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Abstract

All the arguments regarding the difficulty of using external finance for R&D should apply most strongly to small firms, because such firms have access to a narrower range of capital instruments. However virtually all the empirical evidence linking liquidity constraints inversely to firm size has been restricted to the United States, the United Kingdom and a few other countries A good justification for that are the common features of the Anglo-Saxon financial system of those countries often described as "market-based". Therefore we may construct different expectations about the relation between liquidity constraints and firm size in countries with a "bank-based" financial system. The purpose of this paper is to test the hypothesis of an inverse relationship between firm size and liquidity constraints in the Portuguese manufacturing industry. The results indicate that firm size is not relevant for liquidity constraints even though the total sample shows a great dependence from internal liquidity.

JEL Classification: L13; L11; L20

Key words: R&D; Liquidity constraints; Size effects; Panel data

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I – INTRODUCTION

In a frictionless economy where the Modigliani-Miller theorem holds, the financing pattern does not matter for a firm's value or its investment decisions. However, in the presence of capital market imperfections resulting from information asymmetries and agency costs, internal funds are often less costly than external funds. Myers and Majluf (1984) stressed that equity rising is very costly since less informed market participants correctly anticipate that managers acting for existing shareholders are willing to issue new shares when they are overvalued. Similar problems can be found in debt finance. Managers maximizing the welfare of shareholders have incentives to engage in excessively risky investment projects from the creditor' point of view, which make debt finance more costly by an increase in its premiums, which may further attract riskier firms (adverse selection) and thus introduce credit constraints (STIGLITZ and WEISS, 1981). Thus, the availability of internal funds as well as firms' opportunities may be an important determinant for their investment behaviour.

As is stressed by Bond *et al*. (1999: 2) there are good reasons to believe that some types of investment are more likely to be subject to financial constraints than others. Investments in intangible assets tend to be both riskier and harder to collateralise than investments in fixed assets and they may therefore be more prone to financing constraints. The very act of looking for outside support for an R&D project could leak information to rivals (mainly in high tech sectors) and therefore reduce the prospective value of innovation. All the arguments regarding the difficulty of using external finance for R&D should apply most strongly to small firms, because such firms have access to a narrower range of capital instruments, and are less likely to be able to trade off externally financed physical investment and R&D at the margin. This is also consistent with the Fazzari *et al*. (1988) empirical findings that liquidity constraints tend to be more binding as firm size decreases.

However virtually all the empirical evidence linking liquidity constraints inversely to firm size has been restricted to the United States, the United Kingdom and a few other countries (AUDRETSCH and ELSTON, 2002:2). A good justification for that stylised fact are the common features of the Anglo-Saxon financial system of those countries often described as "market-based" – the most important one's characteristic is the relative highest size of stock markets (the ratio of market capitalization to GDP). Therefore we may construct different expectations about the relation between liquidity constraints and firm size in countries with a "bank-based" financial system – which dominant characteristic is the highest relative size of banking system (in terms of domestic assets of deposit money banks) (TSURU, 2000:37).

The purpose of this paper is to test the hypothesis of an inversely relation between firm size and liquidity constraints in the Portuguese manufacturing industry. We do this by examining investment and R&D behaviour across firm size using Accelerator and Error Correction investment models. We use an unbalanced panel of 263 innovative firms (firms with positive R&D expenses) with data for the period 1993 to 1999. In the second section we introduce some considerations about the relation of firm size, liquidity constraints and investment and R&D behaviour and try to discuss some characteristics of the Portuguese financial system relevant for the prediction of results different from the "market-based" model. In the third section we describe the Accelerator and the Error Correction models of investment and how we can use it to analyse the role of financial constraints. In the fourth section we describe our data and in the fifth we make use of a regression model to estimate investment and R&D behaviour of our firms' sample. In the last section some conclusions are presented. The results indicate that firm size is not relevant for liquidity constraints even though the total sample shows a great dependence from internal liquidity. This refutes the hypothesis that under the Portuguese financial system, only the smallest firms tend to be disadvantaged in terms of access to funds.

II – FIRM SIZE, INVESTMENT, R&D AND FINANCIAL CONSTRAINTS

One of the many assumptions upon which many of the results in the literature on capital market imperfections rest is the assumption of asymmetric information. When firms possess more information about the quality of an investment project than potential investors, or when firm can control variables which are not observable to the investor but which affect the return to the project, capital markets will be inefficient. Such conditions are most likely to be satisfied by firms devoting resources to innovation. The production of an innovation is more difficult to predict from observable inputs than is the production of most other types of output.

Under the assumption that managers have an informational advantage over investors regarding the quality of potential investment projects the firms may undertake, Myers and Majluf (1984) show that equity markets will be inefficient. Given this disadvantage, the market requires all firms to issue equity at a discount. The discount can imply such a heavy dilution of the existing shareholders stake in the existing assets of the firm that it is not in their interest to undertake a profitable project. Stiglitz and Weiss (1981) show that asymmetric information leads to similar outcomes in debt markets. Again the key assumption in this model is that the market is at an informational disadvantage vis-à-vis the firm regarding the quality of the investment project for which debt finance is being sought. Creditors react to excess demand by rationing some borrowers rather than by raising interest rates. Raising interest rates increases riskiness of the average investment project in the pool of credit applicants because applicants with safe projects drop out. Once again in equilibrium profitable projects will be forgone.

