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Firm investment and financial conditions in the euro area: evidence from firm-level data

Hiona Balfoussia
Heather D. Gibson

208

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BANK OF GREECE
Economic Analysis and Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

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FIRM INVESTMENT AND FINANCIAL CONDITIONS IN THE EURO AREA:
EVIDENCE FROM FIRM-LEVEL DATA

Hiona Balfoussia
Bank of Greece

Heather D. Gibson
Bank of Greece

Abstract

We explore whether the sensitivity of firm-level investment to cash-flow, typically associated with an external financing premium, is time-varying and in particular whether it varies with overall financial conditions. We find that financial conditions have indeed played a significant role in corporate investment decisions over recent years, rendering financing constraints even more binding. This finding appears to be robust to a number of control variables and robustness tests. Moreover, the impact of credit conditions is not uniform across firms, but rather it varies depending on firm size and leverage, with constrained firms being substantially more likely to condition their investment decisions on overall credit conditions. Our results cast new light on the interplay between financial and real cycle downturns and underline the need for monetary, fiscal and macroprudential policy to be countercyclical with respect to financial conditions.

Keywords: investment, financial conditions, euro area firms

JEL-Classification: E22, E44, E50

Disclaimer: The views expressed in this paper are those of the authors and do not necessarily reflect those of the Bank of Greece.

Correspondence:
Hiona Balfoussia,
Economic Analysis and Research Department,
Bank of Greece,
21 E. Venizelos Ave,
Athens 10250
email: hbalfoussia@bankofgreece.gr

1. Introduction

The substantial decline in investment recorded in recent years and its coincidence with a major financial crisis have prompted new research on the economic drivers of firms' investment decisions. The sensitivity of firm-level investment to cash flow, a recurrent finding in the relevant empirical literature, is particularly worth revisiting. The existence of a significant positive relationship between the two variables is largely undisputed and broadly interpreted as evidence of an external financing premium borne by a subset of firms. However, the possibility that this sensitivity might vary over time has not received much attention. In this paper we explore whether there is such time variation. In particular, we ask whether the sensitivity of investment to cash flow fluctuates with the overall financial conditions prevalent in the market, a question which, to our knowledge, has not to date been directly explored.

We explicitly account for financial conditions in our estimations by using a financial conditions index tailored to capturing supply-side effects. We show that, overall, financial conditions as captured by our index have a significant impact on the investment – cash flow sensitivity, greatly accentuating it. Thus we provide new evidence that tightening overall financial conditions significantly hamper firm level investment over and above the standard "external financing premium" which stems from information asymmetries. Furthermore, this finding is stronger for smaller and more leveraged firms, which are more likely to be financially constrained.

Our findings have important policy implications. Foregoing profitable investment opportunities today implies that future economic growth and potential output are likely to be compromised. Thus leaning against financial cycle downturns by designing macro and macroprudential policy tools to be countercyclical with respect to financial conditions is likely to boost firm investment contemporaneously and to yield additional long-term growth opportunities for the economy in the future.

The remainder of the paper is organized as follows. In the following section we provide an overview of the academic literature which focuses on the empirical relationship between financing constraints and firm-level investment. We then move on, in section 3, to deal with issues of methodology and data. Section 4 presents the results which are then analysed and interpreted in section 5. Section 6 discusses the policy implications of our empirical findings. Finally, section 7 offers some conclusions.

2. The linkages between financing constraints and firm investment – a literature review

i) Early theoretical contributions

The relevant academic literature spans several decades. Amongst the earliest theoretical contributors, Modigliani and Miller (1958) postulated that in frictionless capital markets financial structure and financial factors in general would be irrelevant to "real" firm decisions such as the decision to undertake an investment. They argued that, fundamentally, firm-level investment is driven exclusively by expected future profits. Consequently a firm's optimal choice of capital stock is determined irrespective of financial factors. This was one of the foundations of the neoclassical theory of investment, which views investment as a choice variable in the manager's effort to maximize the firm's value for its shareholders.

