The link investments-finance: an empirical analysis on the Italian mechanic sector

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ABSTRACT

This paper analyzes the investment decisions of the Italian mechanical firms by using a model where investments and financial structure are decided simultaneously by the firms. We introduce a very simple theoretical model that allows an empirical specification where an interpretation based on the new-keynesian "excess sensitivity" literature can be contrasted with a more conventional interpretation, where the cost of financial capital can be interpreted in the light of "firm specific" choices.

Keywords: investment, intertemporal firm choice, capital structure, financing policy
JEL Classification: D92, G32.

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1. Introduction

Financial markets play a fundamental role for information spreading, can reduce monitoring costs for financial institutions and banks lending money to industrial firms. In Italy and other Continental European countries, however, the role of stock market and "spot" financial markets is notoriously much less relevant than the role played by the banking sector[1]. In particular, the latter could not only be performing its institutional role *per se*, but also in complementarity with the banking sector.[2] Differently relevant "spot" financial markets might affect the qualitative behaviour of banks and qualitatively affect the way real investments are financed by the whole financial sector and affect the empirical relevance of firms' financial structure for investment decisions, shown in many empirical works based on "market oriented" financial systems. For this reason in that context it might be not trivial to investigate whether in a "bank oriented" financial system like the Italian one, the interaction between financial sector and real investment decisions of the firms is empirically reproducing a behaviour consistent with the New-Keynesian "excess sensitivity" literature[3], or with the "textbook" orthodox neoclassical investment theory[4], where investment decisions do not show the typical causation chain going from firm profits and profitability to financial structure, risk and cost of capital that characterizes the new-keynesian "excess sensitivity" approach. As we know it, the orthodox neoclassical investment theory (where the investment decisions are often modelled with optimal control techniques[5]) the optimal level of investments is a function of "Tobin's q", i.e. on the ratio between marginal productivity of capital and the replacement cost of capital (i.e. the cost of raising new finance to substitute the existing physical capital), but no explicit link whatsoever is postulated among the firm's financial structure, risk premium and cost of finance, since efficient financial markets (or efficient banking systems) are assumed to properly assess the idiosyncratic firm risk.

The empirical part of this paper is based on a dataset built on the basis of AIDA (which includes all the Italian companies with sales greater or equal to 500.000 euros) after eliminating only the observations that contained omissions or obvious mistakes in reporting the balance sheets and accountancy reports: therefore we can say that our dataset is not a sample, but the whole universe of all the Italian mechanic firms, after eliminating only the mistakes, and the firms that, in

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[1] See, for instance, Allen and Gale, 2000.

[2] See, for instance, Pagano, Panetta and Zingales (1998).

[3] The excess sensitivity literature was inaugurated, as we all know, by the notorious seminal contribution by Fazzari, Hubbard and Petersen (1988) and further developed in 20 years of consolidated literature, which includes, among others, Greenwald and Stiglitz (1988, 1990, 1993), Bernanke and Gertler (1989, 1990), Gertler (1993), Bernanke (1993), Carpenter, Fazzari and Petersen and, more recently, Cooley and Quadrini (2006), assuming financial market imperfections and emphasizing the role of firm's financial structure for the firms' investment decisions and for the macroeconomic equilibrium.

[4] See, for instance, Precious (1987), Abel and Eberly (1994).

[5] See, for instance, Seierstad, A., Sydsæter, K., (1987).

spite of being still reported are clearly in the process of exiting the market. The value added (at factor cost) of the mechanic sector is 33.136 millions euros (at current prices), which, compared to the 259.343 of the whole Italian industry and to the 1.475.401 of the Italian GDP, makes it 12,78% of the whole Italian industry and only 2.24% of the Italian GDP. It is a rather traditional sector that played in the past an important role for the Italian economy (while nowadays a well-known criticism of the Italian economy lies exactly in the fact that the Italian industry is too focused on traditional sectors and too little active in hi tech as well as in R&D and research expenditure) that has experienced, even recently, moments of severe difficulties and crises, however it can still be regarded as a relevant sector for the Italian industry, with relatively homogeneous features for what concerns the features of the dataset, which makes it particularly indicated for statistical analyses.

The next section briefly describes the theoretical background employed for the empirical specification. Section 3 briefly describes the dataset and the empirical implementation. Section 4 contains a few comments on the results.

2. The model

In the theoretical framework employed here we introduce a firm deciding the optimal level of investments given the cost of finance: in the "new-keynesian" excess sensitivity approach this is caused (due to information asymmetries in financial markets and agency costs) by the flow of internally generated profits and by the financial structure. In the orthodox approach, the efficient market hypothesis (EMH) in financial markets holds and the financial structure (as well as the internally generated profits) are not necessarily significant for the determination of the cost of finance. In the theoretical framework employed here we introduce a firm deciding the optimal level of investments given the cost of finance: in the "new-keynesian" excess sensitivity approach this is caused (due to information asymmetries in financial markets and agency costs) by the flow of internally generated profits and by the financial structure. In the orthodox approach, the efficient market hypothesis (EMH) in financial markets holds and the financial structure (as well as the internally generated profits) are not necessarily significant for the determination of the cost of financeIn the theoretical framework employed here we introduce a firm deciding the optimal level of investments given the cost of finance: in the "new-keynesian" excess sensitivity approach this is caused (due to information asymmetries in financial markets and agency costs) by the flow of internally generated profits and by the financial structure. In the orthodox approach, the efficient market hypothesis (EMH) in financial markets holds and the financial structure (as well as the internally generated profits) are not necessarily significant for the determination of the cost of finance.

In the context of continuous time investment models formalized with optimal control, a model of simultaneous investment and financial structure decision has been introduced by Bernstein and Nadiri (1986), while the relevance of profits shocks, or "cash windfalls" (to use the terminology of Blanchard *et al.*, 1994), in the firms' financial structure and the importance of stock markets and "spot" financial markets in determining the risk premium are consolidated issues in the literature on monetary and financial economics. The "excess sensitivity" literature for about 20 years has provided a link between the investment theory and the studies in financial economics concerned with the determination of the optimal firm's financial structure in a context of imperfect financial markets.

In this work, rather that introducing a specific theoretical model, we use a theoretical framework allowing to empirically compare the case of the new-keynesian "excess sensitivity" approach with the standard neoclassical investment model.

In our theoretical framework the firm is operating under a regime of imperfect competition, but where perfect competition can be regarded as a special case. The firm employs capital and labour (for which we make a *ceteris paribus* assumption and say that it is exogenous and constant in the short run), so that the flow of profits contain a stochastic variable capturing the intrinsic uncertainty of the success of the investments performed. The decisions concerning R&D and technology and their relevance for market strategic interactions are one of the potential elements affecting investment decisions[6].

The decision makers of the firm (managers) enjoy a certain degree of discretionality, informational advantage, are able to observe the cash flow before it is known to the outsider from the firms reports, and receive (in addition to their contractual remumeration) fringe benefits that are

[6] For a thorough analysis of the relevance of market strategic interactions and firm growth for the investment decisions See, for instance, the seminal contribution by Sutton (1998). Of course, there is a great deal of elements that makes uncertain the environment of investment decisions, like the intrinsic randomness that characterizes the expenditure in R&D, the outcome of the strategic interactions among rival firms in a non perfectly competitive environment and potential consumers' preference shocks.

associated to the cash flow: i.e., having defined $u(\cdot) - A[I(t)]$ as the flow of variable profits net of the adjustment costs of investments $A[I(t)]$, and $\xi\cdot\{u(\cdot) - A[I(t)]\}$ as the fringe benefits of the managers, the target of the managers may diverge from the one of the shareholders, since the formers maximize the net present value of the profits rather than the value of the shares. What we have said means that, on the point of view of the firm's decision makers, the capital stock and the investments affect the firm's profitability with a certain degree of uncertainty and the value of the firm shares may diverge from the value of the physical capital, measured at its purchasing price.