An inherent part of an R&D project is the accumulation of knowledge. Knowledge is a public good, and the existence of patent systems is typically justified as a mechanism whereby firms invest in knowledge capital to protect their investment. However, patents work only imperfectly and managers believe that informal methods of protecting knowledge capital may be more efficient than patents. Innovative firms clearly possess intellectual property which is unprotected by patents and which has an important impact on the value of its investment projects. Such property cannot be appropriated by another party, because it is specific and it is inalienable property of the firm.

Hart and Moore (1994) have shown that, even in a model of debt with full information, profitable projects will be forgone. The results of this model rest upon two assumptions: first, that the entrepreneur possess an asset which a creditor is unable to appropriate, and second, that this inalienable asset affect the value of assets that can be appropriated (i.e. the firm's collaterisable assets). The threat that the entrepreneur may withdraw the inalienable asset from the production process can limit the debt capacity of the firm below the cost of the investment project. Therefore, whether or not such an investment project is undertaken depends upon the amount of internal finance available to the entrepreneur.

Even if innovative firms could mitigate the effect of capital market imperfections by, for example, revealing some of their knowledge capital to parties outside the firm, doing so may not be optimal. Secrecy is also an important way for firms to protect their intellectual property, particularly for process innovations. Indeed, the importance of leading time over rivals suggests that revealing information may reduce the value of innovation. Bhattacharya and Ritter (1983) and Horstmann, MacDonald and Slavinski (1985) present theoretical models in which it is not optimal for a firm to reveal all of its information, either through a third party such as a financial intermediary, or through patenting its innovations.

These theoretical arguments imply that internal funds will be an important source of finance for innovative firms. However, to what extent will firms be able to separately finance investment projects other than R&D projects? Firms that conduct R&D typically produce the product innovations and implement the process innovations, which are the corresponding outputs of the firms R&D input. Hence, the firm's innovations will affect the returns to its physical capital, and the returns to investment in new physical capital will depend upon firm's future innovations. It is therefore unlikely that firms will be able to separately finance R&D projects and physical investment projects due to the interdependence.

There are convincing arguments in favour of the thesis according to which liquidity constraints become more severe as firms size decreases. The amount of information about a firm is generally not neutral with respect to size. As is stressed by some authors (AUDRETSCH and ELSTON, 2002: 4) small and young firms are most likely to face credit rationing and most potential lenders have little information on the managerial capabilities or investment opportunities of such firms and are likely to be able to screen out poor credit risks or to have control over a borrower's investment. The existence of asymmetric information prevents the suppliers of capital from engaging in price discrimination between riskier and less risky borrowers and so credit rationing will emerge.

Fazzari *et al*. (1988) found that smaller publicly traded firms in United States face liquidity constraints and in particular experience difficulties during periods of macroeconomic downturns. The same conclusions can be quoted from other empirical tests in countries like United Kingdom or other countries with an Anglo-Saxon institutional tradition. That is, the likelihood of a firm experiencing a liquidity constraint decreases along with increasing size. However, some recent studies have suggested that the institutional structure of Germany or of Italy or other Continental European countries, based on undeveloped stock markets and on the prevalence of banking system, precludes the same pattern of liquidity constraints from occurring.

Under the "market-based" financial system (for example the US financial system) a large number of liquid and thick financial markets (stock markets and corporate bond markets) provide wide-ranging financial instruments required by different economic agents. An arm's length relationship is akin to spot transactions, more short-term and less control-oriented. Financiers are protected only by explicit contracts. Thus, the system relies much more on legal enforcement and this means that financiers have strong incentives to intervene only at the stage of liquidation. To facilitate the relationship, financial markets need to be competitive, liquid and thick. In addition, public information and disclosure requirements are more important and necessary to ensure legal enforcement and achieve allocation efficiency.

The "bank-based" system ensures a return to the financier by giving him some control power over the firm being financed. Such power can arise from being a larger shareholder or a major lender to the firm (Japanese main bank system and German house bank system are good examples). Monitoring functions could be integrated in a single bank, which is involved in all three monitoring stages: the ex-ante selection of clients and investment projects, the monitoring of the projects on an ongoing basis, and intervention in case of poor management performance. The relationship between financiers and firms is long term, supported by implicit self-enforcement contracts that can well reduce informational asymmetries and thus agency costs. This relationship is consistent with a less competitive environment including some entry barriers.

In the real world, however, such a dichotomy of financial systems is much too simple and in practice the two types of financial systems coexist in the same country, although their relative importance is different across countries. In Japan, capital markets are much more developed than in Germany or France, although these three countries are basically considered to have relationship based financial systems. In addition, relationship based financing prevails even in the United States for small businesses. Given these differences in the characteristics of the financier-firm relationship, both systems have advantages and disadvantages.