Against this backdrop, Tobin (1968, 1969) subsequently formulated the q-theory of investment, whereby his proposed metric q, defined as the ratio between a unit of physical capital's market value and its replacement value, sufficed to summarize the existence (or absence) of investment opportunities for a particular firm. According to Tobin's influential reasoning, when q is greater than 1, i.e. when the marginal unit of capital adds to a firm's value more than it costs to obtain it, then it is profitable for the firm to install new capital. Hence $q>1$ is an indicator that the firm should accumulate additional capital (i.e. undertake additional investment) and vice versa.

Hayashi (1982) further built on the initial idea that the only determinant of firm investment is the existence of profitable investment opportunities by extending the aforementioned framework to include the assumption of convex costs of adjusting capital. Under some additional assumptions[1] his extension allowed the same underlying concept to be specified in terms of average q, defined as the market value

[1] Perfect competition in the product market, linear homogeneity of the production and adjustment cost functions.

of the firm divided by the replacement cost of installed capital, i.e. an observable metric, rather than in terms of Tobin's marginal q which was unobservable. This marked a turning point, as the theory was thus rendered testable.

ii) Core empirical evidence – the role of cash flow

A flurry of empirical work followed, which by and large points to the conclusion that the neoclassical theory of investment, in its simplest form, is not supported by firm-level data. Were it to hold, q would suffice to explain firm investment, having been cast by the theory as an all-encompassing summary measure of investment opportunities. In practice, a range of other firm-specific variables also seem to have a statistically significant effect on investment when added to the benchmark specification. Cash flow is by far the most frequently included additional explanatory variable and it appears to nearly always have a significant positive impact on firm-level investment decisions.

A number of alternative explanations have been proposed in the literature for this empirical regularity. First, it might reflect measurement error in q. Given that cash-flow is highly correlated with profits and sales, its inclusion in a q-type model of investment may contribute additional information on firm profitability and investment opportunities which observed average q might have failed to capture.

Second, it might reflect imperfect competition in the goods market – a violation of one of the framework's underlying theoretical assumptions. If a firm has monopoly power in the market for the good it produces, the marginal revenue of its capital is not equal to the average profit of installed capital (as assumed when using average instead of marginal q) but rather it also varies with output (Hayashi, 1982). Thus cash flow might be capturing this discrepancy in q. However, the statistical significance of the coefficient on cash-flow persists even when measures such as profits or sales are included in the specification (see for example Fazzari, Hubbard and Petersen, 1988), indicating that these two explanations do not suffice to explain the significance of cash flow for investment.

A third proposed explanation of cash-flow's significance is that managers may be using "free" cash-flow, i.e. any cash-flow left over once all investment in profitable projects has been realized, to overinvest. Such behaviour would be in line with the "empire building hypothesis" and the "hybris hypothesis" on managerial behaviour. Heaton (2002) and Malmendier and Tate (2005) show that overconfident CEOs overvalue their investment projects and, conversely, believe that the market undervalues their firms thereby rendering external financing unduly expensive. As a result, if sufficient internal funds are available, they overinvest relative to the optimal investment level. Such suboptimal investment policies could explain why *q* does not seem to suffice to capture firm investment behaviour. This hypothesis is, however, at odds with other theories on managerial behaviour such as the "quiet life hypothesis" (Atanassov, 2013, and Bertrand and Mullainathan, 2003) and CEO short-termism (Davies *et al.*, 2014). Moreover, Franzoni (2009) show, *inter alia*, that overinvestment seems to be more common in large and more mature firms whereas, when the universe of listed firms is taken as a whole, underinvestment (possibly as a result of financing constraints) seems to be a more dominant feature.[2]

It could alternatively be the case that, while managers invest optimally, they do so by pursuing suboptimal financing strategies, notably by showing a preference for internal funds (which are correlated with cash flow measures) over external financing. The proposed rationale for the undesirability of external financing is that it might subject managers to restrictive contractual terms and closer monitoring of their investment projects – another facet of the "quiet life hypothesis". By this reasoning, there emerges a financing premium as a result of agency costs, which renders *q* an incomplete measure of corporate investment behaviour (Hansen, 1999). A different, though complementary explanation of why external finance may come at a higher cost than internal finance is that the issuance of both new equity and corporate debt may be associated with non-negligible transaction costs. These could however be counterbalanced by possible tax gains of opting for external financing.

