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Investment and External Finance: An Empirical Analysis

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Investment and External Finance:
An Empirical Analysis[*]

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Abstract

This paper looks for evidence that the availability of external finance affects the aggregate investment of non-financial corporations of the US. We do not find any empirical support for this hypothesis. Furthermore, we find that the amount of external finance raised does not depend on the need to finance investment. Share issuance seems to be largely driven by stock market prices; moreover, quite surprisingly, it generates a positive impact on both the Tobin's Q and debt issuance.

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1 Introduction

Hayashi (1982) has shown that in presence of constant returns to scale and competitive markets, the marginal productivity of investment is equal to the average productivity, and it is measured by the ratio between the value of the liabilities of the firm and the replacement cost of capital, i.e. the Tobin's q. The Neoclassical theory of investment and the Tobin's q, nevertheless, differ in many important respects. The Tobin's q theory implies a causal relationship: higher stock market prices drive investment. In the first order condition of the neoclassical model, on the contrary, the variables corresponding to the Tobin's q are not exogenous: the theory rather implies a bidirectional causality. Thus, it is possible that the correlation between q and investment is largely driven by the latter. In this case stock market prices do not influence investment but, being forward looking, provide an *ex ante* valuation of the profitability of both the existent stock of capital and the investment opportunities available to the entrepreneur: the Tobin's q becomes a leading indicator of future investment, even if no direct casual relationship takes place.

In this paper we study empirically the relevance of external finance for the investment of industrial firms. We thus want to estimate if Tobin's theory is supported empirically. Our point is that if financial variables are relevant in order to finance investment, than the sums raised by either primary placements of shares, or debt issuance, or both, must somewhat influence the quantity of investment. In other words, when a measure of the Tobin's q is significant in a regression on investment, for a causal relationship to take place, some other conditions must hold. Firstly, the significance of the Tobin's q must be due to stock market valuations, rather than to the current marginal productivity of capital. [1] Secondly, high stock prices must cause the issuance of new stock and/or new debt. Finally, the amount of finance raised by means of the issuance of new securities must influence investment. Blanchard et al. (1993), for instance, suggest that it is more rational for firms issuing new shares opportunistically, in order to take advantage of high stock prices, to invest the proceeds in bonds. In the absence of new investment opportunities, in fact, the investment in capital incurs in decreasing marginal returns, while the returns obtained by purchasing bonds are constant.

As suggested by Christopher A. Sims in his discussion of Morck et al. (1990), we choose to study the relationship between financial flows and real investment without taking any *a priori* stance on the causality relationships occurring among the variables under analysis. Unlike many previous works on this field, we con-

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[1]The impact of the current value of the marginal productivity of capital on Tobin's q is captured by the denominator of the ratio, when the Hayashi (1982) assumptions hold.

struct a simple theoretical model which permits the choice of the macroeconomic variables at work on a theoretical ground. We thus estimate a reduced form equation using VAR techniques; the VAR has two major advantages: it allows considering all the variables as endogenous, and to analyze simultaneously stationary and non-stationary variables. The only cost imposed by the VAR is the loss of the contemporaneous relationships among the variables, but we regard this problem as minor. Industrial investment projects need long periods to be completed, often lasting several quarters if not years; stocks and bonds issuance, on the contrary, because of large transaction costs, is normally concentrated in a very few emissions, if not a single issue. It seems thus unlikely that contemporaneous relationships among these variables play a major role. We use aggregate data for the US economy that are available for a long time span, of more than fifty years. The analysis covers different business cycles, and this allows to capture the long-run dynamics of the variables. Moreover, since the analysis makes extensive use of Granger causality tests, which have low power, longer time-series enhance the statistical reliability of these tests. The obvious cost is the loss of cross-firms heterogeneity. We thus regard the empirical evidence provided by this study as complementary to that obtained by means of firm-level data, and we show that our results are compatible with these last.

We find no evidence that the funds raised by means of primary placements impact on investment. We rather find that share issuance is largely driven by stock market prices. Moreover, and quite surprisingly, share issuance, in aggregate, not only does not cause a downward pressure on stock prices, but it rather generates a positive impact on our measure of Tobin's q. Furthermore, debt issuance increases as the value of Tobin's q rises, so that share and debt issuance are complements. Our hypothesis is that the three variables react to the same underlying driving force, the expected profitability of firms. Issuance thus rises when the stock market has an upward trend, as managers that benefit from inside information try to anticipate the peak in stock market valuations. This is in line with the theory developed by Pástor and Veronesi (2005) suggesting that firms do not go public uniformly over time, but that rather IPOs tend to be concentrated in waves. Equally surprising, we find evidence that investment shocks have a negative impact on share issuance. Our results complements those of the literature based on firm-level data. Lyandres et al. (2007), in particular, highlight that firms issuing stocks tend to invest more than the average, and suggest that the larger investment causes the poor returns that the shares of these firms normally experience during the two years following the issuance. Given the aggregate nature of our data, we do not find evidence that issuance affects investment, but this is not surprising in consideration of the relevance of large firms for aggregate investment. Moreover, Fama and French (1999) have shown that aggregate investment is largely financed by means of re-

tained earnings. Since we study the *quantity* of cash raised from external sources by firms, we rather find that investment has a negative impact on the amount of cash raised from the stock market. We interpret this result as evidence that the stock market rationally anticipates that the shares of those firms that need to finance large investment projects tend to underperform the rest of the market.[2] As a consequence, firms that need to invest less in real capital (such as those of human capital intensive sectors) experience higher than average price-earning ratios, and the IPOs or seasoned equity offerings of these firms raise larger amounts of cash. Finally, although our results are far from being conclusive, we find some evidence that the significance of the Tobin's q, when regressed on investment, is due to the marginal productivity of capital.

The paper is organized as follows: Section 2 discusses the relevant literature, Section 3 develops the basic theoretical model of investment that we use. Section 4 describes the dataset, while Section 5 sets out the econometric methodology employed. Section 6 describes our empirical results and Section 7 presents our conclusions.

2   The literature

In order to empirically asses the role of stock markets in financing investment, Morck et al. (1990) compare the R^2 of different regression models, providing evidence that the relationship between relative stock returns and investment is not driven by the cost of external finance. Fama and French (1999) depict a quite similar picture: they show that internally generated funds cover about 69.5 per cent of investment, while new issues of stocks play a limited role in their sample, financing only 7.9 per cent of the investment, the rest being financed with debt. Baker et al. (2003), on the contrary, find that the sensitiveness of investment to stock prices is correlated to an index measuring the degree by which firms are equity constrained. Nevertheless, the relationship between q and investment should be particularly strong when shares are priced irrationally, generating unstable but long-lasting equilibria with substantial overpricing.[3] In this case managers and shareholders could exploit this irrationality by issuing new equities to finance investment projects at a substantial discount. This hypothesis has been tested by Chirinko and Schaller (1996) estimating a dynamic investment model; they found

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[2]Shares of firms of industrial sectors that require heavy capital investment normally trade at much lower multiples with respect to fundamentals than those of other sectors. Since the need to finance investment is a drain on cash flows, firms in these industries have lower than average dividend payouts.

[3]For example, because of fundamental psychological factors, as argued by Shiller (2005). See also Kurz (1997).

that bubbles were present in the US stock market, but they had no influence on investment, which was instead driven by fundamentals. More recently, Gilchrist et al. (2005) came to an opposite conclusion employing the VAR methodology. Blanchard et al. (1993) followed a different approach, regressing the difference of the log values of investment to capital ratios on the Tobin's q, and on different measures of fundamentals. They conclude that "market valuation appears to play a limited role, given fundamentals, in the determination of investment decisions."[4] Blanchard et al. (1993) provide an important explanation for the lack of response of investment to abnormally high share prices: they argue that the rational response of managers in this situation is to issue shares, but in order to purchase riskless bonds rather than to finance real investment, since the marginal productivity of capital is decreasing. Overall, though, the empirical evidence produced so far does not provide a strong, convincing support for the hypothesis that stock market valuations are relevant for investment.

So, why do firms go public? The survey of the literature by Ritter and Welch (2002) shows that market conditions are the most important factor influencing the decision to go public, and that the stage of the firm in its life cycle may be relevant, although to a much lesser extent. Analyzing the market of the US, Welch (2004) concluded that stock returns is the only relevant variable in explaining the level of issuance, while in most circumstances the fundamental "corporate issuing motives remain largely a mystery." [5] Another important piece of evidence is provided by Pagano et al. (1998) who have analyzed the determinants of IPOs in the Italian market. According to their analysis, "the likelihood of an IPO is increasing in the company's size and the industry's market-to-book ratio. Companies appear to go public not to finance future investments and growth, but to rebalance their accounts after high investment and growth."[6]

3 The model

Many empirical specifications developed in order to analyze the role of external finance are not based on theoretical models. It is thus not always entirely clear what the correct specification of the variables of interest should be. For example, external finance is often studied as a ratio with respect to the market value of equity, but it can also be normalized using the book value of capital. Furthermore, some works employ the Tobin's q to control for the productivity of investment, while others use the marginal product of capital, or both. We thus choose to develop a

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[4]Blanchard et al. (1993), p. 132.
[5]Welch (2004) p. 106.
[6]Pagano et al. (1998) p. 27.

very simple investment model which accounts for the role of external finance.