Ignoring the constant ξ outside the integral, we define the investment problem at time $t>0$ in continuous time as follows, where all the variables are defined as expected future variables and all assumptions on certainty equivalence are assumed to apply:

$$Max\ V(0) = \int_t^{\infty} exp[-\int_0^t \Phi(\tau)d\tau\ ]\{u(k(t),w^* \mid v_i) - A[I(t)]\}\ dt \qquad (1$$

subject to the following two constraints:

$$dk/dt = I - gk,\ \ k(0)>0 \qquad (2$$

$$\lim_{t\to\infty} k(t) \geq 0 \qquad (3$$

where $u(k(t),w^*|v_x)$ are the variable profits, net of the (exogenous) labor costs w^*, the stock of capital k and are conditional on a stochastic variable v_x that captures the intrinsic uncertainty of investments. We can think of v_x as a variable with a smaller magnitude than $u(\cdot)$ and $k(t)$ and generating that slightly higher or lower cash flow that makes investments more successful (or lucky) than expected or less successful than expected.. $\Phi(t)$ is the (instantaneous) optimized cost of firm's financial funds, and $A[I(t)]$ represents the adjustment costs function of investment, twice continuously differentiable, i.e. $A(0)=0$; $A'>0$; $A''>0$.

Let us further define:

$$\pi(t) = (1-\xi)[u(\cdot) - A(I(t))] \qquad (4$$

Equation 1 states that the firm is solving a forward looking problem of optimal investment once the optimized cost of firm's financial funds $\Phi(t)$ has been determined. In other words, $\Phi(t)$ may be conditioned and influenced by the degree of risk and solvency that the firm received from the market in the past until time t.

In this regard, we may discriminate here between two different approaches: according to the conventional and orthodox view, the optimized cost of capital contains elements of idyosincratic firm's risk that might be associated to its governance and/or to the investment choices that have been done or are being done. The meaning and implications, in our context, of efficient financial markets and/or efficient monitoring performed by the banking system lies in their ability to assess whether or not, for a given unfavourable level of gearing, the firm is properly reallocating its capital and modifying the nature of its investments. Some firms might be doing so, while other might not. All this would boil down into a lack of correlation between gearing ratio and cost of capital.

On the other hand, according to the new-keynesian approach, given the information asymmetries in financial markets and due to the phenomenon of "share rationing", a higher gearing ratio should necessarily be associated to a higher risk premium on the firms' financial liabilities and, as a consequence, a higher cost of financial capital.

More formally, we can think of the optimization problem of the firm's financial structure as follows:

$$\Phi = \min_{\mu} \{(1-\mu)i(t) + [r_f(t) + \phi(\mu)]\, \mu\} \qquad (5$$

Where μ is the share of capital financed by debt (gearing ratio), $i(t)$ is the cost of the own capital $r_f(t)$ is the interest rate on a long term risk free asset, $\phi(\mu)$ is a risk premium on the firm's debt. Equation 5 is the weighted average of the cost of financial funds.

For the sake of our empirical analyses, we keep in mind that the gearing ratio (a variabla available in the AIDA dataset) is a monotonic increasing function of the leverage ratio Ω (also available in the AIDA dataset), since

$$\mu = 1 - \frac{1}{\Omega + 1} = h(\Omega)$$

In particular, in the empirics of this paper we consider a very close proxy of the leverage ratio, denominated (in the dataset AIDA) "risk coefficient". In each and every moment the firm is optimizing the financial structure. Considering equation 5, and assuming that the second order conditions are satisfied, the first order condition are:

$$d\Phi^*/d\mu = r_f + \theta(\mu) + \mu\theta'(\mu) - i = 0 \qquad (6$$

Equation 6 states that the firm is equating the marginal cost of borrowing to the marginal cost of the own capital "i". Let us assume that $\theta(\mu)$ is homogeneous of degree 1, such that

$$\mu\theta'(\mu) = c\theta(\mu)$$

where "c" is a constant, then we get:

$$i - r_f = \theta(\mu)(1+c)$$

or

$$\mu = \theta^{-1}((i-r_f)/(1+c)) \qquad (7$$

assuming that $\theta(\cdot)$ is monotonically increasing and invertible, then equation 7 shows that μ is a monotonically increasing function of $(i-r_f)$, i.e. the difference between the cost of own capital and the interest rate on a risk-free asset. Since we have $\Omega=h(\mu)$, with $h(\cdot)$ monotonically increasing in μ, then Ω is a monotonically increasing function of the difference $(i-r_f)$. We can then define :

$$\Omega = h(\mu) = h(\theta^{-1}((i-r_f)/(1+c))) = b(i-r_f) \qquad (8$$

The leverage ratio is an increasing function of the difference between the cost of own capital and the interest rate on risk-free assets because, for a given r_f, the higher the cost of own capital i, the higher the incentive for the firm to borrow and increase the leverage ratio.

The optimal cost of capital becomes then (omitting, for simplicity, the symbol t):

$$\Phi = r_f + \theta(\mu) + \mu\theta'(\mu) - \mu^2\theta'(\mu) = \Phi^*(\mu) \qquad (9$$

If we further assume that $\theta''(\mu)$ is null or negligible, and keeping in mind that by definition we have $0<\mu<1$, then Φ is monotonically increasing in μ (or in Ω):

$$\Phi^* = \Phi^*(\mu(i-r_f)) \qquad (10$$

According to the new-keynesian “share rationing” interpretation, a reduced profitability of the firm or an increased perceived risk would increase the cost of own capital i, since it would increase the risk premium that any investor would require in order to be willing to invest in the firm’s shares. Therefore, by looking at equation (10), the gearing ratio μ would be negatively correlated to the firm’s profitability, but it should be at the same time positively correlated to the optimized cost of financial capital Φ^*. This interpretation is also consistent with the “excess sensitivity” literature, that postulate a causal link going from firm’s profitability, financial structure (captured by the gearing ratio μ) and financial costs Φ^*.

On the other hand, according to a more conventional interpretation, a correlation could exist between firm’ profitability and gearing ratio μ but this would not necessarily imply any causality between the gearing ratio and the optimized cost of finance Φ^*. In this case, the high correlation between gearing and firm’s profitability might be due to the fact that they are both simultaneously determined by random shocks in consumers’ preferences and demand, and this would not necessarily imply that the firm has become more risky, since it could be reallocating its capital to more profitable investments. In this sense, a causal link between gearing ratio and cost of financial capital could be simply interpreted as an effect of information asymmetries on the actual risk of the firm’s new investments, once a random shock has affected profitability and gearing ratio, while the lack of causal link between gearing ratio and cost of capital could be simply interpreted as the hypothetical ability of the banking sector and financial investors to properly monitor the firm’s risk: in other words, a dissociation between gearing and cost of capital could be determined by the ability of the financial investor to assess whether the firm is properly reallocating capital and changing the nature of its investments after experiencing a negative random shock.

Models with simultaneous determination of investments and financial structure boils down into endogenous cost of finance (for instance, this is done in Mazzoli, 1998 for the continuous time case, and in Mazzoli 2005 for the discrete time case), on the basis of a causal link going from marginal profitability of capital, gearing ratio (i.e. the ratio between debt and physical capital), risk premium and optimized cost of finance. This causal link is due to the fact that, with imperfect financial markets, a higher gearing ratio is associated to higher insolvency risk.

The formal analysis of equations 1-10 broadly shows the potential causal link going from the accumulation of the own capital, gearing ratio and cost of capital and serves as a rationale for the battery of Granger causality tests that are performed in order to determine the relevant variables for our estimates. In particular, Granger Causality of profits flow and gearing ratio on the cost of finance (as well as Granger causality of profit flow on gearing ratio) is consistent with the “excess sensitivity” approach, while the rejection of Granger Causality is consistent with exogeneity of the cost of financial capital: the latter result could be consistent with the neoclassical orthodox approach (where the banks and external suppliers of finance are able to efficiently use any information on the management and performance of the firm to assess the proper risk premium on the firm finance) or with a situation where the gearing ratio and any other conventional risk indicator is not taken into account by the banks, who might grant and price credit on the basis of their personal knowledge of the firms' managers and their qualities.

The model, solved with optimal control techniques yields a result practically identical to the well-known neoclassical investment model, i.e. the following system of differential equations, which can be qualitatively solved by using the method of phase diagrams (see the appendix for its derivation, based on Mazzoli, 1998):

$$\begin{cases} dI/dt = (1/A'') \cdot [-\partial u/\partial k + (\Phi^{o} + g)A'] & (11 \\ dk/dt = I - gk & (12 \end{cases}$$

which yields the saddlepoint equilibrium

$I^{*} = A'^{-1}[\partial u/\partial k)/(\Phi+g)]$ for the locus $(dI/dt)=0$ and

$I = g \cdot k$ for the locus $(dk/dt)=0$.

Therefore, the system composed by equations 11 and 12 yields a result which looks at a first sight very similar to the one of the standard neoclassical investment model. However, some relevant qualitative difference may appear if a link between firm's profitability, gearing ratio and financial costo of capital exists.