Yet another alternative view draws on work by Shiller (1987 and later) highlighting that, while stocks may be correctly priced *relative* to each other, they may be mispriced in absolute terms. The overall price level of the market may not accurately reflect macro fundamentals and in particular the medium-term downside risks and/or growth prospects facing the domestic and global economy. If indeed equity markets can be over or undervalued for prolonged periods of time (as implied

[2] Adjaoud, Charfi and Chourou (2011) provide a comprehensive review of the literature on corporate governance and investment decisions.

by theories on financial bubbles, irrationalities and herd behaviour) the nominator of q will generally not provide a correct measure of the current worth and likely long-run prospects of the firm and thus q itself will provide an imperfect signal for long-term investment decisions. However although this argument implies the existence of a cyclical type of bias, it does not justify the persistently positive coefficient on cash flow.

In fact, the above arguments notwithstanding, the empirical significance of cash flow metrics in models of investment is most often attributed to the existence of more fundamental financial market imperfections, namely information asymmetries. The benchmark model only holds under the assumption of perfect capital markets. Conversely, if firms can access superior information than capital market participants regarding the riskiness and profitability of potential investment projects, the q-theory of investment will be invalid due to the market valuation of the firm (used to calculate q) embedding an "external financing premium" to compensate investors for informational opaqueness. In this sense, the finding of a significant positive coefficient on cash flow essentially constitutes a rejection of the efficient markets' hypothesis. The above interpretation is strongly corroborated by corporate finance theory, which maintains that such market imperfections are indeed likely to reduce firms' capacity to fund investments and thus to influence their investment decisions.

If this workhorse hypothesis of an "external financing premium" is valid, one might expect to find that the theory does not hold for firms with particular characteristics by which they might be classified as likely to be facing external financing constraints due to information asymmetries. Fazzari, Hubbard and Petersen (1988) were the first to empirically explore the differential impact of external financing constraints on firm-level investment decisions. They classified firms as financially constrained or not on the basis of their size, dividend payouts and capital structure, controlling for investment opportunities using Tobin's q. They found that the investment behaviour of firms likely to be financially constrained was significantly more sensitive to the supply of internal funds (as proxied by cash flow) than that of the non-constrained ones, which they interpreted as an indication that external financing constraints are binding for those particular subgroups. Through their seminal empirical analysis they were the first to convincingly draw the two-fold conclusion that cash-flow indeed significantly affects investment and that this is due to imperfections in the capital market.

Numerous subsequent studies followed the same methodology,[3] testing the hypothesis for different economies and types of investment. Early research includes Hayashi and Inoue (1991) for Japan, Chirinko and Schaller (1995), Hubbard et al. (1995), Calomiris and Hubbard (1995), Hubbard (1998) for the US and Bond, Elston, Mairesse and Mulkay (1997) for France, Belgium, Germany and the UK. More recently, Aggarwal and Zong (2006) use data on the US, the UK, Japan, and Germany to show that, after controlling for investment opportunities, investment levels are significantly positively influenced by internal cash flow, indicating that firms' access to external financing is constrained in all four countries. Interestingly, cross-country differences seem to reflect closer outside monitoring in the more bank-based economies. Ağca and Mozumdar (2008) report a significant *albeit* declining investment–cash flow sensitivity for US manufacturing firms, its trend reflecting declining capital market imperfections. Ascioglu et al. (2008) construct a measure of the probability of privately informed trade and use it to classify firms as constrained or unconstrained. Indeed, firms with high information asymmetry have a greater investment–cash flow sensitivity. Carpenter and Guariglia (2008) also employ a measure of insider information on investment opportunities to explore the degree to which UK firms are faced with financial constraints. They find that for small firms in particular the significance of cash flow in investment equations indeed reflects financial constraints caused by information asymmetries in capital markets. Angelopoulou and Gibson (2007), using a panel of UK manufacturing firms, find that investment in financially-constrained firms becomes more sensitive to cash flow in periods of monetary tightness. Financial constraints, however, weaken with growing financial sophistication. Aivazian *et al.* (2005) show that leverage, a proxy for financing constraints, negatively affects investment by Canadian firms. Czarnitzki and