Our fundamental assumption, following Froot and Stein (1998), is that the recourse to external finance is costly, and that such cost is convex. In conditions of limited and asymmetric information the cost of debt becomes convex because bankruptcy risks rise with the amount of outstanding debt, as shown by Kashyap and Stein (1995) and Stein (1998). The issuance of shares may imply convex costs because outside investors assume that managers issue shares opportunistically, as implied by Myers and Majluf (1984) and Krasker (1986). Supporting these theories there is a substantial empirical evidence that the demand curve for newly issued shares is downward sloping, and that large issues must imply a heavy discount, as shown by Masulis and Korwar (1986) and Asquith and Mullins (1986). [7] We assume that investment can be financed either internally, using current or past cash-flows, or externally, issuing shares or debt. Moreover, we assume that only current period cash-flows can be used to finance investment.[8] Thus, over time, the manager must satisfy the following constraint:

$$P_t^I I_t = EF_t + CF_t, \tag{1}$$

where $CF_t = P_t^Y F(K_t, N_t) - w_t N_t$ are current cash-flows, I_t is real investment, K_t is the stock of capital, N_t and w_t are, respectively, the quantity and price of variable inputs, P_t^Y the price of the output and P_t^I the price of investment goods, EF_t is the flow of external finance, and $F(K_t, N_t)$ is a standard production function. The expression above can be written in real terms as:

$$I_t = E_t + R_t F(K_t, N_t) - W_t N_t, \tag{2}$$

where $E_t = \frac{EF_t}{P_t^I}$, $R_t = \frac{P_t^Y}{P_t^I}$, and $W_t = \frac{w_t}{P_t^I}$. For any other aspect, the model presents features in line with the standard literature. We assume constant returns to scale to capital and labor input in the production function, so that the conditions for the equality of the marginal and average Tobin's q hold.[9] The Lagrangian of the problem is the following:

$$\ell = \sum_{t=0}^{\infty} \beta^t \left\{ \left[P_t^Y \left(F(K_t, N_t) - \psi(I_t, K_t) - \phi(E_t, K_t) \right) - w_t N_t - P_t^I I_t \right] + \right.$$
$$\left. -\lambda_t \left[K_t - K_{t-1}(1-\delta) - I_t \right] - \mu_t \left[E_t - I_t + R_t F(K_t, N_t) - w_t N_t \right] \right\}, \tag{3}$$

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[7]Additional evidence can be found in different papers and for countries other than the US, as discussed in Gilchrist et al. (2005).

[8]We are thus assuming that in the accounting of industrial firms capital adjustment costs affect depreciation rather than current period cash flows.

[9]As it was shown by Hayashi (1982).

where $\psi(I_t, K_t)$ and $\phi(E_t, K_t)$ are adjustment cost functions that we specify later on. The only peculiarity of the profit function is the presence of an adjustment cost for external finance.

The first order conditions for investment and external finance are:[10]

$$\frac{\partial \ell}{\partial I_{t+j}} = \beta^{t+j} \left[-P_{t+j}^I - P_{t+j}^Y \psi'(I_{t+j}) + \lambda_{t+j} + \mu_{t+j} \right] = 0, \tag{4}$$

$$\frac{\partial \ell}{\partial E_{t+j}} = \beta^{t+j} \left[-P_{t+j}^Y \phi'(E_{t+j}) - \mu_{t+j} \right] = 0. \tag{5}$$

Rearranging (5), we obtain:

$$\mu_{t+j} = -P_{t+j}^Y \phi'(E_{t+j}). \tag{6}$$

Thus the Lagrange multiplier μ_{t+j} must be equal to the marginal cost of external finance, or the marginal benefits of cash payouts. Replacing this expression in the first order condition (4), we get:

$$P_{t+j}^I + P_{t+j}^Y \psi'(I_{t+j}) + P_{t+j}^Y \phi'(E_{t+j}) = \lambda_{t+j}. \tag{7}$$

This result shows that the value of the capital (the shadow value of investment) equals the marginal adjustment cost plus the marginal cost of external finance.[11]

A fundamental result by Hayashi (1982) shows that the marginal and average Tobin's q are equal when returns to scale are constant. When this is the case, the parameter λ, measuring the marginal increase in value of the stock of capital, becomes equal to the Tobin's q: $\frac{S_{t+j} + B_{t+j}}{K_{t+j}}$, where S_{t+j} and B_{t+j} measure, respectively, the value of equity and debt of the firm. Specifying the adjustment cost functions $\psi(I_t, K_t)$ and $\phi(E_t, K_t)$, it becomes possible to express Eq. (7) in terms of observable variables. In order to obtain the equality of the marginal and average Tobin's

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[10]Since the FOC for capital is not employed in our calculations, we do not report it.

[11]In a standard investment model the inclusion of external finance would be incorrect. In such a framework, in fact, external finance costs are introduced adding a further constraint, with a new control variable. In the first order conditions the control variable disappears, because it enters linearly in the constraint. Thus the new Lagrange multiplier imposes a restriction on the value of the discount factor β, that can be further explained specifying the market imperfections. In this framework the result is different because external finance enters the problem non-linearly. As long as our assumption that external finance costs (or benefits from cash outflows) are non linear holds, the solution of Equation (7) includes external finance explicitly, regardless the function specified. It must be observed, though, that this does not imply a unique causal relationship: external finance may act as a constraint for investment, or cash outflows may result from investment. The estimation technique must take into account this problem of endogeneity.

q, both these functions must be linearly homogeneous, respectively in investment and capital, and in external finance and capital.[12] As a consequence, when these conditions hold, the first derivatives of both functions are linear in the ratios $\frac{I_t}{K_t}$ and $\frac{E_t}{K_t}$. Eq. (7), therefore, becomes:

$$P^I_{t+j} + P^Y_{t+j}\alpha\frac{I_{t+j}}{K_{t+j}} + P^Y_{t+j}\gamma\frac{E_{t+j}}{K_{t+j}} + P^Y_{t+j}k = \lambda_{t+j}, \tag{8}$$

where k is a constant. From Eq. (8) we obtain the expression for the measure of average Q that we construct:

$$Q = \frac{\lambda_{t+j} - P^I_{t+j}}{P^Y_{t+j}} = \frac{\frac{S_{t+j}+B_{t+j}}{K_{t+j}} - P^I_{t+j}}{P^Y_{t+j}} = \alpha\frac{I_{t+j}}{K_{t+j}} + \gamma\frac{E_{t+j}}{K_{t+j}} + k. \tag{9}$$

This is the standard expression showing the marginal return, as measured by Q, of the investment of a dollar in additional capital of the firm. We only obtain an extra term in external finance, depending on the sign of the variable $\frac{E_{t+j}}{K_{t+j}}$. When the sign is positive, the return of the investment flow $\frac{I_{t+j}}{K_{t+j}}$ is measured by Q minus the cost of finance. When the sign is negative, then the return of the investment for liability holders includes both a capital gain measured by Q, and a cash outflow, that can be in the form of either dividend, share repurchase or debt repayment.

This model suggests the specification of external finance in terms of a ratio with respect to a measure of the book value of capital, in order to have a functional form coherent with the neoclassical model, as discussed by Hayashi (1982). Moreover, it suggests the use of a measure of Tobin's q corrected by subtracting the ratio $\frac{P^I_{t+j}}{P^Y_{t+j}}$, as in Eq. (9).[13] In the absence of such a transformation, the model is, in fact, misspecified, because it lacks a variable. Using our dataset, the omission of this variable changes the results quite substantially, increasing the significance of the remaining variables. Analogously, measuring financial flows, such as equity issuance, as a ratio with respect to market capitalization has a noteworthy impact, because of the noise introduced in the variable by stock prices.

The model can easily be specialized, differentiating between equity and debt, to take into account different slopes of the cost functions. The story remains the same, the firm in this case equates at the margin benefits or costs of different liabilities.

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[12] A widely used specification of such a function is $\psi(I_t, K_t) = \frac{\alpha}{2}(\frac{I_t}{K_t} - v)I_t$, as in Hubbard et al. (1995), or analogously, $\phi(E_t) = \frac{\gamma}{2}(\frac{E_t}{K_t} - w)^2 K_t$.

[13] As shown, for example, in Schaller (1990).

4 Dataset

We employ a database which consists of quarterly aggregate data from 1953:Q2 to 2004:Q4 for the US economy. The data are taken from the Flow of Funds Accounts maintained by the Federal Reserve Board, and they regard all non-farm, non-financial corporations. The only exceptions are the deflator used to actualize all the data, the net value added used to calculate the marginal productivity of capital, and the value of nominal GDP that are taken from the NIPA dataset of the Bureau of Economic Analysis.

We study financial flows measuring their relevance in relation to the value of the capital stock, as suggested by our model. Furthermore, following Hall (2001), we have considered the value of both equity and debt in defining the Tobin's q. We have not followed Hall (2001) in calculating the market value of debt liabilities so that, in our measure of the Tobin's q, equity is calculated at market valued while debt is calculated at book value. However, since we are not interested in market values *per se*, this does not represent a problem. Furthermore, we show in an Addendum available from the authors that using Hall's (2001) data with debt at market value the results do not change significantly.