Based on the above analysis, Portugal can be classified into the “bank-based system” jointly with the French-origin OECD countries (Belgium, France, Greece, Italy and Spain). According with the specific characteristics of the Portuguese financial system, based on an undeveloped stock market compared not only to the US, but to some extent, other large European countries as well, and according with an industrial structure which includes a relatively large number of small and medium sized firms, we may expect a complex dependence on internal funds by small and large firms. This complexity is reinforced in the presence of a concentrated ownership (absence of ownership dispersion) and control (absence of separation between ownership and control) even of large firms that gives an active interest of its family owners in the day-to-day operations of the typical firm.

Like other Continental European countries, the stock market is not an important source of finance and ownership is concentrated among quoted and not-quoted firms in Portugal. Audretsch and Elston (2002: 2), for example, say that German institutional structure has, among other features, financial intermediaries that have close long-term relations to German firms in a way that do not exist in other countries such as United States. And as Carpenter and Rondi (2001: 8) stress “many other industrialized countries (Belgium, Germany, Denmark, etc) share the Italian model of corporate governance to a limited degree (Becht and Roell, 1999)” based on ownership and control that are not typically at the same arms-length relationship found in Anglo-Saxon economies. We are trying to understand in what way some of those institutional characteristics influence the conduct of manufacturing firms in the Portuguese economy.

III – ECONOMETRIC METHODOLOGY

The empirical tests in this paper focus principally on one main hypothesis. We argue that innovative small firm's investment and R&D should be financially constrained and this means that firm size may be inversely correlated with internal funds. We argue that small and young innovative firms should face financing constraints because they have not developed relationships with lenders and because they face the idiosyncratic risk associated with small scale. Small and young firm's investment and R&D should display a relatively larger sensitivity to changes in their internal finance flows than large firms.

To test our hypothesis we use two different models. The first has the following accelerator investment specification

$$\frac{I_{i,t}}{K_{i,t-1}} = \sigma^I \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_1{}^I \Delta Y_{i,t} + \beta_2{}^I \Delta Y_{i,t-1} + \beta_3{}^I \frac{CF_{i,t}}{K_{i,t-1}} + \beta_4{}^I \frac{CF_{i,t-1}}{K_{i,t-2}} + d_t{}^I + \eta_i{}^I + \varepsilon_{i,t}{}^I$$

where *i* indexes firms and *t* time (see Bond, Elston, Mairesse, and Mulkay (1997) and Harhoff (1998) for details). The firm's investment scaled by its beginning of the period capital stock is represented by $\frac{I}{K}$, and ΔY represents the variation in firm's sales. Using lagged investment captures some of the dynamics of the investment decision and sales variation captures accelerator effects that may influence investment. $\frac{CF}{K}$ is firm's cash flow computed as funds available for investment and R&D spending, i.e., as net income plus depreciation plus R&D expenditures and is a proxy for the flow of internal finance. We also include a set of time dummies represented by *d*, which remove the influence of common cyclical variation and macroeconomic conditions in the data, including the variation in the user cost of capital; the fixed firm specific factors are represented by η and the remaining disturbance effect is represented by ε.

Corresponding R&D equation can be derived in the same way by treating R&D and investment symmetrically. Thus we have

$$\frac{R_{i,t}}{C_{i,t-1}} = \sigma^R \frac{R_{i,t-1}}{C_{i,t-2}} + \beta_1{}^R \Delta Y_{i,t} + \beta_2{}^R \Delta Y_{i,t-1} + \beta_3{}^R \frac{CF_{i,t}}{C_{i,t-1}} + \beta_4{}^R \frac{CF_{i,t-1}}{C_{i,t-2}} + d_t{}^R + \eta_i{}^R + \varepsilon_{i,t}{}^R$$

where $R_{i,t}$ denotes the firm's R&D expenditures and $C_{i,t-1}$ is the respective knowledge capital stock. Here we adopt the "steady state" approximation, as is described by Bond *et. al*. (1999: 17), to compute the R&D capital stock. Using lagged investment and R&D captures some of the dynamics of these variables and sales variation captures accelerator effects.

One problem with this specification is linked with the difficulty in capturing firms' expectation of future profitability. Modelling expectations is notoriously difficult. But to the extent that expectations about future profits are correlated with current cash flow, failure to control for them may result in a biased estimate for cash flow. Many investment studies conducted with US or UK data have used stock prices to construct a proxy for Tobin's Q. The use of Tobin's Q allows researchers to avoid explicitly modelling expectations by arguing that they are embedded in stock prices, which are forward looking. Unfortunately only a little portion of Portuguese's economy manufacturing firms is quoted in the stock market and we are not able to apply such a model.