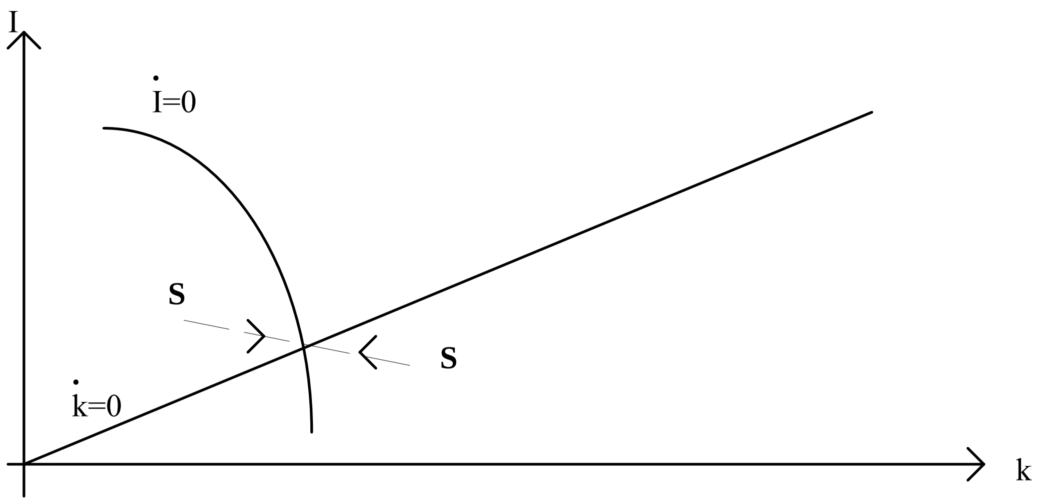

FIGURE 1

In the figure, SS is the stable saddlepath. In this case $\partial u/\partial k$ is the "marginal profitability" of capital (and not the marginal productivity of capital), which depends on the profit rate. In the conventional orthodox case, if there is a shock on profits and profitability, this would only affect the equilibrium though the marginal profitability of capital. In the new-keynesian/excess sensitivity case a shock on profits would have a double impact on the equilibrium: in addition to the traditional orthodox impact, conveyed by the marginal profitability of capital, we would have an additional "financial channel" to the extent that the firm's profitability would affect the gearing ratio and hence the optimized cost of financial capital for this firm will be Φ^*, which includes a risk premium, assumed to be a function of the gearing ratio. The latter would amplify the shock of firm's profitability.

3. Empirical implementation

The empirical implementation of the models starts from the assumption that the investment decisions are taken in continuous time but observed at discrete intervals and once exogenous disturbances and shocks affect the equilibrium conditions (equations 11 and 12), frictions associated to the existence of a time-consuming process of information spreading in financial markets, affect the adjustment process of the different variables, which is, for this reason, only gradual. In order to account for this detail, we have followed the "General-to-Specific" methodology (Harvey, 1989, Hendry, 1985, 1988), consisting of estimating first a general unrestricted model with lagged variables (in our case, given that we only have 6 years of observations, one lag only for all the variables) and then obtaining the final "parsimonious" specification by imposing some zero restrictions through a battery of variable deletion tests (test of joint significance of the statistically less significant variables) on the parameters. In this way, within a general theoretical framework, it is up to the data to exactly indicate the speed of movement and adjustment process of the different variables.

For the sake of our analysis we first specify the functional form of the function to be employed for the empirical implementation, then a battery of Granger Causality tests[7] are implemented in order to achieve the actual specification and choose the appropriate variables and proxies and finally the estimates are implemented with the "General-to-Specific" methodology.

Taking equations (11) and (12), we assume the following analytical forms for the relevant functions:

$u=exp(\gamma k^{\alpha})$ where $\alpha=1/\delta$ and $\delta >> k$ (13

which implies $\partial u/\partial k= exp(\gamma k^{\alpha})\alpha\gamma k^{\alpha-1}= (u/k)\alpha\gamma k^{\alpha}$ (14

which means

marginal profitability of capital= (average profitability of capital)$\alpha\gamma k^{\alpha}$

This functional form, which, of course, is only locally valid, since it requires the stock of physical capital k to be much smaller than a given exogenous parameter δ, has the advantage of explicitly including the variable k, that may capture the effect of firm size (measured not in terms of employees, but in terms of k).

$A(I) = \lambda I^{\beta}$ (15

Which implies

$A'(I) = \beta\lambda I^{\beta-1}$ (16

All this, substituted into equation (11), yields a theoretical optimal level of investment (in logs) equal to:

$\ln I^* = a_0 + a_1 \ ln\ k^* + a_2\ ln(u/k)^*_t + a_3\ ln(\delta+\Phi)^*$

where the symbol * stands for otpimized value of the variable and

$a_0 =[ln(\alpha\gamma)-ln(\beta\lambda)]/(\beta-1);$

$a_2= \alpha/(\beta-1)$

$a_1= a_3 = 1/(\beta-1)$ however, since for the estimates we do not know the exact value of the rate of capital depreciation δ and, in addition, the cost of own capital is actually not observable on the basis of our available dataset, the variable $(\delta+\Phi)$ is approximated by the cost of borrowed money, which is only a component of Φ. This means that if one empoys as a regressor Φ, the coefficient of Φ is expected to be, in general, different from a_1 . For this reason it would be better to be able to

[7] The concept of Granger Causality, very commonly employed in econometrics for over 35 years, was first introduced in Granger (1969).

postulate a functional link between the (unobservable) optimized cost of finance Φ^* and the (observable) gearing ratio μ, so that μ could be used as a proxy for Φ^* in the econometric estimates. Unfortunately, as we are going to point out in the next section, the battery of Granger causality tests that we have performed here do not allows us to do that and we have to use therefore the cost of borrowed money as a proxy for $(\delta+\Phi^*)$.

3.1 A few Granger Causality tests

The first step of the empirical implementation consist of veifying through some Granger Causality tests, the different causal links that differentiate conventional view on investments from the new-keynesian/excess sensitivity approach.

For a first set of Granger Causality test we employ Arellano-Bond GMM-DIF estimators[8]. Give the way the estimator is constructed, we can have instruments that are very likely to be statistically significant (and pass the appropriate test) without the need for additional instruments. The variables in Arellano-Bond GMM-DIF are re-defined in terms of differences, but all the variables employed are stationary and therefore any potential bias coming from co-integration and/or spurious regression is avoided. All the Granger Causality tests are performed with 3 lags in the relevant variables.

From tables 2 and 3 in the appendix one can conclude that average profitability of capital Granger causes gearing and gearing Granger causes average profitability of capital. From tables 6 and 7 in the appendix we find that the cost of borrowed money does not Granger cause the average productivity of capital and that the average profitability of capital does not granger cause the cost of borrowed money. In table 4 we find that the cost of borrowed money does not Granger cause gearing and in table 5 we find, on the other hand that gearing does Granger cause the cost of borrowed money, but the instruments are not statistically significant. Therefore the test of table 5 is inconclusive. The test if table 5 is repeated in table 8 and the test of table 4 is repeated in table 9 with instrumental variables

[8] GMM-DIF estimators, very common and available in any econometric software dealing with panel data analysis (such as, for instance, STATA, LIMDEP or DPD), were first introduced by Arellano and Bond (1988) and applied to estimate investment functions in Blundell *et al.* (1992)

In tables 8 and 9 we find that, with statistically significant instruments, the cost of borrowed money does not Granger cause gearing and gearing does not Granger cause the cost of borrowed money.

The battery of Granger causality test that we have performed suggest an interpretation of the link finance-investment which is consistent with the conventional orthodox view and not consistent with the new-keynesian/excess sensitivity literature. Exogenous shocks in the profits are absorbed in the amount of debt and, as a consequence, in the gearing ratio, but it does not seem to exist a statistically significant link going from gearing, risk and cost of borrowed money. Therefore, on the basis of the points made in section 2, since there does not seem to be a functional link between gearing and cost of borrowed money we are going to use an empirical specification of the investment function that does not include gearing as a proxy for risk or cost of finance, but we use instead the cost of borrowed money as a proxy for $(\delta+\Phi^*)$, i.e. the rate of capital depreciation plus the cost of finance.

3.2 The results of the estimates

As we said, we follow here the "General-to-specific" methodology applied to panel data. It is a methodology originally developed within the time series literature and its application to panel data is still not common. In this case, since the variables are nonstationary, there might be some (marginal) problems of bias by using a model specificed in differences like the Arellano-Bond GMM-DIF, therefore we employ the method of instrumental variables.