We obtain a measure for real capital, following Hall's (2001) procedure, by capitalizing forward the value of aggregate investment minus depreciation.[14] We calculate the marginal productivity of capital using the net value added before investment spending, which provides an exact measure for the marginal productivity of capital (MPK). The variable INFLOWS measures the sum of all financial flows, given by the change in net liabilities outstanding, minus dividends, plus equity issuance. All variables are deflated using the deflator for fixed investment. Since the same deflator was used to proxy the price for investment, P_t^I does not appear as independent variable in our estimations.

5 Estimation Methodology

We have chosen to employ standard Vector Auto-Regression (VAR) techniques, in order to avoid problems due to the possible endogeneity among the variables. In line with Gonzalo and Pitarakis (2004), who have shown that for VAR models that include three or more variables the AIC becomes, by far, the best performing lag length criterion, we employ this criterion to determine the lag length of our VAR. Moreover, the lag length selected by the Likelihood Ratio turns out to be, in most

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[14]Assuming an annual depreciation rate of 10 per cent, corresponding to a quarterly rate of 2.5996 per cent. The initial value (that is virtually irrelevant) is taken from Robert E. Hall's dataset. See Hall's web page at http://www.stanford.edu/ rehall/.

cases, in line with the AIC. In all the models we estimate, autocorrelation functions as well as Lagrange Multiplier tests highlight weak presence of serial correlation in the residuals, suggesting that overall the models are reasonably well specified. Throughout the paper all the impulse response functions are generated using the Generalized Impulses Procedure, as described in Pesaran and Shin (1997). Different procedures for the impulse responses, however, produce outcomes that are virtually identical.

A further advantage of the VAR technique is that it can produce valid estimates even thought some of the variables included in the system are non-stationary, as long as the system as a whole remains stable.[15] This is a relevant feature for our analysis, as some of the variables considered are stationary (such as investment or the different variables measuring financial flows), while others (Q and MPK), are not. Having both stationary and non-stationary variables, we thus estimate the VAR models without first-differencing the non-stationary variables. The inclusion in our models of these variable in levels does not affect the overall stability of the system and the reliability of our estimations. In fact, testing for the stability of system, we find that the eigenvalues are well inside the unit circle. Besides, analysis of the residuals originated by the estimated VAR models shows that they are stationary. This, in turn, confirms further on that the systems under analysis are indeed stable. However, when we proceed to the interpretation of the impulse-response functions and the Granger causality tests, the issue of non-stationarity in some variables must be taken into account, insofar some standard inferential results cannot be applied. Conventional Granger causality tests are, in fact, no longer valid when an I(1) variable is used as a regressor. In this situation though, Lutkepohl and Kratzig (2004) show that the test can be performed by estimating a VAR with an extra lag, and conducting the Wald test ignoring the last redundant lag.[16] The only problem with this procedure is that, because of the redundant parameters, it is not fully efficient. Nevertheless, given the length of our database, we have a large number of degrees of freedom, so that the lack of power of the tests should not be a problem. A further great advantage of the dataset we use, is that it should be subject to very small measurement errors, since the flow of funds data cover the whole population of US firms. This is particularly relevant in Granger causality

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[15]More specifically, Sims et al. (1990) have shown that in VAR models which contain both stationary and non stationary series, the coefficients of non integrated regressors will have normal asymptotic distributions while those of integrated regressors will have non normal asymptotic distribution, and Granger causality tests with non standard limiting distributions (See also Hamilton (1994), Lütkepohl (1993) and Canova (2007)). The stability of the VAR, in turn, is evaluated computing the associated eigenvalues and checking that they fall within the unit circle.

[16]See also Dolado and Lutkepohl (1996).

analysis, since errors in variables generate spurious causality.[17]

We introduce two dummy variables for the quarters 1979:Q3 and 1980:Q1. In the first quarter the change in regime due to the adoption of the new operating procedures by the FED under Paul Volker produced a violent reduction of commercial paper issuance that was entirely reversed two quarters afterwards. The impact of these shocks is evident in all variables that include changes in the stock of debt. Moreover we introduce a seasonal dummy for the third quarter of the year that turns out to be always significant for all the variables, including issuance. We test for the introduction of a deterministic time trend, and it turns out to be significant in the equations where issuance is the dependent variable. Given that the inclusion of a term trend in such a VAR is quite controversial, we choose not to include it, following Sims' approach; nevertheless its inclusion would not alter the results. Finally, we control our model augmenting the VAR systems with growth in real GDP and oil prices, and five and ten-years term spreads. None of these variables, however, has a significant impact on our results.

6 External finance and investment

6.1 Aggregate flows

In this first subsection we investigate the relevance of external finance for investment. The analysis is carried out by means of a simple VAR model including the variables INV, INFLOWS, and Q (shown in Fig. 1). The variable INFLOWS measures all net flows of external finance, including capital raised in the stock market, and the increase in debt liabilities, minus dividends paid and shares repurchased.[18] Granger causality tests for the above-mentioned model are reported in Table 1. These tests show that INFLOWS do not Granger-cause neither investment, nor Q, at standard significance levels. This suggests that financial constraints do not limit aggregate investment. Moreover, INFLOWS are not Granger-caused neither by INV, nor Q, as one would expect if external finance is raised in order to finance investment. Fig. 2 shows the impulse response function of INFLOWS to a one standard deviation shock on Q and INV, and that of INV to a one standard deviation shock on INFLOWS. The impact of inflows on investment is irrelevant, since the impulse response is never statistically different from zero. Moreover, as shown in Fig. 3, INFLOWS is never significant in explaining the forecasting error variance of investment at standard significance levels, for any time horizon. IN-FLOWS, in fact, accounts for only 0.72% and 4.89% of the forecast error variance

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[17]See Sargent (1987).

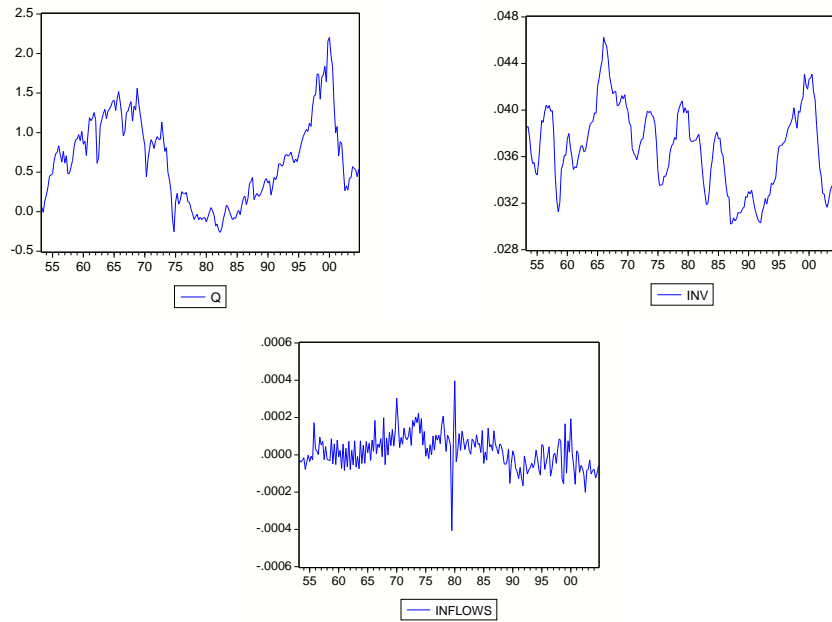[18]We will later on specify the model separating share issuance from changes in the net debt position.

Figure 1: Time series plot of the variables Q, INV, and INFLOWS for the period 1953:Q2-2004:Q4.

of investment after, respectively, 10 and 40 quarters (10 years).[19] Considering that our measure of inflows includes all transfers of cash between corporate firms and capital stock owners, this result suggests that the availability of external finance has a limited impact on aggregate investment. Financial constraints do not seem to play a relevant role for investment of non financial corporate firms. According to the impulse response functions of Fig. 2, shocks on investment and Q generate

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[19]The variables INV, INFLOWS, and Q are in this order for the Cholesky decomposition that we use for the variance decomposition only. The AIC suggests the use of a VAR with four lags. In this formulation our prior is that inflows (or outflows) are an outcome of real investment decisions. However, it is very important to observe that our results do not depend on the chosen ordering of the VAR. Other alternative orderings produce results that are extremely similar to those set out. This normally occurs when the variables are poorly correlated. In our case INV is positively correlated with both Q and INFLOWS, but the coefficients, even though statistically significant at the five per cent level, are small (0.486637 and 0.311923, respectively), and the correlation between Q and INFLOWS is very close to zero (-0.033676) and statistically not significant at the five percent confidence level. The impact of INFLOWS innovation on the system is therefore limited. Moreover, both Q and INV have a high autocorrelation coefficient, while this is not the case for INFLOWS. This implies that shocks to the first two variables are extremely persistent. As a consequence, even the ordering between the first two variables is not important because the direction of the contemporaneous effect is scarcely relevant.

Table 1: Causality tests among Q, INV and INFLOWS.