An alternative approach is to nest the accelerator model in a an error correcting specification for investment

$$\frac{I_{i,t}}{K_{i,t-1}} = \sigma^I \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_1{}^I \Delta Y_{i,t} + \beta_2{}^I \Delta Y_{i,t-1} + \theta^I (\mathrm{k}_{\mathrm{i,t-2}} - y_{i,t-2}) + \beta_3{}^I \frac{CF_{i,t}}{K_{i,t-1}} + \beta_4{}^I \frac{CF_{i,t-1}}{K_{i,t-2}} + \\ + d_t{}^I + \eta_i{}^I + \varepsilon_{i,t}{}^I$$

and for R&D

$$\frac{R_{i,t}}{C_{i,t-1}} = \sigma^R \frac{R_{i,t-1}}{C_{i,t-2}} + \beta_1{}^R \Delta Y_{i,t} + \beta_2{}^R \Delta Y_{i,t-1} + \theta^R (c_{i,t-2} - y_{i,t-2)}) + \beta_3{}^R \frac{CF_{i,t}}{C_{i,t-1}} + \beta_4{}^R \frac{CF_{i,t-1}}{C_{i,t-2}} + \\ + d_t{}^R + \eta_i{}^R + \varepsilon_{i,t}{}^R$$

The long run properties of the models are quite different. While the long-run properties of accelerator model depend on the parameters, σ, β_1, β_2 the long-run properties of the error correction model depend only on the form of the error correction mechanism ($k_{i,t-2} - y_{i,t-2}$). Error correcting behaviour requires $\theta < 0$, so that a capital stock above the desired level is associated with lower future investment or R&D, and vice versa (BOND *et. al.*, 1997: 5).

It is well known that significant coefficients on the cash flow variables in this type of model cannot be interpreted directly as evidence of financial constraints. Therefore many studies focussed on differences in the coefficients on financial variables between different sub-samples of firms. For this reason we will emphasize differences in the results on the cash flow coefficients between small and large manufacturing firms of the Portuguese economy using OLS, Within Groups and GMM estimators.

IV – DATA AND SUMMARY STATISTICS

The database that we use in this study has been constructed by the Portuguese Central Bank and is composed of about 15000 firms from all sectors of the Portuguese economy. We selected an unbalanced panel of 263 firms and 1202 observations covering the years 1993 to 1999 in the manufacturing industry. Firms were selected according with the criterion of having positive R&D expenses in not less than three consecutive years during the period under consideration. We partitioned the sample according with the exogenous criteria of size. Using the European Union tradition firms with less than 250 employees were considered Small and Medium Enterprises and the others are Large Enterprises. Table 1 shows the distribution of firms by size and sector.
We can see that SME are predominant in all sectors with the exception of Petroleum and Paper and in Electrical Machinery and Professional Goods there are only small firms in our sample. This is in accordance with the Portuguese industrial structure including a relatively large number of small and medium sized firms.
Table 2 presents means, medians, standard errors and the inter-quartile ranges of the most important variables. The firm's mean employment is less than 250 confirming the relevance of SME in our sample. According with the values of Standard Errors R&D is more volatile than physical investment.

V – EMPIRICAL RESULTS

Our main hypothesis is that innovative small firm's investment, R&D should be financially constrained, and this means that firm size may be inversely correlated with internal funds. As was stressed in section 3 of this paper, we shall use the Accelerator and the Error Correction models specification and report the OLS levels, Within Groups and GMM first differences estimators. We expect that estimated cash flow coefficient would be positive and more significant in the sub-sample of small firms when compared with large firms.

Table 3 and Table 4 report the OLS, Within Groups and GMM estimators of the R&D Accelerator specifications described above. As we can see in all the three methods, there are no special differences between small and large firms on the estimated coefficients of cash flow except for the GMM estimator. On the contrary, the results with the total sample are more significant than with the sub-samples of SME and LE. Table 5 and Table 6 present the same conclusions for the investment Accelerator specification, normally the model performs better with the total sample than with the partition between SME and LE.

Table 7 and Table 8 report the results of the same estimators in an Error Correcting specification for R&D. Again the cash flow coefficients evidence a positive sign but it is more significant in the total sample estimations. This is particularly true with OLS and Within Group specifications. Table 9 and Table 10 present the estimated results of the investment specification. Results are not so convincing but we can also conclude that the hypothesis formulated that innovative small firm's investment and R&D should be financial constrained meaning that firm size may be inversely correlated with internal funds is not valid in our sample. However the results indicate considerable sensitivity to Cash Flow variations for the total sample.

VI – CONCLUSIONS

Some studies have recently emerged suggesting that the Continental European model of finance is distinct from its Anglo-Saxon counterpart, and this is related with the different importance of stock market and the banking system (Audretsch and Elston, 2002; Carpenter and Rondi, 2000). In Germany smaller firms have fewer liquidity constraints benefiting from the specialized institutional structure that provides long-term and competitively priced capital to SME. Only medium sized firms experiment liquidity constraints. In Italy, small firms as a group do not appear to face an especially large premium for external funds. A lot of them are mature firms (an important characteristic of Italian industry structure) with an ancient relationship with lenders. Only young firms' investment appears to be more sensitive to fluctuations in internal finance.