Since we only have yearly observations from the year 2000 to the year 2005 and we loose one year since the beginning because we need to construct flow variables from stock variables (since ve construct the variable "investments" from the changes in the stock of physical capital) we have only employed one period lag (i.e. one year lag) for all the relevant variables, in order not to loose too many degrees of freedom and be able to perform statistically reliable specification tests.

The data have been constructed from the dataset Aida, by including all the available firms belonging to the mechanic sector (ATECO code 29), and appearing in the dataset from 10/27/2006 to 11/1/2006. This correspond, to a good degree of approximation, to the whole universe of Italian mechanic firms, rather than a sample.

The estimates of the final "parsimonious" specification of the investments function is reported below. The lagged dependent variable has been kept (although it is not *per se* significant). The cost of borrowed money is significant at the level of confidence of 90% (so less significant than the remaining variables, which are significant at the level of confidence of 95%). The average productivity of capital is significant in its lagged value, but, as we said in section 2, is consistent with the methodological approach follwed here, since it might be due to frictions, that might make slow and gradual the process of adjustment of the different variables to their optimal equlibrium value.

The variables employed are the following:

```
       Linv = Log of Investments
       Linv1 = one period lag of the Log of Investments
      Limmat = Log of the stock of physical capital
     Limmat1 = one period lag of the log of the stock of physical capital
        Lpmc = Log of the marginal profitability of capital
       Lpmc1 = one period lag of the Log of the marginal profitability of
capital
        Ldap = Log of the cost of borrowed money
       Ldap1 = one period lag of the log of the cost of borrowed money
       _cons = constant
```

The appendix contain the estimate of the “general unrestricted” model and the specification (variable deletion tests) that allow to obtain the final specification (see tables 10 and 11).

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FINAL SPECIFICATION OF THE INVESTMENT EQUATION
------------------------------------------------------------------------------
        Linv |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       Linv1 |   .0005919   .0009381     0.63   0.528    -.0012466    .0024305
      Limmat |   .0069479   .0025952     2.68   0.007     .0018615    .0120343
       Lpmc1 |   .0014353   .0006712     2.14   0.032     .0001198    .0027508
        Ldap |  -.0056296   .0033713    -1.67   0.095    -.0122373    .0009781
       _cons |   18.17514   .0400057   454.31   0.000     18.09673    18.25355
-------------+----------------------------------------------------------------
     sigma_u |  .01066778
     sigma_e |  .01392058
         rho |  .36998508   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(2514,5026) =     0.51       Prob > F    = 1.0000
------------------------------------------------------------------------------
Instrumented:   Linv1 Limmat Lpmc1 Ldap
Instruments:     Linv2 Linv3 Limmat2 Limmat3 Lpmc2 Lpmc3 Ldap2 Ldap3 Llev Llev1
Llev2
                Llev3 LROI LROI1 LROI2 LROI3


STATISTICS:

Fixed-effects (within) IV regression         Number of obs      =         7545
Group variable: impresa                      Number of groups   =         2515

R-sq:  within  = 0.0472                      Obs per group: min =            3
       between = 0.0382                                     avg =          3.0
       overall = 0.0183                                     max =            3

                                             Wald chi2(4)       =  1.30e+10
corr(u_i, Xb)  = -0.8151                     Prob > chi2        =    0.0000


