.576**	1.122
	(2.118)	(2.115)	(2.289)	(2.231)	(2.235)	(2.603)
Execut_Ext Learn.	-8.251**	-21.287***	-21.917**	-21.998***	-20.66***	-19.076***
	(1.614)	(4.653)	(4.4648)	(4.624)	(4.653)	(4.628)
Project_Ext Learn.	7.231	22.903***	23.469***	24.646	24.615***	23.974***
	(4.634)	(4.649)	(4.305)	(4.454)	(4.248)	(4.391)

Source: Authors' elaboration based on Pintec 2000, 2003, 2005, and 2008.

*Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 97.*

TABLE 5. Fixed Effects - OLS and QR (10%, 25%, 50%, 75% and 90% quantiles) S&Y - Food Sector

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	0.10 Q	0.25 Q	0.50 Q	0.75 Q	0.90 Q
Project Capab	-3.787	0.613	-0.326	0.215	0.622	-0.034
	(2.441)	(2.907)	(2.759)	(2.939)	(2.977)	(3.509)
Execution Capab	4.732	2.852	3.417	2.313	3.478	4.982
	(3.677)	(2.22)	(2.264)	(2.305)	(2.581)	(2.717)
Ext.Learning Capab	0.073	-0.687	-0.629	-0.751	-0.877	-0.269
	(0.946)	(1.28)	(1.178)	(1.296)	(1.392)	(2.112)
Project_Execut	1.241	-5.097	-3.018	-3.878	-5.833*	-1.098
	(2.067)	(3.117)	(2.999)	(3.050)	(2.932)	(3.348)
Execut_Ext Learn	-4.773	-0.383	-1.597	0.151	0.166	-1.724
	(2.752)	(2.539)	(2.549)	(2.586)	(2.815)	(2.997)
Project_Ext Learn	1.395	-0.115	1.393	1.420	2.218	1.153
	(1.780)	(4.282)	(4.213)	(4.094)	(4.085)	(4.818)

*Source: Author's elaboration based on Pintec (Pesquisa de Inovação Tecnólogica) 2000, 2003, 2005 and 2008. Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 78.*

TABLE 6. Fixed Effects - OLS and QR (10%, 25%, 50%, 75%, and 90% quantiles) S&Y - Chemicals Sector

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	0.10 Q	0.25 Q	0.50 Q	0.75 Q	0.90 Q
Project Capab	-0.043	-0.713	-1.649	-1.645	-1.233	-0.950
	(1.3667)	(2.830)	(2.785)	(2.873)	(2.975)	(3.116)
Execution Capab	2.346	6.870	8.224	7.813	7.571	8.264
	(7.636)	(5.068)	(5.006)	(5.004)	(4.942)	(5.642)
Ext.Learning Capab	-1.559	-1.347	-0.883	-1.403	-1.713	-1.150
	(2.408)	(1.503)	(1.522)	(1.627)	(1.498)	(1.785)
Project_Execut	-5.061	-6.863	-6.963	-6.952*	-6.797*	-7.599
	(2.213)	(3.877)	(3.863)	(3.777)	(3.603)	(4.713)
Execut_Ext Learn	-1.702	-7.960	-8.180*	-7.731	-7.770	-7.758
	(8.064)	(5.894)	(5.896)	(5.882)	(5.946)	(6.103)
Project_Ext Learn	4.862*	8.054**	8.265**	7.767*	7.395*	6.531
	(1.2)	(3.980)	(3.971)	(3.994)	(3.989)	(4.415)

*Source: Author's elaboration based on Pintec (Pesquisa de Inovação Tecnólogica) 2000, 2003, 2005 and 2008. Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 48.*

TABLE 7. Fixed Effects - OLS and QR (10%, 25%, 50%, 75%, and 90% quantiles) S&Y- Electronics Sector

	(1) OLS	(2) 0.10 Q	(3) 0.25 Q	(4) 0.50 Q	(5) 0.75 Q	(6) 0.90 Q
Project Capab	0.799	-1.031	-1.296	-1.811	-4.082	-2.437
	(9.300)	(3.896)	(3.689)	(3.467)	(3.272)	(3.693)
Execution Capab	4.449	3.817	3.405	2.572	4.278	1.977
	(0.502)	(4.037)	(4.073)	(4.279)	(4.170)	(4.468)
Ext.Learning Capab	2.058	-2.885	-2.977	-2.115	-2.261	-2.296
	(6.963)	(3.209)	(2.927)	(2.819)	(2.685)	(2.770)
Project_Execut	-1.091	-3.417	-4.338	-3.793	-2.968	0.358
	(2.587)	(3.893)	(3.677)	(3.420)	(3.545)	(3.819)
Execut_Ext Learn	-1.013	0.048	-1.086	-1.304	-3.686	-2.790
	(3.217)	(5.259)	(5.210)	(5.129)	(4.779)	(5.401)
Project_Ext Learn	-1.759	3.007	4.678	4.671	7.514	4.101
	(12.767)	(5.376)	(5.119)	(5.086)	(4.773)	(5.727)

*Source: Author's elaboration based on Pintec (Pesquisa de Inovação Tecnólogica) 2000, 2003, 2005 and 2008. Notes: * Significant at 10%, ** significant at 5%, *** significant at 1%. All regressions control for Innovation, R&D, Domestic, Age, Size, Regions, Sectors and Years. Number of observations: 55.*