	Q	INV	INFLOWS
		Null hypothesis: $\gamma_{ij}(L) = 0$ for $i \neq j$	
Q	–	0.000	0.279
INV	0.046	–	0.117
INFLOWS	0.221	0.307	–

Test for null hypothesis that $x_{1,t}$ does not Granger-cause $x_{2,t}$. The "dependent" variables $x_{2,t}$ are reported in the columns while the variables $x_{1,t}$ appear in the rows of the table. We indicate with $\gamma_{ij}(L) = 0$ for $i \neq j$ the null hypothesis that the coefficients of the lagged "dependent" variables are equal to zero. The test is a Wald test, we report the P-values, computed using the κ^2 distribution with 4 degrees of freedom. When the "dependent" variable is I(1), the Wald test is conducted on a regression including one extra lag.

a positive response of INFLOWS that is statistically significant at the five per cent confidence level. Nevertheless, obtaining confidence intervals by means of Montecarlo simulations, it can be shown that the proportion of the variability of IN-FLOWS explained by Q and INV, (8.18% and 7.99% respectively after 10 periods and 9.54% and 8.48% respectively after 40 periods) is not statistically significant at standard confidence levels. This suggest that even if investment and Q have an impact on financial flows to and from the firm, their relevance is rather limited. In line with the Neoclassical Theory, the Granger causality test shows that the relationship of causality between INV and expected value of future productivity of capital (as measured by Q) is bi-directional and statistically significant at standard significance levels. Impulse-response functions show that innovations in Q have a strong positive impact on investment.[20] As expected, shocks on Q explain a large share (47.27% after 10 quarters and 51.74% after 40 quarters) of the forecasting error variance of INV.

We now sophisticate the baseline VAR previously employed by decomposing INFLOWS into changes in the value of the stock of debt net of interest flows (DDEBT), and net equity issuance (ISSUES), measuring the sums raised by means of primary placements of shares minus the amount spent to repurchase shares.[21]

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[20]To save space we do not report the related diagrams.

[21]The AIC indicates that three is the optimal number of lags in this case. We include a dummy for 1998:Q4, corresponding to the stock market shock following the Russian crises, since net issues in
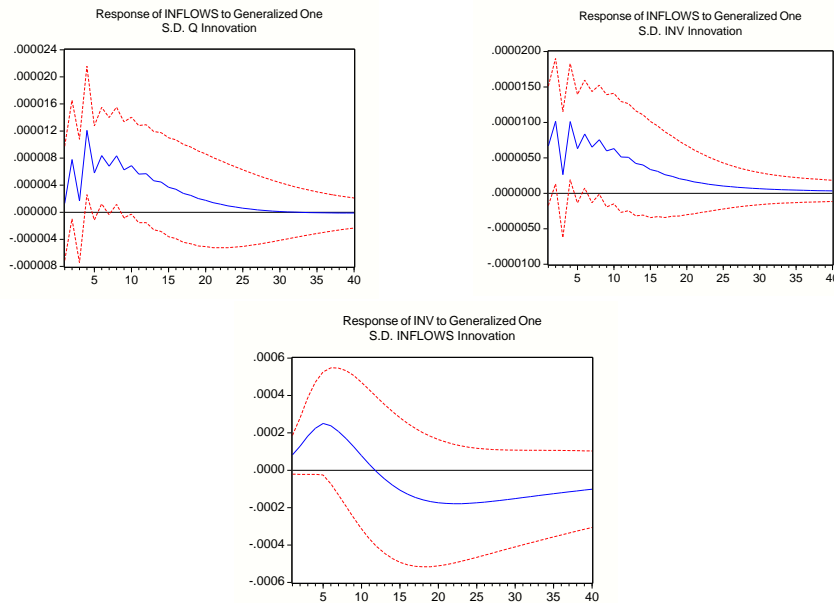
Figure 2: Impulse response functions of INFLOWS to a one-standard deviation shock on Q and INV, and of INV to a one-standard deviation shock on INFLOWS. Horizontal axis shows 10-years response horizon. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

The two variables are depicted in Figure 4. It is quite evident that there is a negative correlation between the two series (the correlation is -0.28 in our sample), so that, on aggregate firms in the US increase debt issuance to repurchase shares or issue new shares to reduce debt. Granger causality tests for the VAR including Q, INV, DDEBT and ISSUES are reported in Table 2. We obtain some evidence that share issuance has a weak, positive impact on investment, in fact, the null that IS-SUES do not Granger-cause INV is reject, although only at 10% significance level. Moreover, the impulse response function of Fig. 5 confirms that shocks on share issuance have a positive impact on investment (although only marginally significant at 5% level). The variance decomposition, though, highlights that shocks on ISSUES explain a negligible (and, as before, not statistically significant) portion of the forecasting error variance of INV (1.68% after 10 quarters, and 2.23% after 40 quarters). On the contrary, there is no evidence that investment decisions affect net share issuance. The other new insight obtained by discriminating between equity

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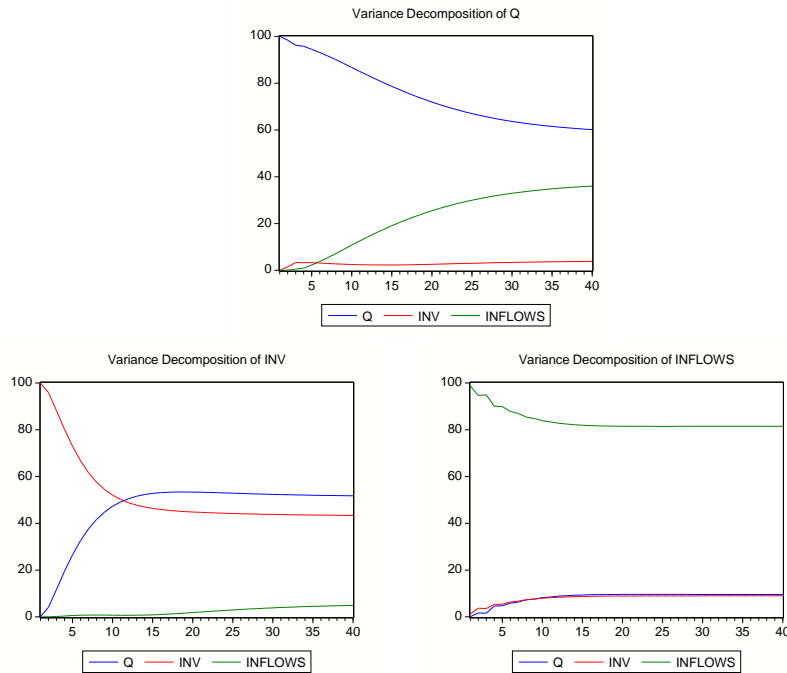that period are abnormally low.

Figure 3: Forecast error variance decomposition of Q, INV and INFLOWS at horizons up to ten years. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. Vertical axis shows the percentage of the forecast variance due to each innovation, the sum adding up to 100. Cholesky ordering: Q, INV, INFLOWS.

and debt finance is that net share issues positively respond to shocks on Q and negatively to shocks affecting DDEBT. The variance decomposition of Fig. 6 shows that Q and DDEBT explain, respectively, 7.22% and 11.46% of the forecasting error variance of ISSUES after 10 quarters and 18.31% and 12.31% after 40. Even in this case though, these values are not statistically significant. While the linkage between Q and ISSUES is weak (in fact, both the impulse response function and the Granger causality test are not statistically significant), the linkage between DDEBT and ISSUES is neater (being, in this case, both the impulse response function and the Granger causality test statistically significant). Net issuance of shares grows when stock market prices are high, and it declines when firms issue new debt, as it would be the case if they issue debt in order to repurchase shares. On the contrary, DDEBT is not influenced by the other variables we analyze.
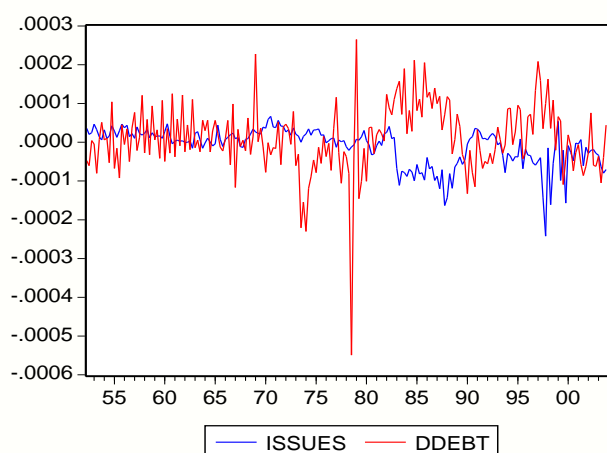
Figure 4: Time series plot of the variables ISSUES (net issues of stocks) and DDEBT (changes in the levels of debt) for the period 1953:Q2-2004:Q4.

6.2 Gross equity issues

We now proceed to the estimation of a further VAR model which makes use of a newly constructed database. The specific feature of this new database is that issues are now gross, and include proceeds from IPOs, capital increases, private placements and convertible bonds.[22] The crucial difference between this new one and the database previously employed is thus that share repurchases are not taken into account. Moreover, the new data were available only for the period 1970:Q1-2004:Q4, so they cover a shorter lapse of time than the previous. The main purpose of this exercise is to test whether investment responds to gross issues, since, after all, gross values of primary placements (GROSSISSUES) should be relevant if equity is used as a source of finance. Fig. 7 shows, in fact, that the relationship between gross issues and changes in the stock of debt is completely different from that between net issues and DDEBT. While the correlation between DDEBT and net issues is negative, GROSSISSUES and DDEBT turn out to be complement (the correlation between the two series in our sample is, in fact, 0.21.) We thus estimate a VAR model similar to the previous one where, however, net share issuance is replaced by gross issues.[23] Granger causality tests are reported in Table 3. While shocks on net issues seemed to produce a weak impact on aggregate investment,

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[22]The data are taken from the Statistical Supplement to the Federal Reserve Bulletin.