TEST OF JOINT SIGNIFICANCE OF THE VARIABLES INCLUDED IN THE REGRESSION
 ( 1)  Linv1 = 0
 ( 2)  Limmat = 0
```

```
 ( 3)  Lpmc1 = 0
 ( 4)  Ldap = 0
 ( 5)  _cons = 0

           chi2(  5) = 1.3e+10
         Prob > chi2 =    0.0000
```

We reject the null hypothesis of joint non significance of the regressors employed

4. Concluding remarks

The empirical analysis of investments performed here yields results that are consistent with the conventional orthodox neoclassical approax and non consistent with the new-keynesian "excess sensitivity" literature. According to the new-keynesian "share rationing" interpretation, a reduced profitability of the firm or an increased perceived risk would increase the cost of own capital, since it would increase the risk premium that any investor would require in order to be willing to invest in the firm's shares. Therefore the gearing ratio would be negatively correlated to the firm's profitability, but it should be at the same time positively correlated to the optimized cost of financial capital. Hence a causal link going from firm's profitability, financial structure (captured by the gearing ratio and financial costs is established.

On the other hand, according to a more conventional interpretation, a correlation could exist between firm' profitability and gearing ratio, but this would not necessarily imply any causality between the gearing ratio and the optimized cost of finance. In this case, the high correlation between gearing and firm's profitability might be due to the fact that they are both simultaneously determined by random shocks in consumers' preferences and demand, and this would not necessarily imply that the firm has become more risky, since it could be reallocating its capital to more profitable investments. In this sense, a causal link between gearing ratio and cost of financial capital could be simply interpreted as an effect of information asymmetries on the actual risk of the firm's new investments, once a random shock has affected profitability and gearing ratio, while the lack of causal link between gearing ratio and cost of capital could be simply interpreted as the hypothetical ability of the banking sector and financial investors to properly monitor the firm's risk: in other words, a dissociation between gearing and cost of capital could be determined by the ability of the financial investor to assess whether the firm is properly reallocating its capital and changing the nature of its investments after experiencing a negative random shock.

The empirical analysis of this paper, based on a set of Granger causality tests and on estimates of an investment function are consistent with the latter neoclassical and conventional approach, rather than the new-keynesian "excess sensitivity" approach.

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APPENDIX
Derivation of equations 11 and 12

Let us start from the definition of the yield on shares:

$$r^*_S(t) = \frac{D(t)}{p_S(t)N(t)} + \frac{\dot{p}_S(t)}{p_S(t)} \qquad (17$$

Where r^*_S is the (exogenous) market yield on shares, p_S the stock price, N the existing number of shares, D the dividends. Since, as discussed below, we introduce in the model a time-dependent and time-cunsuming process of information spreading, so that any information on the profits affecting the stock price p_S and the risk premium on borrowed finance takes some time before it is known throughout the financial markets, we can say that at time t, the stock price p_S is mainly predetermined, and may be regarded as exogenous.

With asymmetric information and imperfect financial markets, if the managers enjoy some degree of discretionality and are only concerned with remunerating the shareholders at the expected ex ante rate of return on shares r^*_S, the higher the rate of growth of the share price, the lower the dividends that the managers need to pay in order to keep the remuneration of the shares of their company at the market level. The non distributed profits could increase the value of the firm (and as a consequence the value of the firm's control), or could be reallocated in the future. The dividend distribution can therefore be thought of as the cost that the management has to support in order to raise external finance on the stock market.

Therefore, the dividends will be:

$$D(t)= r^*_S(t)p_S(t)N(t)-\dot{p}_S(t)N(t) \qquad (18$$

Managers are constrained to choose their dividend policy in order to remunerate the shareholders at the market yield on shares[9]. Once such a "market" constraint is satisfied, the managers retain the remaining profits. If the cash flow is not sufficient to pay for the required level

[9] We can imagine that if the elements affecting the time path of $p_S(t)$ act, for a sufficient length of time, in such a way that the capital gain element prevails to the extent that

$$D(t)= r^*_S(t)p_S(t)N(t)-\dot{p}_S(t)N(t) < 0$$

then this situation of "negative dividends" would correspond to a situation where the firm finds it convenient to issue new shares on the stock market.

of dividends, the firm could pay the shareholders by reducing the past accumulated profits (reserves), or the shares. However, such a reduction of the reserves has to be financed by issuing new debt, or new shares, or by reducing the level of physical capital. The reduction in the level of physical capital may bring about the liquidation of the firm. We now define the cost of the firm's own capital as the negative cash flow that the firm has to pay in order to provide itself with this source of capital. Therefore:

$$c(t) = r^{*}_{S}(t)p_{S}(t)N(t)-\dot{p}_{S}(t)N(t) \quad (19$$

where c(t) stands for cost of own capital. Hence, the unit cost of own capital will be:

$$i(t) = \frac{c(t)}{E(t) + R(t)} \quad (20$$

where *E(t)* and *R(t)*, are respectively the *subscription* value of the shares (not the market values of the shares, since, on the point of view of the managers, bygones are bygone) and the reserves originating either from past accumulated profit retentions, or, again, by means of shareholders' subscription. Therefore equation 14 can be rewritten as follows:

$$i(t) = \frac{r^{*}_{S}(t)p_{S}(t)N(t)-\dot{p}_{S}(t)N(t)}{E(t) + \int_{0}^{t} | [\pi(t)-(r_{f}+\phi(\Omega))B(t)-D(t)]dt} \quad (21$$

where *B(t)* is the firm’s debt. The denominator of equation (21) shows that the own capital is increased by past accumulated profits. If the remuneration of debt and own capital entirely exhausts π, then the firm does not accumulate profits. If the remuneration of debt and own capital leads to financial flows greater than π (when for example $p_{S}(t)$ not only instantaneously adjusts, but also overshoots to variations in π), then the numerator of (21) increases more than the denominator, and the cost of the own capital also increases. Furthermore, the denominator will be smaller the less risky and leveraged has been the firm in the past. The managers have incentive not to reveal immediately the information on firm cash flow even if they receive some compensation in terms of shares: if, for instance, the cash flow is known to outsiders only when the firms reports are come out, while the managers may observe the profits at any moment in time, for a certain period of time the increase in profits would not generate an in crease in the stock price, the managers would enjoy immediately the increase in fringe benefits (and in case they get compensations associated to the stock price, they would still get it eventually, once the process of information spreading has taken place), the denominator of (21) would increase, the cost of own capital would decrease, reducing, in perspective $\phi(\Omega)$ and the whole cost of finance. However, in general, if we assume that the process of information spreading in financial markets takes time, we may think that the risk premium would not be instantaneously reduced for a successful firm increasing its profits and reducing its leverage. As shown below, we capture this precise detail by assuming that the risk premium contained in the cost of finance and discount factor, in case of a successful firm is reduced gradually in time, according to a process of information spreading that reproduce the one described by Shiller (1989). Any hypothesis on the relations between $\pi(\cdot)$ and p_S should (at least implicitly) rely on some assumptions concerning the diffusion of information about the profits and the profitability of the firm. In fact one could say that the effects of an increase in $\pi(\cdot)$ on the cost of financial capital might be ambiguous and depend on the assumptions on how p_S reflects a risk premium depending in its turn on the process of information spreading concerning the firm's profits. Therefore, the information concerning both the risk premium on p_S and the risk premium $\phi(\Omega)$ would be caracterized by a time dependent diffusion process through the financial markets. Furthermore, both p_S and $\phi(\Omega)$ would depend on $\pi(\cdot)$.

We assume then that the optimized cost of finance $\Phi(t)$ contains a "risk premium" negatively correlated with profits $\pi(\cdot)$. If the firm has positive profits and has issued shares on the stock market, a process of information spreading, affecting the risk premium on the cost of finance takes place.

On the basis of the above assumptions we approximate the link from $\pi(t)$ to Φ^* by the following generic function, approximating the optimized cost of finance to the risk premium a(t), a negative function of the process of information spreading, and of the profits. We will define below a parameter β reflecting the diffusion in time of the information concerning the profits π. For the sake of simplicity, we also assume that the risk premium charged to a "risky" firm will be the same for the firms not having "significantly positive" profits and for those not issuing securities on financial markets. (since the available information concerning the latter is generally considered much lower than for firms issuing shares on the stock market. In other words, both the firms with "not significantly positive" profits and those not issuing shares on the stock markets will be charged with the constant risk premium ξ^*. All the others enjoy the advantage of the "process of information spreading", but this process could be suddenly interrupted whenever the performance of a firm worsens, causing profits to by "not significantly positive". By "not significantly positive", for the sake of the algebraic tractability of the model we do not mean

$\pi > 0$

but we mean instead

$\pi > 1$

by considering a sufficiently small unit of measure (i.e., for instance not an EURO, but a cent of an EURO)

The causal link going from $\pi(t)$ to Φ^* is meant to explicitly reproduce the dynamics of the "epidemic" model of information spreading invoked by Shiller in his above-mentioned contribution. We define therefore:

$$\Phi^*(t) = r^o_S + a(t) \qquad (22$$

where r^o_S is the long run risk free interest rate, and "*a*" is a risk parameter associated with the lack of information (available to outsiders) on the quality of management and on the quality of investments of the firm under consideration.

$$a = \begin{cases} a_1(\bar{\xi})/t & \text{for } \pi > 1 \text{ and } t > 1 \text{ with } d(a_1)/d\xi < 0 \\ \xi^* & \text{for } \pi \leq 1 \text{ and/or } t \leq 1 \end{cases} \qquad (23$$

The conditions on the variable "*t*" reflect the fact that the phenomena of information spreading and processing, that asymptotically reduce and remove the risk parameter "*a*", do not take place immediately (i.e. at the exact time t=0 where the firm materially issues shares on the stock market), but after a length of time required by the market to process the data on which they may base their valuations of riskiness. For these reasons, "*a*" depends on a parameter ξ reflecting the process of information spreading only when $t > 0$, while for $t=0$ the firm is still regarded as "risky" and charged with the constant parameter ξ^* for risky investments.

(23) says that the risk factor *"a"* (and the function $a_1(\xi)$) tends to disappear when "*t*" tends to infinity: the rationale for such an assumption is that when the available amount of information on the behaviour of a given firm becomes very high, outsiders increase their ability to make inferences on the quality and characteristics of the firm's behaviour (profitability of investments, dividend policies, skills of the decision makers, etc.). In a sense, one could say that asymptotically the degree of information asymmetry is reduced.

It seems natural to assume that in these circumstances "ξ" depend on the qualitative characteristics of the process of information spreading. It also seems natural to assume that the information spread by such a process must reflect the performances of the firm under consideration. Following Shiller, we define a parameter β which reflects the diffusion in time of the information concerning the profits π. For the sake of simplicity, we also assume that the risk premium charged to "risky" firms will be the same for the firms having non-positive profits and for those not issuing shares in the stock markets (since the available information concerning the latter is generally considered much lower than for the firms issuing shares in the stock markets). In other words, both the firms with non positive profits and those not issuing shares in the stock markets will be charged with the maximum (constant) risk premium ξ^*. All the others enjoy the advantages of the "process of information spreading", but this process of information spreading could be suddenly interrupted whenever the performance of a firm worsens, causing the profits π to be non positive.
If at any time the profits of the firm fall below the level $\pi=0$, then the firm is charged with the maximum (constant) risk premium ξ^*. The virtuous circle of information spreading may begin again (by setting again $t=0$) if and only if the profits increase again to the point where $\pi>0$. Furthermore, for $\pi>0$ and $t\geq 0$, we assume that the process of information spreading does not only detect when the profits are positive but will also show "how good the performance" of the firm is, i.e. "how high" the profits are. Therefore, for $\pi>0$ and $t>0$, we have the following function:

$$\xi = \xi(\pi(t),t) \qquad (24$$

Hence, under some (above mentioned) circumstances, Φ^* is a function of the total profits $\pi(t)$. Its analytical form is meant to capture the above-metioned “epidemic” mechanism of information spreading introduced by Shiller.

We define then the function $\xi(\pi(t),t)$ as follows:

$\xi(\pi(t),t) = (\beta/t)log(\pi\cdot t)$ (25

In definition (25), with an appropriate value for the constant parameter β, a dynamic behaviour can be reproduced where the function $\xi(\cdot)$ is monotonically increasing in "π" and has a point of maximum in t^o for what concerns the variable "*t*". When "*t*" further increase after the point of maximum t^o (i.e. when the 'removal rate' prevails over the process of diffusion determined by the "information carriers"), the function is decreasing in "*t*" (while it is still increasing in π). The phenomenon described by equation (25) could reproduce the effects of an exogenous shock in the profits π, which would affect the risk premium.

We can now define the Hamiltonian of the as follows:

$$H = exp\,[- \Phi^*(\pi(t))t\,]\;\; [u(\cdot) - A(I(t))] + z(t)\cdot[I(t) - g(k(t))] \qquad (26$$

Since the discount factor is a function of π, which is, in its turn, a function of both the state variable *k(t)* and of the control variable *I(t)*, the system is time dependent. Again, it might not have a solution, and, in any case, the determination of a solution requires a particular "heuristic" procedures. The method of solution is exactly the same as the one followed in Mazzoli (1998, ch. 7). The risk valuation of the external investor reacts to any new information about successful technical innovation affecting variable profits able to increase the profitability and performance of the firm *as soon as such information is known and spreads around in the market*.

The transversality conditions are the following:

$$\lim_{t\to\propto} z(t)\geq 0,$$

$$\lim_{t\to\propto} z(t)\;[k^*(t)-k(t)]=0 \qquad (27$$

where k^* is the optimal level of physical capital. Remembering that

$$\pi(t) = u(k(t)|v_i) - A[I(t)]$$

it is assumed, in what follows, that the transversality conditions are satisfied. For $\pi>0$ and $t>0$. Assuming that the second order conditions are satisfied, the first order conditions will be the following:

$$\partial H/\partial I = 0 = -e^{-\Phi(\pi(t))t}\cdot\; A' - e^{-\Phi(\pi(t))t}\cdot[\; t\,(d\Phi/\,d\pi\,)\cdot(-A')\;]\cdot\pi\; + z(t) \qquad (28$$

Hence

$$d\Phi/d\pi = (d\Phi/da)\cdot(da/di)\cdot(di/d\pi) = \beta/(t^2\pi) \qquad (29$$

$$\partial H/\partial I = 0 = -e^{-\Phi(\pi(t))t} \cdot A' - e^{-\Phi(\pi(t))t} \cdot (\beta/t) \cdot (-A') + z(t) \qquad (30$$

and solving for z

$$z = A'\,[1 - (\beta/t)]\, e^{-\Phi(\pi(t))t} \qquad (31$$

The condition for the state variable is the following:

$$dz/dt = -(\partial H/\partial k) = -(\partial u/\partial k)\; e^{-\Phi(\pi(t))} + t\,[(d\Phi/d\pi)(\partial u/\partial k)] \cdot e^{-\Phi(\pi(t))} \cdot \pi(t) + z(t) \cdot g$$

(32)

Hence, substituting in it equation (30) we get:

$$dz/dt = e^{-\Phi(\pi(t))t}\,(-\partial u/\partial k)\;[1 - (\beta/t)] \qquad (33$$

By putting together the definition of $z(t)$ and al the differential equations, we get the following system:

$$\begin{cases} z(t) = A'[1 - (\beta/t)]\, e^{-\Phi(\pi(t))t} & (34 \\ dz/dt = e^{-\Phi(\pi(t))t}\cdot(-\partial u/\partial k)\,[1 - (\beta/t)] & (35 \\ dk/dt = I - gk & (2 \end{cases}$$

Time differentiating equation (34) we get the following:

$$dz/dt = e^{-\Phi(\pi(t))t} A''\,[1-(\beta/t)] \cdot (dI/dt) - \Phi\cdot e^{-\Phi(\pi(t))t} A'\,[1-(\beta/t)] + e^{-\Phi(\pi(t))t} A'[1-(\beta/t^2)] \; +$$

$$+\, e^{-\Phi(\pi(t))t}\,(-t)\,\{(-\beta/t^3)\cdot \log(\pi\cdot t) + (\beta/\pi t^3)[\pi + t(-A')(dI/dt)]\} \qquad (36$$

where, for simplicity, the arguments of π have been omitted.

In equation (36), for $t \to \propto$, the last two addends, i.e.

$e^{-\Phi(\pi(t))t} A'[1-(\beta/t^2)]$

and

$e^{-\Phi(\pi(t))t} (-t) \{(-\beta/t^3) \cdot log(\pi \cdot t) + (\beta/\pi t^3)[\pi+t(-A')(dI/dt)]\}$

tend to zero, and the term $[1-(\beta/t)]$ tends to 1.

Therefore, for $t \to \infty$, we would obtain a model analogous to the standard neoclassical investment model, i.e. the following:

$$\begin{cases} dI/dt = (1/A'') \cdot [-\partial u / \partial k + (\Phi^o + g)A'] & (11 \\ dk/dt = I - gk & (12 \end{cases}$$

which yields the saddlepoint equilibrium

$I^* = A'^{-1}[\partial u/\partial k)/(\Phi+g)]$ for the locus $(dI/dt)=0$ and

$I = g \cdot k$ for the locus $(dk/dt)=0$.

Dataset and data processing

The data have been constructed from the dataset Aida, by including all the available firms belonging to the mechanic sector (ATECO code 29), and appearing in the dataset from 10/27/2006 to 11/1/2006. This correspond, to a good degree of approximation, to the whole universe of Italian mechanic firms, rather than a sample.

We have extracted all the available company accounts and reports from the year 2000 to the year 2005 (3076 firms), after eliminating all those showing values equal to 0 for the physical capital (i.e. those who were only nominally existing but would have actually interrupted their activity).

On the basis of the available company accounts the following indexes have been calculated:

- Average profitability of capital:

$$profmediacap = \frac{RO}{K} \cdot 100$$

where RO = operational result and K = Total physical assets.

- Gearing:

$$gearing = \left(1 - \frac{CP}{K} \right) \cdot 100$$

where CP is the own capital.

- Leverage:

$$lev = \frac{Debt}{CP} \cdot 100$$

- Cost of borrowed money :

$$denaroaprest = \frac{financial\cos ts}{Debito} \cdot 100$$

- Return on equity:

$$roe = \frac{profits}{networth} \cdot 100$$

- Return on investiment:

$$roi = \frac{MOL}{investedcapital} \cdot 100$$

We have employed the definitions used in SIES (a research centre of the Catholic University, directed by Piero Ganugi), where MOL = value added – other incomes – long run pension retirement debt of the employess (TFR)

Invested capital = assets – commercial debt – TFR.

Since the value of the physical capital is already net of the rate of depreciation then

$$investiments = K_t - K_{t-1}$$

The firms that were manifestedly in the process of exit or financial distress (likely to go bankrupt, i.e. with negative average capital profitability or negative leverage). Then the total number of firms amounts to 2515.

The dataset is characterized as follows:

```
obs:        15,090
vars:           15
```

In order to be able to use logarithms, a traslation of the variables has been done, so that any variable would be redifined by summing to its value the absolute value of its minimal value plus 1.

TABLE 1 Descriptive statistics

Investiments (inv):

	Percentiles	Smallest		
1%	-1626423	-8.63e+07		
5%	-344034	-5.47e+07		
10%	-162627	-4.67e+07	Obs	15090
25%	-45905	-2.77e+07	Sum of Wgt.	15090
50%	-4909.5		Mean	66781.49
		Largest	Std. Dev.	1612013

75%	58552	3.07e+07		
90%	330965	4.03e+07	Variance	2.60e+12
95%	749345	4.89e+07	Skewness	.0164401
99%	2687628	8.68e+07	Kurtosis	1354.992

Average profitability of capital (pmc):

	Percentiles	Smallest		
1%	2.42561	0		
5%	7.888105	0		
10%	12.2502	.0062195	Obs	15090
25%	24.17606	.0360071	Sum of Wgt.	15090
50%	58.04565		Mean	566.599
		Largest	Std. Dev.	37390.6
75%	151.7564	110567.5		
90%	372.9872	151466.4	Variance	1.40e+09
95%	695.7	499959.6	Skewness	120.3105
99%	2342.285	4559675	Kurtosis	14652.16

Gearing (gea):

	Percentiles	Smallest		
1%	-3933.07	-4.12e+07		
5%	-1149.692	-1407237		
10%	-570.5254	-221536	Obs	15090
25%	-168.7426	-136676.4	Sum of Wgt.	15090
50%	-14.00251		Mean	-3127.852
		Largest	Std. Dev.	335636.6
75%	51.88609	99.31914		
90%	79.5385	99.3444	Variance	1.13e+11
95%	87.84356	99.44144	Skewness	-122.6061
99%	96.17188	99.82874	Kurtosis	15050.69

Leverage (lev):

	Percentiles	Smallest		
1%	26.48719	2.178801		
5%	59.07955	4.164096		
10%	91.58812	4.683643	Obs	15090
25%	191.5964	5.544341	Sum of Wgt.	15090
50%	458.6954		Mean	1260.551
		Largest	Std. Dev.	4110.544
75%	1097.167	60030.48		
90%	2646.228	70452.25	Variance	1.69e+07
95%	4669.69	74824.48	Skewness	43.64929
99%	13155.79	348871	Kurtosis	3428.234

Cost of borrowed money (dap):

	Percentiles	Smallest		
1%	0	-1.23357		
5%	.1090392	-.0731791		
10%	.3553682	-.0701593	Obs	15090
25%	1.121968	-.0589	Sum of Wgt.	15090
50%	2.307314		Mean	2.770524
		Largest	Std. Dev.	2.647813
75%	3.78812	61.40627		
90%	5.424129	61.72268	Variance	7.010914
95%	6.672499	71.64997	Skewness	6.65994
99%	11.00291	77.25556	Kurtosis	128.0681

Return on equity (ROE):