The results presented in this paper suggest that some financial constraints usually exhibited by small innovative firms are also extensible to firms of all sizes. The results indicate that firm size is not relevant for liquidity constraints even though the total sample shows a great dependence from internal liquidity. This refutes the hypothesis that under the Portuguese financial system, only the smallest firms tend to be disadvantaged in terms of access to funds. We need further research to justify this conclusion.

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APPENDIX

The database we use in this study was constructed by the Portuguese Central Bank and is composed of about 15000 firms from all sectors of the Portuguese economy. We selected an unbalanced panel of 263 firms and 1202 observations covering the years 1993 to 1999 in the manufacturing industry. Firms were selected according with the criterion of having positive R&D expenses in not less than three consecutive years during the period under consideration.

Investment (I) is additions to plant, property and equipment

Output (Y) is sales deflated by the aggregate GDP deflator

Cash Flow (CF) is computed as funds available for investment and R&D spending, i.e. as net income plus depreciation plus R&D expenditures

Capital Stock (K) is obtained by applying a perpetual inventory procedure

Knowledge Capital (C) we adopt the "steady state" approximation, as is described by Bond *et. al*. (1999: 17) to compute the R&D capital stock

Table 1

Firm's Sample Composition by Sector and Size

INDUSTRIES		SIZE		Total
		SME	**LE**	
15	Food and Beverages	13	6	19
17	Textiles	27	19	46
18	Wearing	12	6	18
19	Leather	7	3	10
20	20 Wood and Cork	6	3	9
21	21 Paper	3	5	8
22	Printing	5	2	7
23	Petroleum and refined products	-	1	1
24	Quimicals	7	2	9
25	Rubber	11	1	12
26	Non-Metallic Mineral Products	24	8	32
28	Fabricated Metal Products	8	3	11
29	Machinery & Equipment, nec	31	3	34
31	Electrical Machinery	8	3	11
32	Radio, TV & Communication Equipment	1	-	1
33	Professional Goods	3	-	3
34	Motor Vehicles	4	3	7
35	Other Transport Equipment	5	1	6
36	Furniture	16	3	19
TOTAL		**191**	**72**	**263**

Table 2

SUMMARY STATISTICS (263 firms – 1993/9)

VARIABLES	MEAN	STANDARD ERROR	MEDIAN	1º Quart	3º Quart
I/K	.2081495	.1538109	.1757413	.0943919	.2841319
V/K	3.147765	3.487524	2.1741	1.402861	3.637218
CF/K	.2802248	.3820907	.221063	.1516041	.3301428
R/K	.0390975	.2012845	.0081232	.0027297	.0239135
Δlr	-.0002939	1.761421	.0219362	-.9692976	.9940108
CF	5520.746	29746.77	994.8029	396.5157	2751.818
V	62596.62	441691.6	12102.2	4845.336	30491.05
R	195.8085	878.4389	44.35449	14.28163	126.0973
I	43470.463	31307.85	892.9567	331.8346	2387.427
K	32353.96	179299.3	5091.169	2111.006	13714.87
NUMBER OF EMPLOYEES	245.5736	368.3859	117	54.14286	292

Table 3

R&D [$\Delta r_{i,t}$]. Accelerator Models. OLS and Within Groups Estimators.

Dependent Variable Δr_{it}						
	OLS			***Within***		
	Total	***SME***	***LE***	***Total***	***SME***	***LE***
$\Delta r_{i,t-1}$	-.41417	-.37299	-.51796	-.51889	-.493375	-.563328
	(.03947)	(.04702)	(.07378)	(.050572)	(.061364)	(.094315)
t-st	-10.49*	-7.93*	-7.02*	-10.26*	-8.04*	-5.97*
Δy_t	-.03932	.230715	-.96655	-.53374	-.049093	-2.10473
	(.30424)	(.32452)	(.71747)	(.532989)	(.560896)	(1.37325)
t-st	-0.13	0.71	-1.35	-1.00	-0.09	-1.53
Δy_{t-1}	-.27240	.071697	-.96973	-.28125	.2529554	-1.39133
	(.29489)	(.34935)	(.55670)	(.492931)	(.592204)	(.909122)
t-st	-0.92	0.21	-1.74***	-0.57	0.43	-1.53
CF_t / K_{t-1}	.890829	.779930	1.38047	2.5065	1.862279	4.726395
	(.30415)	(.30273)	(1.128)	(.833479)	(.877006)	(2.12439)
t-st	2.93*	2.58*	1.22	3.01*	2.12**	2.22**
CF_{t-1} / K_{t-2}	-.37041	-.35118	-.65252	.135495	.0378851	1.001752
	(.16418)	(.15548)	(.97402)	(.292359)	(.283408)	(1.74387)
t-st	-2.26**	-2.26**	-0.67	0.46	0.13	0.57
constant	-.00042	-.19532	.144233	-.49477	-.404584	-1.38090
	(.18890)	(.30787)	(.45254)	(.471192)	(.593433)	(.819896)
	-0.00	-0.63	0.32	-1.05	-0.68	-1.68***
R^2	0.2115	0.2	0.2766	0.3441	0.3424	0.4131
F-stat	8.78	8.78	5.95	13.82	8.97	5.71
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets

Table 4

R&D [$\Delta r_{i,t}$]. Accelerator Models. GMM$_{diff}$ Estimator (Arellano-Bond)

Dependent Variable $\Delta r_{i,t}$			
	GMM$_{diff}$ (Arellano- Bond)		
	Total	***SME***	***LE***
$\Delta r_{i,t-1}$ t-st	-	-	-
Δy_t t-st	-.5052429 (.8316345) -0.61	.240499 (.8927421) 0.27	-2.435541 (2.086439) -1.17
Δy_{t-1} t-st	-.1682776 (.7310832) -0.23	1.224947 (.9529558) 1.29	-2.008024 (1.310566) -1.53
CF_t / K_{t-1} t-st	2.645216 (1.243689) 2.13**	.9378993 (1.299425) 0.72	8.427886 (2.830659) 2.98*
CF_{t-1} / K_{t-2} t-st	.5625688 (.664904) 0.85	.1437773 (.679263) 0.21	2.470269 (2.11607) 1.17
constant	-.0317356 (.1624167) -0.20	.1734082 (.1827538) 0.95	-.3784558 (.3113118) -1.22
Sargan Test [χ^2]	18.22 (0.1970)	13.46 (0.4910)	13.15 (0.5146)
Arellano – Bond Test m(1)	-4.31 (0.0000)	-3.38 (0.0007)	-1.68 (0.0932)
Arellano – Bond Test m(2)	1.68 (0.0921)	-0.80 (0.4243)	0.80 (0.4245)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets; Sargan Test of over-identifying restrictions – H_0: all used instruments are valid; Arellano Bond test (m_j) - H_0: absence of autocorrelation between error terms in the first difference equations.

Table 5

Investment [I_t / K_{t-1}].Accelerator Models. OLS and Within Groups Estimators

Dependent variable I_t / K_{t-1}						
	OLS			***Within Groups***		
	Total	***SME***	***LE***	***Total***	***SME***	***LE***
I_{t-1} / K_{t-2} t-st	.123414 (.03726) 3.31*	.124420 (.04496) 2.77*	-.07367 (.07553) -0.98	-.179803 (.043426) -4.14*	-.154740 (.051959) -2.98*	-.444297 (.078364) -5.67*
Δy_t t-st	.074706 (.05477) 1.36	.039343 (.07204) 0.55	.238993 (.06678) 3.58*	-.120123 (.074461) -1.61	-.183186 (.097830) -1.87***	.0948971 (.074487) 1.27
Δy_{t-1} t-st	.110782 (.05327) 2.08**	.120293 (.07773) 1.55	.117711 (.04969) 2.37**	-.067965 (.068944) -0.99	-.085661 (.102994) -0.83	-.009374 (.049374) -0.19
CF_t / K_{t-1} t-st	.199940 (.05447) 3.67*	.169282 (.06692) 2.53**	.254611 (.10084) 2.52**	.537012 (.116486) 4.61*	.6756077 (.152601) 4.43*	.1210747 (.115072) 1.05
CF_{t-1} / K_{t-2} t-st	.021640 (.02991) 0.72	.018424 (.03483) 0.53	.176628 (.09428) 1.87***	.1475623 (.041282) 3.57*	.1676183 (.049736) 3.37*	.0536687 (.096967) 0.55
constant	.168085 (.03436) 4.89*	.114937 (.06833) 1.68***	.008663 (.04019) 0.22	.0895889 (.066113) 1.36	.0210473 (.103524) 0.20	.2652147 (.043810) 6.05*
R^2 F-stat	0.1157 6.77 (0.000)	0.0936 3.63 (0.0003)	0.2975 6.59 (0.000)	0.1892 6.14 (0.000)	0.2393 5.42 (0.000)	0.3481 4.33 (0.0002)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets

Table 6

Investment [I_t / K_{t-1}].Accelerator. GMM$_{diff}$ estimators (Arellano-Bond)

Dependent Variable I_t / K_{t-1}			
	GMM$_{diff}$ (Arellano- Bond)		
	Total	***SME***	***LE***
I_{t-1} / K_{t-2} t-st	-.4654179 (.0690982) -6.74*	-.4500129 (.0785973) -5.73*	-.5408499 (.1266494) -4.27*
Δy_t t-st	-.3419184 (.1207369) -2.83*	-.4686192 (.1530768) -3.06*	.1577832 (.1354881) 1.16
Δy_{t-1} t-st	-.22401 (.1044289) -2.15**	-.3505986 (.1596781) -2.20*	.0164274 (.0873649) 0.19
CF_t / K_{t-1} t-st	.6127792 (.17871) 3.43*	.7056068 (.2236815) 3.15*	.2036857 (.1693158) 1.20
CF_{t-1} / K_{t-2} t-st	.2431003 (.095964) 2.53**	.3237927 (.1145686) 2.83*	.072805 (.1362954) 0.53
Constant	-.061993 (.0228741) -2.71*	-.0970798 (.030164) -3.22*	.0222477 (.0196512) 1.13
Sargan Test [χ^2]	11.75 (0.6261)	8.14 (0.8820)	9.92 (0.7676)
Arellano – Bond Test m(1)	2.17 (0.0301)	-0.74 (0.4575)	-0.98 (0.3285)
Arellano – Bond Test m(2)	0.16 (0.8714)	0.88 (0.3800)	-0.55 (0.5840)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets; Sargan Test of over-identifying restrictions – H_0: all used instruments are valid; Arellano Bond test (m_j) - H_0: absence of autocorrelation between error terms in the first difference equations.