[23]The lag length suggested by the AIC and LR criterion for the VAR employed in this section is equal to 4.

Table 2: Causality tests among Q, INV, DDEBT and ISSUES

Null hypothesis: $\gamma_{ij}(L) = 0$ for $i \neq j$

	Q	INV	DDEBT	ISSUES
Q	–	0.000	0.0500	0.154
INV	0.240	–	0.701	0.164
DDEBT	0.851	0.704	–	0.060
ISSUES	0.583	0.099	0.336	–

Test for null hypothesis that $x_{1,t}$ does not Granger-cause $x_{2,t}$. The "dependent" variables $x_{2,t}$ are reported in the columns while the variables $x_{1,t}$ appear in the rows of the table. We indicate with $\gamma_{ij}(L) = 0$ for $i \neq j$ the null hypothesis that the coefficients of the lagged "dependent" variables are equal to zero. The test is a Wald test, we report -values, computed using the κ^2 distribution with 4 degrees of freedom. When the "dependent" variable is I(1), the Wald test is conducted on a regression including one extra lag.

this VAR suggests that primary placements of shares do not influence investment. The Granger causality tests of Table 3, the variance decomposition of Fig. 10, and the impulse response function of Fig. 8 show, in fact, that both gross equity issuance and changes in the stock of debt have no significant impact on aggregate investment. These new results shed some light on the driving forces behind primary placements. Q innovations explain a large (i.e. 60.68 % after 10 periods and 65.21 % after 40 periods) share of the forecasting error variance of GROSSISSUES. Moreover, Q Granger-causes GROSSISSUES at standard significance levels. This confirms previous findings, as those of Welch (2004), that share issuance is strongly dependent on equity valuations. The new evidence that this exercise provides is that investment also affects equity issuance. The null that INV does not Granger-cause GROSSISSUES is, in fact, soundly rejected. More surprising results emerge from the impulse response functions shown in Fig. 9. Positive Q shocks have a strong positive impact on issuance, while positive investment shocks have a significant *negative* impact. Not only primary placements of shares are not used to finance investment, but the impulse response functions suggest that investment reduce the issuance of shares, at least at the very short horizon, i.e. between the second and sixth quarter. These results imply that, in first order, insiders issue shares when they judge that the market fully prices expected earnings, or, even better, when stock markets overprice the shares. This is in line with the theory,
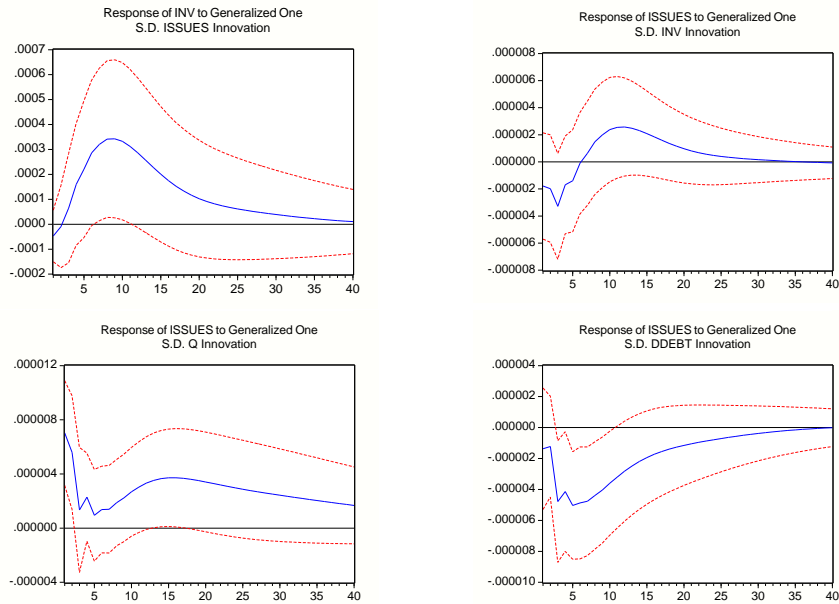
Figure 5: Impulse response of INV to a one-standard deviation shock on ISSUES, and of ISSUES to a one-standard deviation shock on INV, Q and DDEBT. Horizontal axis shows 10-years response horizon. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

explored by Pástor and Veronesi (2005), that IPOs are concentrated in waves. This happens because entrepreneurs choose the optimal timing for the IPOs, waiting for favorable market conditions such as low expected returns or high aggregate profitability, both implying high levels of Q. Supporting empirical evidence comes from Daniel and Titman (2006): they highlight that firms issuing shares substantially underperform the market during the following two years period. Lyandres et al. (2007) find strong evidence suggesting that the underperformance of issuers is due to the fact that issuers invest more than non-issuers. They thus interpret their results as supporting the implication of the neoclassical theory that investment reduces firm-level expected returns, because of decreasing marginal productivity, as shown by Cochrane (1991). In this light we interpret our second, more surprising result as suggesting that since the market anticipates that those firms that need to finance large investment will underperform, the *quantity* of cash that these firms raise in the market is lower the higher their investment needs. In other words, it will be easier to raise finance for those firms that need little additional investments
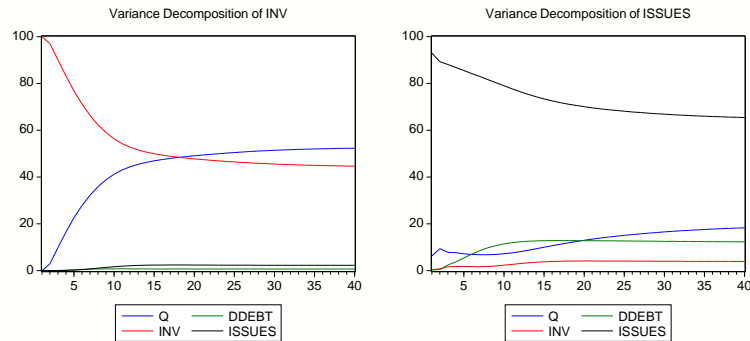
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Figure 6: Forecast error variance decomposition of INV and ISSUES at horizons up to ten years. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. Vertical axis shows the percentage of the forecast variance due to each innovation, the sum adding up to 100. Cholesky ordering: Q, INV, DDEBT, ISSUES.

and whose shares are accordingly priced at high price-earnings multiples. What we should expect is that, in general, firms are sold on the market at the end of the investment cycle, to reap the benefits of past successful investment. This is what our results highlight, and they follow closely those obtained by Pagano et al. (1998) studying the market for IPOs in Italy. Table 3 also shows that DDEBT is now Granger-caused by both Q and GROSSISSUES, while a bi-directional causality arises between Q and GROSSISSUES. Moreover, the impulse response functions of Fig. 8 and Fig. 9 highlight that shocks on share issuance have a significant *positive* impact on both DDEBT and Q. These results suggest that GROSSISSUES and DDEBT are complements, and they both positively respond to shocks on Q. Moreover, the impulse response function of Fig. 9 and the variance decomposition of Fig. 10 highlight that Q shocks have strong positive impact on net debt issuance, explaining a large (14.2 % after 10 periods and 16.56 after 40 periods) and statistically significant share of its forecasting error variance. More surprisingly, even Q responds to GROSSISSUES shocks, even if this last variable explains a relatively modest share of the its variance. Our hypothesis is that both variables react to the same underlying driving force, the profitability of firms. In this case GROSSISSUES must rise when the stock market has an upward trend, as insiders try to anticipate the peak in stock market valuations, in line with the prediction of Pástor and Veronesi (2005) and Chemmanur and Fulghieri (1999).
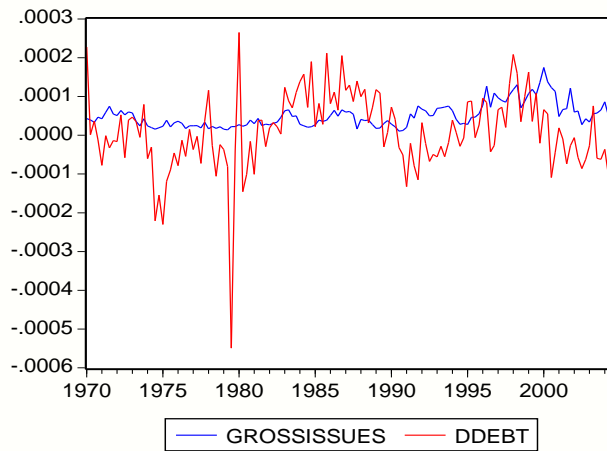
Figure 7: Time series plot of the variables GROSSISSUES (gross issuance of stocks) and DDEBT (changes in the levels of debt) for the period 1970:Q1-2004:Q4.