[3] An opposing minority also emerged, notably Kaplan and Zingales (1997, 2000) who argued that the classification adopted by Fazzari et al. (1988) tends to assign firms incorrectly. They make use of more detailed financial information to reclassify the same firms over an identical sample period and find that financially constrained firms have the lowest sensitivity of investment to cash flow. On a larger dataset Cleary (1999) also report similar results. Fazzari et al. (2000) respond and address the criticisms. More recently, Allayannis and Mozumdar (2004) show that the findings of Kaplan and Zingales (1997) can be explained by a few influential observations whereas those of Cleary (1999) can be explained by observations of firms with negative cash flows. The main point to take away from the work by Kaplan and Zingales and Clearly is that for firms under distress the cash flow sensitivity might be reduced, giving rise to a U-shaped relationship. Moyen (2004) provides a theoretical model accommodating both views.

Binz (2008) find that external financing constraints become more binding for German firms as their size declines, affecting both capital and R&D investment. The availability of internal funds is particularly critical for R&D investment. Ughetto (2008) studies a large panel of Italian firms and reports that cash flow is highly significant in explaining capital investment. Its role is more important the smaller the firm, and especially so for small firms which are active in R&D. Finally, Bokpin and Onumahu (2009) find that a number of micro level factors, including firm size, profitability and cash flow are significant in forecasting investment decisions for firms operating in emerging markets. Stein (2003) and Bond and Van Reenen (2007) provide insightful reviews of this literature.

iii) Research developments since the financial crisis

In the wake of the financial crisis of 2008 this well-explored field of research received a new boost, spurred largely from the substantial decline in investment recorded over recent years. Indeed, at the end of 2015 investment across the euro area remained well below its pre-crisis level, its post-crisis trajectory having been markedly weaker than in most previous recession and crisis episodes (see Barkbu *et al.*, 2015). The crisis and the associated recession experienced contemporaneously in most advanced economies provided a natural experiment, a unique opportunity for researchers to better understand the impact of firm-specific financing constraints and overall financial conditions on corporate decisions. Recently, this has increasingly been done without resorting to cash flow as a proxy, but rather by using more direct measures.

Campello *et al.* (2010) show that the financial crisis systematically affected real investment, *albeit* unevenly across firms. In December 2008 they surveyed 1,050 chief financial officers (CFOs) in 39 countries collecting novel types of data, including an *ex ante* measure of corporate investment plans as well as information on whether investment was canceled because of credit constraints. They find that financially constrained firms planned deeper cuts in investment, technology, marketing and employment relative to financially unconstrained firms during the crisis. In fact, nearly 90% of constrained companies said that financial constraints restrict their pursuit of attractive projects and more than half of these firms were actually forced to cancel valuable investments. Furthermore, constrained firms were forced to use up a sizeable portion of their cash savings during the crisis, while they also accelerated the withdrawal of funds from their outstanding credit lines because of concerns that their banks may restrict future access to them. Finally, constrained firms also displayed a much higher propensity to sell off assets as a way of generating funds during the crisis, reflecting pro-active disinvestment strategies.

Buca and Vermeulen (2015) explicitly consider whether the reductions in bank credit supply consistently reported by euro area loan officers during the crisis led to reduced investment on behalf of firms.[4] While, in principle, firms can always opt for other forms of credit (e.g. corporate bond issuance) when faced with a reduction in bank loan supply, this may be less of an option in a bank-based economy such as the euro area, and especially during a financial crisis. Indeed the authors report significant effects. They use a panel of aggregated balance sheet data for different manufacturing industries from six euro area countries (Germany, France, Italy, Spain, Belgium, Portugal) within which they are able to track aggregate investment and aggregate indebtedness, bank debt and non-bank debt at the country and industry level, for three segments: small, medium and large firms. They then exploit the cross-country and cross-sector differences in dependence on bank loans to identify whether the tightening reported by loan officers had real effects on the investment spending of those industries. After controlling for demand factors, they find that investment spending by bank-dependent borrowers declined more sharply relative to that of non-bank-dependent borrowers following the tightening of bank credit. The effects they find are sizeable, implying that market financing was not readily available to fund profitable investment projects during the recent financial crisis.