Tabela 7

R&D [$\Delta r_{i,t}$]. Error Correction Models. OLS and Within Groups Estimators

Variável Dependente $\Delta r_{i,t}$						
	OLS			***Within Groups***		
	Total	***PME***	***GE***	***Total***	***PME***	***GE***
$\Delta r_{i,t-1}$ t-est	-.71553 (.05296) -13.51*	-.69874 (.06628) -10.54*	-.74837 (.09544) -7.84*	-1.10737 (.074920) -14.78*	-1.17294 (.096593) -12.14*	-1.04038 (.123786) -8.40*
Δy_t t-est	-.61143 (.37651) -1.62	-.26232 (.42640) -0.62	-1.3649 (.78667) -1.74***	-.364703 (.559294) -0.65	-.074423 (.591127) -0.13	.3245641 (1.41397) 0.23
Δy_{t-1} t-est	-.29449 (.32484) -0.91	.083577 (.38761) 0.22	-.96133 (.62157) -1.55	-.142484 (.478928) -0.30	.8697038 (.649961) 1.34	-.546743 (.802031) -0.68
$(r-y)_{t-2}$ t-est	-.54859 (.05873) -9.34*	-.54530 (.07241) -7.53*	-.54270 (.10998) -4.93*	-1.32583 (.117492) -11.28*	-1.45709 (.159527) -9.13*	-1.20058 (.170094) -7.06*
y_{t-2}	-.21594 (.06075) -3.55*	-.22226 (.08807) -2.52**	-.14461 (.14274) -1.01	-.708195 (.447171) -1.58	.3605482 (.553484) 0.65	-2.19146 (.888071) -2.47**
CF_t / K_{t-1} t-est	1.20987 (.34148) 3.54*	1.18735 (.34202) 3.47*	1.22615 (1.2829) 0.96	2.708739 (.909723) 2.98*	1.743162 (1.07349) 1.62	3.348096 (1.66609) 2.01***
CF_{t-1} / K_{t-2} t-est	-.11101 (.17148) -0.65	-.13369 (.16474) -0.81	-.57727 (1.0876) -0.53	.2634902 (.259354) 1.02	.1433628 (.267292) 0.54	3.26582 (1.69441) 1.93***
constant	-.74049 (.64696) -1.14	-.81024 (.8608) -0.94	-1.2221 (1.6085) -0.76	-.616139 (4.34371) -0.14	-11.3858 (5.03488) -2.26**	16.05229 (10.0439) 1.60
R^2 F-stat	0.4071 18.97 (0.000)	0.3965 12.12 (0.000)	0.4512 6.65 (0.000)	0.6782 22.8 (0.000)	0.6860 15.29 (0.000)	0.7919 10.72 (0.000)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets

Table 8

R&D [$\Delta r_{i,t}$]. Error Correction Models. GMM$_{diff}$ Estimators (Arellano-Bond)

Dependent Variable $\Delta r_{i,t}$			
	GMM$_{diff}$ (Arellano- Bond)		
	Total	***SME***	***LE***
$\Delta r_{i,t-1}$ t-st	-	-	-
Δy_t t-est	.0800209 (.9314236) 0.09	.2195491 (1.056444) 0.21	3.120338 (2.86131) 1.09
Δy_{t-1} t-est	.42091 (.8381568) 0.50	2.362173 (1.377155) 1.72***	.2161837 (1.904863) 0.11
$(r\text{-}y)_{t-2}$ t-est	-1.32094 (.3251715) - 4.06*	-1.153369 (.3292062) - 3.50*	-.8622869 (.5358514) - 1.61
Y_{t-2} t-est	-.6782117 (.727927) -0.93	1.046114 (.9011983) 1.16	-3.901225 (1.660691) - 2.35*
CF_t / K_{t-1} t-st	1.644669 (1.594189) 1.03	.9372688 (2.174124) 0.43	4.581869 (2.359417) 1.94***
CF_{t-1} / K_{t-2} t-st	1.761306 (1.001949) 1.76***	.1458108 (1.139747) 0.13	5.28464 (3.46229) 1.53
Constant	.1178939 (.2434109) 0.48	.0896825 (.3294746) 0.27	.057702 (.4856986) 0.12
Sargan Test [χ^2]	11.23 (0.6680)	3.72 (0.9969)	10.49 (0.7259)
Arellano – Bond Test m(1)	-1.18 (0.2361)	-0.11 (0.9144)	-1.06 (0.2912)
Arellano – Bond Test m(2)	0.69 (0.4900)	-	0.24 (0.8125)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets; Sargan Test of over-identifying restrictions – H_0: all used instruments are valid; Arellano Bond test (m_j) - H_0: absence of autocorrelation between error terms in the first difference equations