6.3 Is the market a sideshow?

In order to evaluate to what extent current or future profitability drive investment and financial flows, in this section we replicate part of the analysis of the previous section, but making use of a different model of investment. We now substitute the value of MPK for that of Q in the reduced form that we estimate. This reduced form is easily obtained under a static investment model, assuming the presence of linearly additive convex (quadratic) costs on investment and external finance. Since we are studying aggregate investment, the convex costs can be considered as the consequence of the scarcity of the factors of production. In order to increase aggregate investment, resources previously devoted to other uses must be hired: this, in turn, results in higher input prices. The aim of this section is to isolate the role of current marginal productivity of capital (MPK) from that of future values of MPK, as they are captured in the measure of Q by the market value of firm liabilities. By studying the role of current MPK we can thus understand whether the impact of Q on investment and/or external finance is *not* driven by stock market valuations. To see why this is the case, we need a few lines of algebra. Under the assumption of constant returns to scale to capital and labor input in the production function,[24] marginal productivity of capital is equal to the ratio between the value added before investment spending and capital. In fact, by using

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[24]So that the conditions for the equality of marginal and average Q hold.

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Table 3: Causality tests among Q, INV, DDEBT and GROSSISSUES

	Q	INV	DDEBT	GROSSISSUES
Null hypothesis: $\gamma_{ij}(L) = 0$ for $i \neq j$				
Q	–	0.088	0.011	0.000
INV	0.021	–	0.917	0.010
DDEBT	0.584	0.973	–	0.897
GROSSISSUES	0.087	0.842	0.003	–

Test for null hypothesis that $x_{1,t}$ does not Granger-cause $x_{2,t}$. The "dependent" variables $x_{2,t}$ are reported in the columns while the variables $x_{1,t}$ appear in the rows of the table. We indicate with $\gamma_{ij}(L) = 0$ for $i \neq j$ the null hypothesis that the coefficients of the lagged "dependent" variables are equal to zero. The test is a Wald test, we report -values, computed using the κ^2 distribution with 4 degrees of freedom. When the "dependent" variable is I(1), the Wald test is conducted on a regression including one extra lag.

a standard Cobb-Douglas specification for the production function, and computing the first derivatives with respect to K and N, we get:

$$\Pi = P^Y K^\alpha N^{1-\alpha} - wN - P^I I \tag{10}$$

$$\frac{\partial \Pi}{\partial K} = P^Y \alpha \frac{Y}{K}, \qquad \frac{\partial \Pi}{\partial N} = P^Y (1-\alpha)\frac{Y}{N} - w = P^Y \frac{Y}{N} - \alpha P^Y \frac{Y}{N} - w. \tag{11}$$

Setting the second condition to zero and substituting it into the first, one obtains:

$$\alpha P^Y Y = P^Y Y - wN, \qquad \frac{\partial \Pi}{\partial K} = \frac{P^Y Y - wN}{K}. \tag{12}$$

The equation defining the marginal product of capital can then be solved for the value of capital. Recalling the value of Q and substituting the value of K from the previous equation, we obtain:

$$Q = \left[\frac{S+B}{P^I K} - 1\right]\frac{P^I}{P^Y} = \left[\frac{[S+B]MPK}{P^I[P^Y Y - wN]} - 1\right]\frac{P^I}{P^Y}. \tag{13}$$

This formulation illustrates that part of the variability of Q is caused by changes in the current values of the marginal productivity of capital (MPK). Fig. 11, which de-
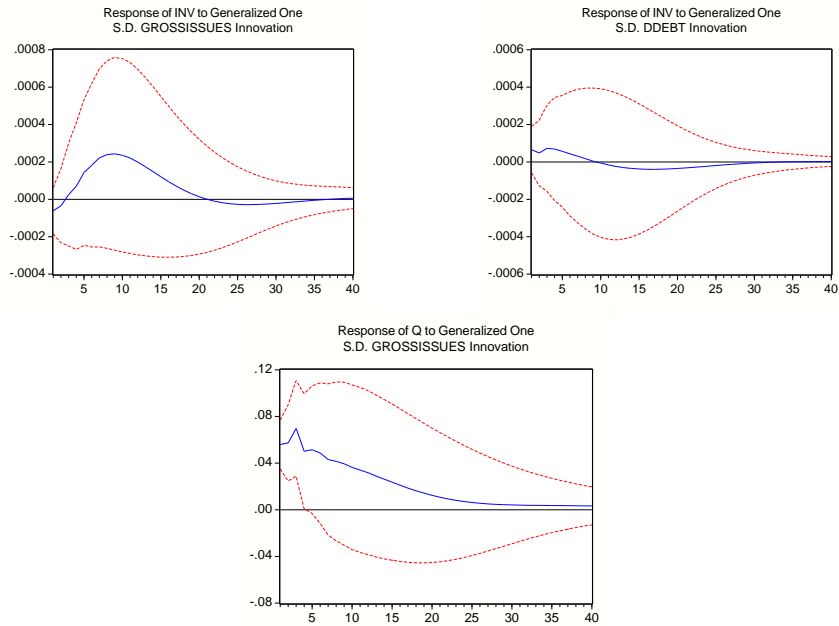
Figure 8: Impulse response of INV to a one-standard deviation shock on GROSSISSUES and DDEBT, and of Q to a one-standard deviation shock on GROSSISSUES. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

picts the stochastic properties of two time series, shows that, except for the first five years, the two series clearly co-move. We thus initially replicate the VAR analysis of section 6.1, replacing Q with MPK, in order to isolate the impact of MPK from that of other components, stock prices in particular.[25] The Granger causality tests (not reported) produce results very similar to those of the baseline VAR, which includes Q in place of MPK, the only difference being that there are even stronger rejections of the null hypotheses that MPK does not Granger-cause INV and vice versa. As the standard Neoclassical Theory suggests, bidirectional causality between the two variables occurs. Fig. 12 shows that investment shocks initially have a positive impact on MPK, while the response becomes negative and significant from the fifth quarter onward. MPK shocks have a strong and highly significant positive impact on investment that dies out only after more than 15 quarters. The variance decomposition of Fig. 13 shows that MPK explains a larger portion of

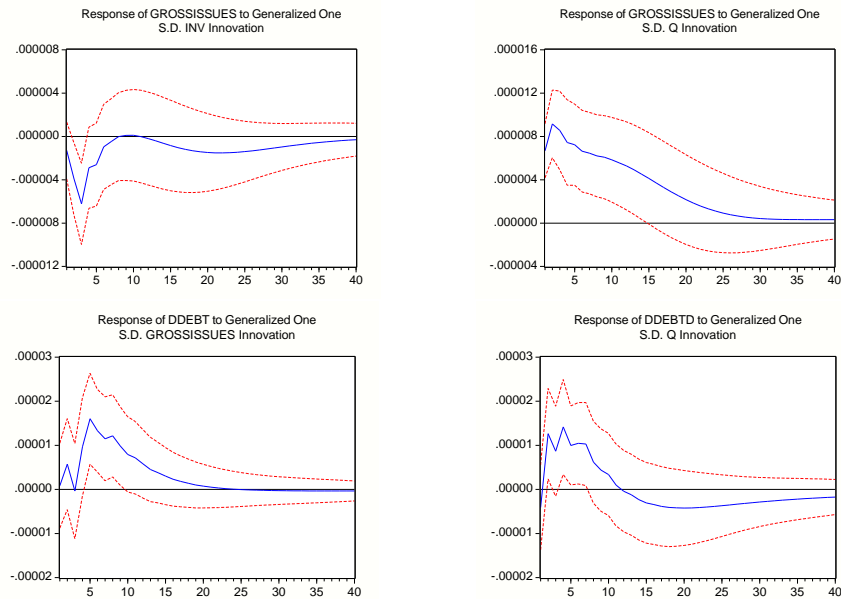[25]The lag length suggested by the AIC and LR criterion for the VAR employed in this section is equal to 4.

Figure 9: Impulse response of GROSSISSUES to a one-standard deviation shock on INV and Q anf of DDEBT to a one standard deviation shock on GROSSISSUES and Q. Horizontal axis shows 10-years response horizon; The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

the forecasting error variance of INV than Q. Likewise, INV explains a larger portion of the forecasting error variance of MPK than Q, confirming that MPK has a stronger positive impact on investment than Q, and the impact of investment on MPK is much stronger than that on Q.[26] More specifically, MPK innovations explain 72.46 % of the forecasting error variance of INV after 10 periods and 70.44 % after 40 periods, while INV innovations explain 32.24 % after 10 periods and 46.72% after 40 periods, of the forecasting error variance of MPK.[27]

Once again, the forecasting variance of INFLOWS is not explained neither by

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[26]Also in this case, however, the inclusion in our VAR model of an I(1) variable does not impair the stability of the model itself. The eigenvalues of the system fall within the unit circle and the residuals turn out to be stationary. This time we have chosen to have MPK first in the Choleski decomposition, but even in this case the ordering chosen does not affect the results substantially.