```
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -63.70082      -218011.9
 5%    -11.37094      -4853.542
10%    -2.044347      -2301.078       Obs               15090
25%     1.942154      -2145.321       Sum of Wgt.       15090

50%     8.243765                      Mean          -3.035546
                        Largest       Std. Dev.      1777.964
75%         19.4       1072.721
90%     34.83572       1129.676       Variance        3161157
95%     47.66188        6512.75       Skewness      -122.1747
99%      80.4847       7911.024       Kurtosis       14982.15
```

Return on investiment (ROI):

```
-------------------------------------------------------------
      Percentiles      Smallest
 1%    -3.944929      -350.1084
 5%     2.204489      -121.6909
10%     4.138676      -108.9699       Obs               15090
25%     7.540343      -85.74021       Sum of Wgt.       15090

50%     12.40032                      Mean           15.06638
                        Largest       Std. Dev.      12.81965
75%     19.87019       140.0991
90%     29.35436       176.7845       Variance       164.3435
95%     37.64623       212.6329       Skewness       .3666827
99%      57.6242       226.3389       Kurtosis       64.32517
```

For each of the above defined variables, in the estimates “Lx” reads for “*log x*” and “x1” reads for x_{t-1}

Granger Causality Tests with Arellano-Bond GMM-DIF

TABLE 2

Does Average Profitability of Capital cause Gearing?

```
*GMM-DIF *

Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group variable (i): Enterprise                  Number of groups   =      3819

                                                F(6, 7631)         =  21720.89

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.gearing    |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gearing      |
          LD |   31.16936   1.703501    18.30   0.000     27.83003    34.50869
         L2D |   42.23215   9.636113     4.38   0.000     23.34272    61.12158
         L3D |   37.54724   8.940673     4.20   0.000     20.02106    55.07342
profmediac~1 |
          D1 |   -14.5921   11.24905    -1.30   0.195    -36.64333    7.459128
profmediac~2 |
          D1 |  -.0213292   .0053284    -4.00   0.000    -.0317744    -.010884
profmediac~3 |
          D1 |  -.0186926   .0039718    -4.71   0.000    -.0264784   -.0109068
_cons        |   6251.327   1854.453     3.37   0.001      2616.09    9886.564
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =    11.46      Prob > chi2 = 0.3226

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
         H0: no autocorrelation   z =  -0.88   Pr > z = 0.3771

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 3

Does Gearing cause Average Profitability of Capital?

GMM-DIF

```
Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group variable (i): enterprise                  Number of groups   =      3819

                                                F(6, 7631)         =    199.33

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.           |
profmediacap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
profmediacap |
          LD |   .0521067   .0468443     1.11   0.266    -.0397209    .1439343
         L2D |   .0004182    .000098     4.27   0.000     .0002262    .0006103
         L3D |    .000312   .0000591     5.28   0.000     .0001961    .0004279
gearing1     |
          D1 |  -.0364332   .0333737    -1.09   0.275    -.1018549    .0289885
gearing2     |
          D1 |  -.9457429   .2021242    -4.68   0.000    -1.341962   -.5495238
gearing3     |
          D1 |  -.4063983   .1339465    -3.03   0.002    -.6689702   -.1438263
_cons        |   48.70205   130.6161     0.37   0.709    -207.3414    304.7455
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =     6.68      Prob > chi2 = 0.7554

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
         H0: no autocorrelation   z =  -0.16   Pr > z = 0.8702

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 4

Does Cost of borrowed money cause Gearing?

GMM-DIF

```
Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group variable (i): enterprise                  Number of groups   =      3819

                                                F(6, 7631)         =  49257.02

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.gearing    |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
gearing      |
          LD |   31.30273   .6101909    51.30   0.000     30.10659    32.49887
         L2D |   24.72634   3.384509     7.31   0.000     18.09177    31.36091
         L3D |   24.80872   6.942361     3.57   0.000     11.19979    38.41766
denaroapre~1 |
          D1 |  -668.0544    3371.82    -0.20   0.843    -7277.749     5941.64
denaroapre~2 |
          D1 |  -98.98627   1132.844    -0.09   0.930    -2319.672    2121.699
denaroapre~3 |
          D1 |  -98.71366   275.9533    -0.36   0.721    -639.6581    442.2307
_cons        |   4266.247    1064.66     4.01   0.000     2179.221    6353.272
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =     5.61      Prob > chi2 = 0.8466

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 5

Does gearing cause the cost of borrowed money?

GMM-DIF

```
Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group variable (i): enterprise                  Number of groups   =      3819

                                                F(6, 7631)         =     10.50

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.           |
denaroaprest |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
denaroaprest |
          LD |   .2707763   .0927053     2.92   0.004     .0890485    .4525041
         L2D |   .0377471   .0361636     1.04   0.297    -.0331434    .1086377
         L3D |   .0064455   .0158718     0.41   0.685    -.0246676    .0375586
gearing1     |
          D1 |   .0000152   5.97e-06     2.55   0.011     3.53e-06     .000027
gearing2     |
          D1 |    .000099   .0000286     3.46   0.001     .0000429    .0001552
gearing3     |
          D1 |   1.68e-07   .0000216     0.01   0.994    -.0000421    .0000425
_cons        |  -.1820187   .0308579    -5.90   0.000    -.2425085   -.1215288
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =    29.79      Prob > chi2 = 0.0009

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
         H0: no autocorrelation   z =  -2.75   Pr > z = 0.0059

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 6

Does Cost of Borrowed Money cause Average Profitability of Capital?

GMM-DIF

```
Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group var4iable (i): enterprise                 Number of groups   =      3819

                                                F(6, 7631)         =    149.69

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.           |
profmediacap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
profmediacap |
          LD |   .0040751   .0034244     1.19   0.234    -.0026377     .010788
         L2D |  -1.04e-06   .0000453    -0.02   0.982    -.0000898    .0000878
         L3D |   .0001353   .0000306     4.43   0.000     .0000754    .0001953
denaroapre~1 |
          D1 |   78.64758   81.74915     0.96   0.336    -81.60321    238.8984
denaroapre~2 |
          D1 |  -77.40505   151.5489    -0.51   0.610    -374.4826    219.6725
denaroapre~3 |
          D1 |  -25.99273   37.12351    -0.70   0.484    -98.76501    46.77955
_cons        |   3.475319   197.5524     0.02   0.986    -383.7817    390.7323
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =     1.19      Prob > chi2 = 0.9996

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
         H0: no autocorrelation   z =  -2.28   Pr > z = 0.0228

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 7

Does Average Profitability of Capital cause Cost of Borrowed Money?

```
*GMM-DIF*

Arellano-Bond dynamic panel-data estimation     Number of obs      =      7638
Group variable (i): enterprise                  Number of groups   =      3819

                                                F(6, 7631)         =     11.30

Time variable (t): year                         Obs per group: min =         2
                                                               avg =         2
                                                               max =         2

Two-step results
------------------------------------------------------------------------------
D.           |
denaroaprest |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
denaroaprest |
          LD |   .4514305   .1322211     3.41   0.001     .1922408    .7106202
         L2D |  -.0087512   .1160051    -0.08   0.940     -.236153    .2186506
         L3D |   .0058835   .0298059     0.20   0.844    -.0525443    .0643113
profmediac~1 |
          D1 |  -.0006854   .0016874    -0.41   0.685    -.0039932    .0026224
profmediac~2 |
          D1 |  -2.29e-07   2.18e-07    -1.05   0.295    -6.57e-07    1.99e-07
profmediac~3 |
          D1 |  -2.02e-07   1.98e-07    -1.02   0.307    -5.90e-07    1.86e-07
_cons        |  -.1512036   .1170709    -1.29   0.197    -.3806948    .0782875
------------------------------------------------------------------------------

Sargan test of over-identifying restrictions:
         chi2(10) =     8.71      Prob > chi2 = 0.5595

Arellano-Bond test that average autocovariance in residuals of order 1 is 0:
         H0: no autocorrelation   z =  -0.50   Pr > z = 0.6198

note: the residuals and the L(2) residuals have no obs in common
      The AR(2) is trivially zero
```