Table 9

Investment (I_t / K_{t-1}). Error Correction Models. OLS and Within Groups Estimators

Dependent Variable I_t / K_{t-1}						
	OLS			***Within groups***		
	Total	***SME***	***LE***	***Total***	***SME***	***LE***
I_{t-1} / K_{t-2} t-st	.168537 (.05746) 2.93*	.185280 (.07277) 2.55*	-.13545 (.07537) -1.80**	-.112335 (.064949) -1.73***	-.125548 (.074782) -1.68***	-.641592 (.136341) -4.71*
Δy_t t-st	.203066 (.07760) 2.62*	.20121 (.11278) 1.78***	.30765 (.05928) 5.19*	-.113467 (.110755) -1.02	-.163316 (.135865) -1.20	-.008639 (.097237) -0.09
Δy_{t-1} t-st	.183429 (.06847) 2.68*	.252689 (.10464) 2.41**	.08107 (.04558) 1.78***	.1631883 (.102941) 1.59	.1415281 (.149612) 0.95	-.031290 (.071474) -0.44
$(k\text{-}y)_{t-2}$ t-st	-.07656 (.02370) -3.23*	-.09528 (.03868) -2.46**	-.03965 (.01526) -2.60**	-.367089 (.078211) -4.69*	-.364066 (.097706) -3.73*	-.002921 (.073445) -0.04
Y_{t-2} *t-st*	-.02418 (.01130) -2.14***	-.01336 (.02222) -0.60	-.02442 (.00982) -2.49**	.2441301 (.081058) 3.01*	.3852687 (.120496) 3.20*	-.078387 (.051259) -1.53
CF_t / K_{t-1} t-st	.136883 (.07438) 1.84***	.113857 (.09639) 1.18	.047663 (.09430) 0.51	.7302381 (.171928) 4.25*	.9983628 (.235261) 4.24*	.2151052 (.104781) 2.05**
CF_{t-1} / K_{t-2} t-st	-.01468 (.03542) -0.41	-.02094 (.04370) -0.48	.200136 (.08575) 2.33**	.1325951 (.050149) 2.64*	.1577109 (.060815) 2.59**	-.005478 (.102307) -0.05
constant	.227888 (.13334) 1.71***	.057826 (.22524) 0.26	.320703 (.11681) 2.75*	-2.67431 (.784552) -3.41*	-3.75252 (1.06563) -3.52*	1.09612 (.588072) 1.86*
R^2 F-stat	0.2095 7.32 (0.000)	0.1839 4.16 (0.000)	0.4503 6.63 (0.000)	0.3994 7.19 (0.000)	0.5139 7.40 (0.000)	0.6099 4.41 (0.000)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets

Table 10

Investment (I_t / K_{t-1}). Error Correction Models. GMM_{diff} Estimators (Arellano-Bond)

Dependent Variable I_t / K_{t-1}			
	GMM_{diff} (Arellano- Bond)		
	Total	***PME***	***GE***
I_{t-1} / K_{t-2} t-st	-.0484803 (.1215848) -0.40	-.0312382 (.1439065) -0.22	-.3375037 (.1748304) -1.93***
Δy_t t-est	.2237603 (.2280176) 0.98	.2496455 (.3068331) 0.81	-.147568 (.1986207) -0.74
Δy_{t-1} t-est	.5442652 (.2695013) 2.02**	.6925187 (.368099) 1.88**	-.1992178 (.2206836) -0.90
$(k\text{-}y)_{t-2}$ t-est	-.6281912 (.2790819) -2.25**	-.7316655 (.3881249) -1.89***	.2321454 (.201609) 1.15
Y_{t-2} t-est	.1492393 (.0959303) 1.56	.3452694 (.142628) 2.42*	-.2383092 (.0757377) -3.15*
CF_t / K_{t-1} t-est	.535304 (.2270529) 2.36**	.7775402 (.3723061) 2.09**	.3964927 (.1387625) 2.86*
CF_{t-1} / K_{t-2} t-est	.1815904 (.1449116) 1.25	.2634039 (.1854643) 1.42	-.1238825 (.1302777) -0.95
constant	.0155696 (.034371) 0.45	.0206982 (.0510369) 0.41	.0304441 (.021352) 1.43
Sargan Test [χ^2]	18.75 (0.1746)	12.15 (0.5944)	11.11 (0.6774)
Arellano – Bond Test m(1)	-1.45 (0.1475)	-0.92 (0.3551)	-0.65 (0.5129)
Arellano – Bond Test m(2)	1.64 (0.1018)	-†	0.36 (0.7216)

Note: t-statistic significant at *1% **5% e ***10% levels; all estimated equations include time dummy variables; standard errors in brackets; Sargan Test of over-identifying restrictions – H_0: all used instruments are valid; Arellano Bond test (m_j) - H_0: absence of autocorrelation between error terms in the first difference equations.