[27]While Q accounts for 49.14 % after 10 periods and 51.74 % after 40 periods of the forecasting error variance of investment, MPK accounts for 72.46 % after 10 periods and 70.44 % after 40 periods.
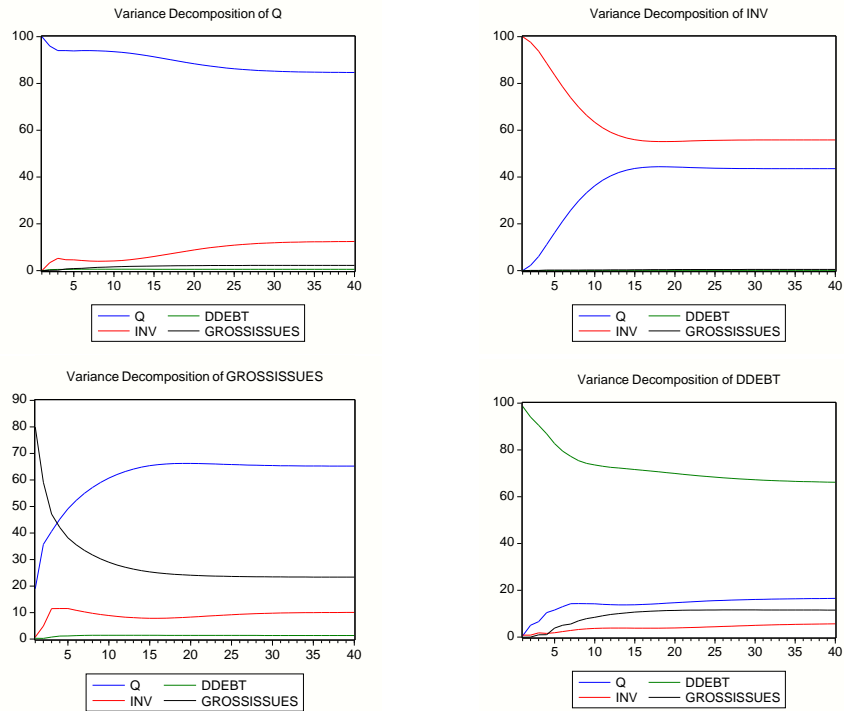
Figure 10: Forecast error variance decomposition of Q, INV, GROSSISSUES and DDEBT at horizons up to ten years. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. Vertical axis shows the percentage of the forecast variance due to each innovation, the sum adding up to 100. Cholesky ordering: Q, INV, DDEBT, GROSSISSUES.

investment nor by the marginal productivity of capital.[28] Moreover, consistently with the previous results, investment and INFLOWS turn out to be totally unrelated. These results suggest that the correlation between Q and investment is, to a large extent, driven by the variability of current values of the marginal productivity of capital, rather than by its expected future values captured by stock markets.

Finally we estimate a VAR model which includes MPK, INV, DDEBT and GROSSISSUES. Comparing the new Granger causality tests of Table 4 with those of Table 3 we can observe that the null that MPK does not Granger-cause INV is now soundly rejected, since the p-value is equal to 0.001. This supports the view that the impact of Q on investment is largely driven by MPK, rather than by

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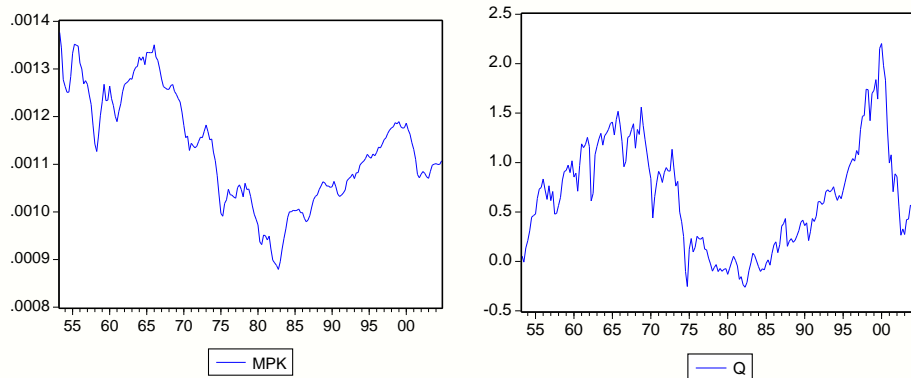[28]To save space the relative diagram is not reported.

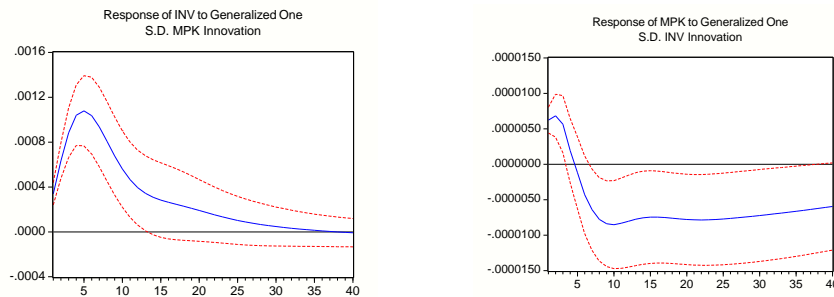Figure 11: Values of marginal productivity of capital (MPK) and Q for the period 1953:Q2-2004:Q4.

Figure 12: Impulse response functions of investment to MPK innovations and MPK to investment innovations. Horizontal axis shows 10-years response horizon. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

stock prices. The second striking difference between the two VAR models regards GROSSISSUES: while the null that Q does not Granger-cause GROSSISSUES is rejected at standard significance levels, the null that MPK does not Granger-cause GROSSISSUES is never rejected. Moreover, the impulse response function of Fig. 14 confirms that the impact of MPK shocks on GROSSISSUES is never significant at conventional significance levels. This suggests that gross equity issuance is driven by stock market valuations, rather than by the current marginal productivity of capital. On the contrary, changes in the stock of debt are affected by the current period MPK. Fig. 14, in fact, shows that MPK shocks have a significant positive impact on DDEBT. Moreover, the null that MPK does not Granger-cause DDEBT
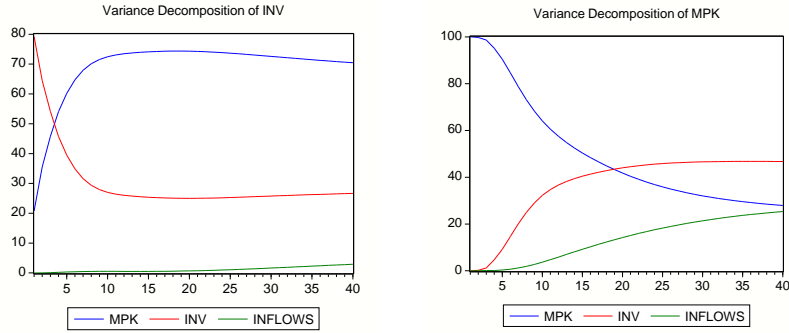
Figure 13: Forecast error variance decomposition of INV and MPK at horizons up to ten years. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. Vertical axis shows the percentage of the forecast variance due to each innovation, the sum adding up to 100. Cholesky ordering: MPK, INV, INFLOWS.

Table 4: Causality tests among MPK, INV, DDEBT and GROSSISSUES

	MPK	INV	DDEBT	GROSSISSUES
	Null hypothesis: $\gamma_{ij}(L) = 0$ for $i \neq j$			
MPK	–	0.001	0.032	0.782
INV	0.002	–	0.238	0.0513
DDEBT	0.218	0.570	–	0.543
GROSSISSUES	0.020	0.549	0.497	–

Test for null hypothesis that $x_{1,t}$ does not Granger-cause $x_{2,t}$. The "dependent" variables $x_{2,t}$ are reported in the columns while the variables $x_{1,t}$ appear in the rows of the table. We indicate with $\gamma_{ij}(L) = 0$ for $i \neq j$ the null hypothesis that the coefficients of the lagged "dependent" variables are equal to zero. The test is a Wald test, we report -values, computed using the κ^2 distribution with 4 degrees of freedom. When the "dependent" variable is I(1), the Wald test is conducted on a regression including one extra lag.

is rejected at the 5 % level, as it was the case for Q. In the next section, though, we show that controlling for both Q and MPK, the impact of MPK on DDEBT becomes insignificant. Overall these results confirm that stock market valuations drive share issuance, but have no relevant impact on investment.
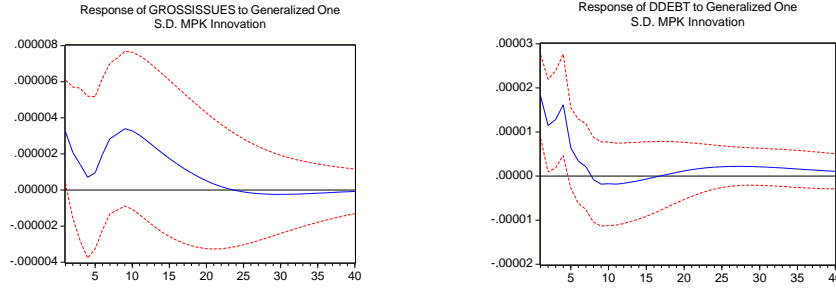
Figure 14: Impulse response functions of GROSSISSUES and DDEBT to MPK innovations. Horizontal axis shows 10-years response horizon. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

6.4 Macroeconomic Determinants of External Finance

Table 5: Causality tests among Q, MPK, DDEBT and GROSSISSUES

	Q	MPK	DDEBT	GROSSISSUES
	Null hypothesis: $\gamma_{ij}(L) = 0$ for $i \neq j$			
Q	–	0.004	0.015	0.000
MPK	0.819	–	0.328	0.054
DDEBT	0.291	0.148	–	0.951
GROSSISSUES	0.053	0.587	0.110	–

Test for null hypothesis that $x_{1,t}$ does not Granger-cause $x_{2,t}$. The "dependent" variables $x_{2,t}$ are reported in the columns while the variables $x_{1,t}$ appear in the rows of the table. We indicate with $\gamma_{ij}(L) = 0$ for $i \neq j$ the null hypothesis that the coefficients of the lagged "dependent" variables are equal to zero. The test is a Wald test, we report -values, computed using the κ^2 distribution with 4 degrees of freedom. When the "dependent" variable is I(1), the Wald test is conducted on a regression including one extra lag.