TABLE 8

Does Gearing cause Cost of Borrowed Money?

```
 *INSTRUMENTAL VARIABLES*

Fixed-effects (within) IV regression         Number of obs      =     11457
Group variable: entreprise                   Number of groups   =      3819

R-sq:  within  =      .                      Obs per group: min =         3
       between = 0.0418                                     avg =       3.0
       overall = 0.0182                                     max =         3

                                             Wald chi2(6)       =  12216.57
corr(u_i, Xb)  = -0.8661                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
denaroaprest |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    gearing1 |   .0001614   .0001578     1.02   0.306    -.0001479    .0004706
    gearing2 |   .0009363   .0009401     1.00   0.319    -.0009062    .0027789
    gearing3 |   .0003098   .0007312     0.42   0.672    -.0011233     .001743
denaroapre~1 |  -.2358417   .0219136   -10.76   0.000    -.2787916   -.1928919
denaroapre~2 |  -.2061544   .0197409   -10.44   0.000    -.2448459    -.167463
denaroapre~3 |  -.0856863   .0147885    -5.79   0.000    -.1146713   -.0567013
       _cons |   4.620177    .485575     9.51   0.000     3.668468    5.571887
-------------+----------------------------------------------------------------
     sigma_u |  5.2551138
     sigma_e |  2.5688337
         rho |  .80713482   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(3818,7632) =     1.09       Prob > F    = 0.0011
------------------------------------------------------------------------------
Instrumented:   gearing1 gearing2 gearing3
Instruments:    denaroaprest1 denaroaprest2 denaroaprest3 prodmediacap1
prodmediacap2 prodmediacap3 lev1 lev2 lev3

THE INSTRUMENTS ARE STATISTICALLY SIGNIFICANT

Test of overidentifying restrictions:   2.306  Chi-sq( 3)  P-value =  .5113

. Gearing does not Granger cause the cost of borrowed money
```

TABLE 9

Does the cost of borrowed money cause Gearing?

*INSTRUMENTAL VARIABLES (INSTRUMENTS: LEVERAGE AND AVERAGE PRODUCTIVITY OF CAPITAL *

Fixed-effects (within) IV regression		Number of obs =	11457
Group variable: enterprise		Number of groups =	3819
R-sq:	within = 0.7152	Obs per group: min =	3
	between = 0.6605	avg =	3.0
	overall = 0.6575	max =	3
		Wald chi2(6) =	26176.96
corr(u_i, Xb) = -0.7172		Prob > chi2 =	0.0000

gearing	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
denaroapre~1	-35501.03	50881.47	-0.70	0.485	-135226.9	64224.81
denaroapre~2	-98406.7	42777.78	-2.30	0.021	-182249.6	-14563.78
denaroapre~3	24695.02	54085.05	0.46	0.648	-81309.73	130699.8
gearing1	26.12226	.5113036	51.09	0.000	25.12012	27.12439
gearing2	8.942549	1.883408	4.75	0.000	5.251137	12.63396
gearing3	56.01681	2.80905	19.94	0.000	50.51118	61.52245
_cons	349388.7	238904	1.46	0.144	-118854.5	817631.9
sigma_u	302922.36					
sigma_e	202109.61					
rho	.6919673	(fraction of variance due to u_i)				

F test that all u_i=0: F(3818,7632) = 0.25 Prob > F = 1.0000

Instrumented: denaroaprest1 denaroaprest2 denaroaprest3
Instruments: gearing1 gearing2 gearing3 lev1 lev2 lev3 prodmediacap1 prodmediacap2 prodmediacap3

LEVERAGE AND AVERAGE PROFITABILITY OF CAPITAL ARE NOT STATISTICALLY SIGNIFICANT INSTRUMENT

Test of overidentifying restrictions: 16.014 Chi-sq(3) P-value = .0011

*INSTRUMENTAL VARIABLES (INSTRUMENTS: ROI AND ROE *

```
Fixed-effects (within) IV regression         Number of obs      =      11457
Group variable: Enterprise                   Number of groups   =       3819

R-sq:  within  = 0.9183                      Obs per group: min =          3
       between = 0.8486                                     avg =        3.0
       overall = 0.8224                                     max =          3

                                             Wald chi2(6)       =  91242.04
corr(u_i, Xb)  = -0.7159                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
     gearing |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
denaroapre~1 |   9754.365   44517.25     0.22   0.827    -77497.84    97006.57
denaroapre~2 |  -44855.25   64439.51    -0.70   0.486    -171154.4    81443.87
denaroapre~3 |  -20114.55   21876.82    -0.92   0.358    -62992.32    22763.22
    gearing1 |   26.36504   .2437003   108.19   0.000     25.88739    26.84268
    gearing2 |   9.737622   .8917215    10.92   0.000      7.98988    11.48536
    gearing3 |   55.03176   1.906018    28.87   0.000     51.29603    58.76748
       _cons |   199129.1   236962.5     0.84   0.401    -265308.9    663567.2
-------------+----------------------------------------------------------------
     sigma_u |  212362.34
     sigma_e |  108238.99
         rho |  .79378683   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(3818,7632) =     0.88       Prob > F    = 1.0000
------------------------------------------------------------------------------
Instrumented:   denaroaprest1 denaroaprest2 denaroaprest3
Instruments:    gearing1 gearing2 gearing3 roe1 roe2 roe3 roi1 roi2 roi3
```

ROI E ROE ARE STATISTICALLY SIGNIFICANT INSTRUMENTS

```
. overidxt

Test of overidentifying restrictions:   0.130  Chi-sq( 3)  P-value =   .988
```

By Using statistically significant instrument (ROI and ROE) we find that the cost of borrowed money does not cause gearing.

TABLE 10

GENERAL "UNRESTRICTED" SPECIFICATION OF THE INVESTMENTS EQUATION EMPLOYED FOR THE "GENERAL TO SPECIFIC" METHODOLOGY.

For Convenience the list of variables is reported again here

```
       Linv = Log of Investments
       Linv1 = one period lag of the Log of Investments
      Limmat = Log of the stock of physical capital
     Limmat1 = one period lag of the log of the stock of physical capital
        Lpmc = Log of the marginal profitability of capital
       Lpmc1 = one period lag of the Log of the marginal profitability  of
capital
        Ldap = Log of the cost of borrowed money
       Ldap1 = one period lag of the log of the cost of borrowed money
       _cons = constant
```

Estimating method: instrumental variables.

```
Fixed-effects (within) IV regression         Number of obs      =        7545
Group variable: enterprise                   Number of groups   =        2515

R-sq:  within  = 0.0707                      Obs per group: min =           3
       between = 0.0797                                     avg =         3.0
       overall = 0.0624                                     max =           3

                                             Wald chi2(7)       =  1.33e+10
corr(u_i, Xb)  = -0.4330                     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        Linv |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       Linv1 |   .0006017   .0009292     0.65   0.517    -.0012195     .002423
      Limmat |   .0075289   .0028392     2.65   0.008     .0019642    .0130936
     Limmat1 |  -.0045759   .0044517    -1.03   0.304    -.0133012    .0041493
        Lpmc |  -.0015044   .0015033    -1.00   0.317    -.0044507    .0014419
       Lpmc1 |   .0017545   .0006897     2.54   0.011     .0004028    .0031063
        Ldap |  -.0056416   .0037585    -1.50   0.133    -.0130081    .0017248
       Ldap1 |   .0012199   .0036672     0.33   0.739    -.0059677    .0084076
       _cons |   18.22982   .0577011   315.94   0.000     18.11672    18.34291
-------------+----------------------------------------------------------------
     sigma_u |  .00666201
     sigma_e |  .01375143
         rho |  .19008705   (fraction of variance due to u_i)
------------------------------------------------------------------------------
F  test that all u_i=0:     F(2514,5023) =     0.45       Prob > F    = 1.0000
------------------------------------------------------------------------------
Instrumented:   Linv1 Limmat Limmat1 Lpmc Lpmc1 Ldap Ldap1
Instruments:     Linv2 Linv3 Limmat2 Limmat3 Lpmc2 Lpmc3 Ldap2 Ldap3 Llev Llev1
Llev2 Llev3 LROI LROI1 LROI2 LROI3


Test of overidentifying restrictions:   6.278  Chi-sq( 9)  P-value =  .7118
```

According to the Sargan test of instruments significance we do not reject the hypothesis H0 of significance of the instruments employed.

TABLE 11

Joint test of significance of the variables to be omitted

```
 ( 1)  Limmat1 = 0
 ( 2)  Lpmc = 0
 ( 3)  Ldap1 = 0

           chi2(  3) =    5.18
         Prob > chi2 =    0.1594
```

We do not reject H0. The variables omitted in the final “parsimonious specification” are not significant.