We now want to further inspect whether the actual driving force of external finance is the marginal productivity of capital or rather stock market valuations, or both. The issue is investigated estimating a VAR model which includes Q, MPK,
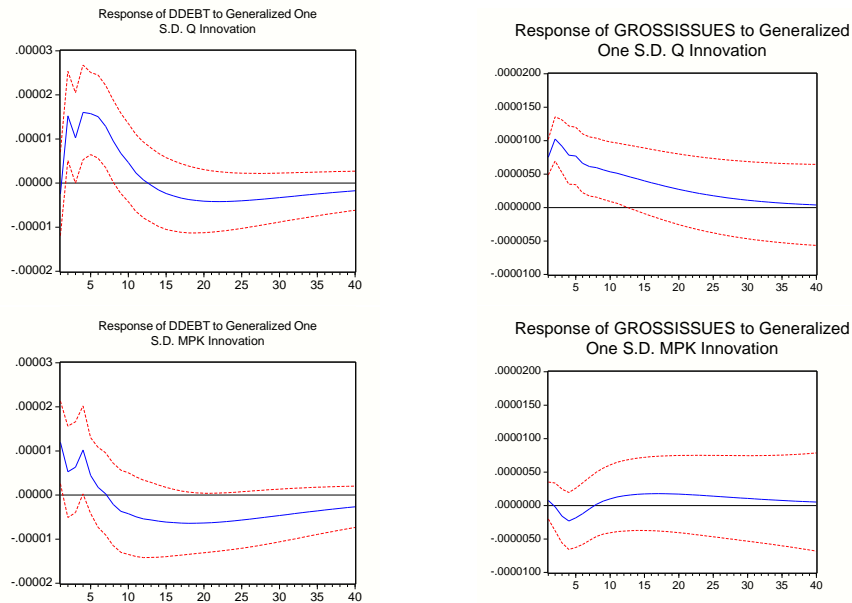
Figure 15: Impulse response functions of DDEBT and GROSSISSUES to a one-standard deviation shock on Q and MPK. Horizontal axis shows 10-years response horizon. The responses are generated by using the generalized impulse response procedure, confidence intervals shown are at the 95% level.

DDEBTD and GROSSISSUES.[29] By including both Q and MPK in the analysis, we hope to capture the impact of stock market valuations, after controlling for the effect of MPK. The analysis is carried out by making use of the dataset for gross values of primary placements already employed in Section 6.2. The Granger causality tests reported in Table 5 show that the null hypotheses that Q does not Granger-cause MPK and external finance are soundly rejected at standard significance levels. On the other hand, MPK does not appear to Granger-cause neither Q not DDEBT, while it appears to Granger-cause GROSSISSUES, but only at 10% significance level. Moreover, as already highlighted by previous analysis, the null that GROSSISSUES do not Granger-cause Q must be rejected, although only at 10% significance level.

The variance decomposition set out in Fig. 16 shows that, as expected, Q ex-

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[29]The lag length suggested by the AIC criterion for the VAR employed in this section is equal to 4. The LR criterion also supports this choice. Also in this case the inclusion of I(1) variables in the VAR model does not affect the stability of the model. In fact, all the eigenvalues of the system fall within the unit circle. Notice that the ordering adopted for the Cholesky decomposition is Q, MPK, DDEBTD and GROSSISSUES.

plains a large share of the forecasting error variance of MPK (respectively 53.38% and 51.61% after 10 and 40 quarters). Most importantly for our analysis, it also shows that the sources of external finance are largely explained by Q, while the importance of MPK is negligible. This result is especially true for GROSSISSUES, where Q explains 64.62% and 68.40% of the forecasting error variance after, respectively, 10 and 40 quarters. With regard to DDEBT, Q explains 24.68% and 25.19% of the forecasting error variance after 10 and 40 quarters, while the portion explained by MPK is, respectively, 5.6% and 14.56%. Moreover, as expected, none of the above variables play a significant role in explaining the forecasting error variance of Q. This, in turn, supports the view of the Tobin's q as a leading (forward looking) indicator.

Overall, these results highlight that the driving force that affects external finance is given by stock market valuations, while the role reserved to the marginal productivity of capital turns out to be largely negligible. Such conclusion is also supported by the impulse-response functions reported in Fig. 15. In fact, positive shocks on Q have positive and statistically significant impact on both the sources of external finance.[30] On the contrary, positive shocks on MPK appear to have negligible impact.[31]

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[30]This, in turn, supports the argument set out in Section 6.2, where it was shown that the two sources of external finance are complement.

[31]It can also be shown that shocks on Q have positive and statistically significant impact on MPK. Such impulse response function is not reported to save space.
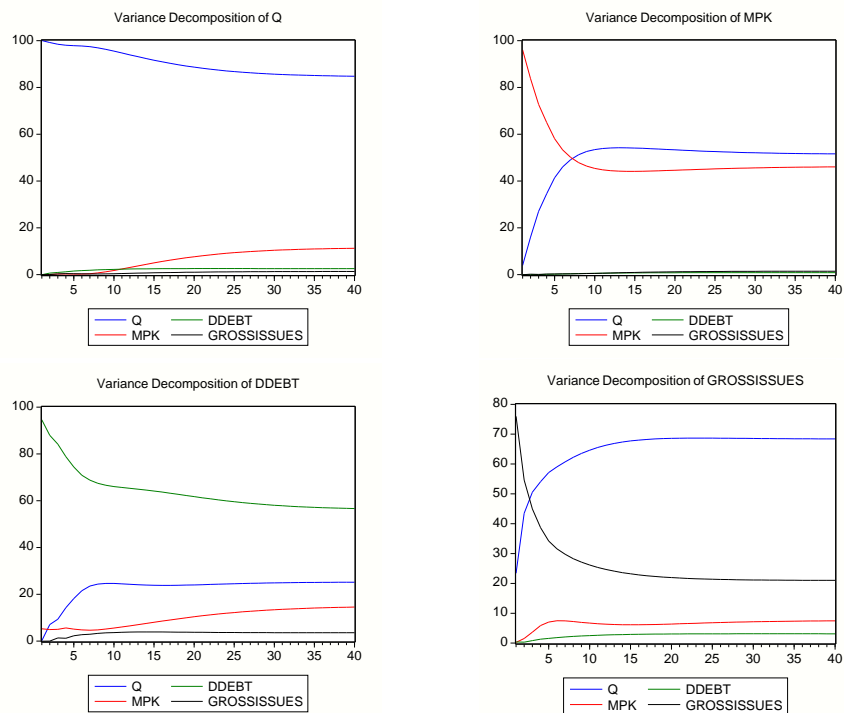
Figure 16: Forecast error variance decomposition of Q, MPK, DDEBT, and GROSSISSUES at horizons up to ten years. The source of this forecast error is the variation in the current and future values of the innovations to each endogenous variable in the VAR. Vertical axis shows the percentage of the forecast variance due to each innovation, the sum adding up to 100. Cholesky ordering: Q, MPK, DDEBT, GROSSISSUES.

7   Conclusions

The basic result of our analysis is that the amount of resources raised issuing shares and debt by industrial corporations in the US has no significant impact on aggregate investment, contrary to what we would expect if the availability of external finance represents a relevant constraint. These results are in line with Blanchard, Rhee, and Summers (1993), Chirinko and Schaller (1996), and Fama and French (1999). More surprisingly, we also find that the amount of finance raised by means of primary placements depends only marginally on the needs to finance investment. In the case of shares, we even find that positive investment shocks cause a significant *negative* impact on issuance. Moreover, we find that

the issuance of shares is largely driven by stock market valuations, confirming the findings of Welch (2004). We thus conjecture, in line with Pagano et al. (1998), that industrial firms issue shares in order to reap the benefits of successful past investment, when market prices match or exceed insiders' valuations. Moreover, Lyandres et al. (2007) find that the underperformance of shares of the firms issuing stock is due to the fact that those firms invest more. We thus argue that our finding that investment shocks reduce the quantity of finance raised in the stock market is a rational response of the market to the underperformance of the shares of the firms that have to sustain large investments.

We also find that share issuance has a significant *positive* impact on our measure of Tobin's q. Moreover, debt issuance is positively influenced by both the value of the Tobin's q and share issuance itself; equity issuance and changes in the level of debt are thus complements. We thus conjecture that the three variables react to the same underlying driving force, the expected profitability of firms. Issuance thus rises when stock prices follow an upward trend, as managers that benefit from inside information try to anticipate the peak in stock market valuations.

As expected, a neat linkage exists between investment and Tobin's q, whereas the causality relationship goes from q to investment. We find some *prima facie* evidence, though, that the significance of the Tobin's q when regressed on investment is due to the marginal productivity of capital, rather than to the stock market valuations. On the contrary, external finance is driven by market valuations, rather than by current values of the marginal productivity of capital. Finally, we find evidence that debt levels positively respond to net equity issue shocks, where the latter is the difference between share issuance and share repurchases. This result confirms that, in the aggregate, industrial companies in the US issue debt in order to purchase shares.

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