Campello *et al.* (2012) employ a unique data set to explore how firms in Europe used credit lines during the financial crisis. They find that firms likely to have restricted access to other types of financing (small, private, non-investment-grade and unprofitable ones) drew more funds from their credit lines during the crisis than their large, public, investment-grade, profitable counterparts. Their work clearly illustrates that the extent to which financing constraints are binding varies over time, with

[4] There exists ample evidence that banks reduced their willingness to extend credit to firms during this period. For instance, in the Bank Lending Survey of the European Central Bank, where seniour loan officers of a representative sample of euro area banks are asked questions on developments regarding their lending policies, one can observe a significant tightening of credit around the time of the crisis.

overall financial conditions. Thus financial constraints are particularly likely to affect corporate decisions such as investment during financial cycle downturns.

Gaiotti (2013) finds that the impact of bank credit availability on firm investment is time varying and most significant during economic contractions. Carvalho, Ferreira and Matos (2015) explore the role of publicly traded firms' bank relationships in their investment decisions, using syndicated bank loan data. They find that during the recent crisis firms with only one main lender reduced investment significantly more than those with multiple lenders, further evidence that market financing constraints were at play. Similarly, Almeida *et al.* (2012) demonstrate that firms with a substantial proportion of their long-term debt maturing soon after the third quarter of 2007 reduced investment in comparison with other firms over the following quarters, implying that they were unable to roll over the loans or find alternative financing sources.

Ferrando *et al.* (2014) investigate the link between the pursuit of financial flexibility through conservative leverage policies and firms' ability to respond to unexpected changes in their investment opportunities. Using firm data from 9 European countries, they identify as financially flexible firms which had low leverage for a number of consecutive years and test whether financial flexibility –interpreted as spare borrowing capacity– has an impact on firm investment. The underlying intuition is that a conservative leverage policy safeguards the firm's ability to undertake investment in the future, when asymmetric information and contracting problems might otherwise force it to forego profitable growth opportunities. The authors show that indeed financial flexibility has a large positive impact on a firm's investment ability. This impact, however, varies across firms depending on the degree to which they are financially constrained, with private, smaller and younger firms being likely to invest more in relative terms than larger corporations, if financially flexible. Moreover, the authors provide evidence that firms with "spare borrowing capacity" (i.e. financial flexibility) reduce their investment by less than others, in the event of exogenous liquidity shocks in the capital markets, such as the recent financial crisis.

Duchin, Ozbas and Sensoy (2010) also document heterogeneity in the effects of the financial crisis on firm investment. Using COMPUSTAT data, they show that among US listed firms the decline in investment was largest among firms with low cash reserves, high short-term debt or operations in industries that depend on external finance.

In sum, this recent body of micro-level empirical research reaffirms that firm-specific financing constraints are at play, materially affecting corporate investment decisions. Additionally, it explores the intertemporal dynamics of this effect, providing clear evidence of time-variation, credit constraints having become a significantly more important determinant of firm investment during the recent crisis.

iv) Our contribution to the literature

Our paper contributes to this already extensive academic literature by focusing more explicitly on the importance of overall financial conditions as a determinant of firm-level investment decisions, over and above the well-established impact of firm-specific financing constraints due to information asymmetries. In particular we explore whether the significance of the aforementioned external financing premium varies over time, in line with the overall financial conditions prevalent in the economy.

Our approach is novel in that, to do so, we directly include an all-encompassing relative measure of credit conditions in the benchmark specification. This measure, which has been shown to track developments over the post-euro period well, allows a much more refined identification of periods of tightening or easing financial conditions than do year dummies based on formal recession definitions for example, and can be precisely tailored to the accounting year of each firm in our sample. We are primarily interested in exploring the importance of overall financing conditions *per se* for firm investment but, in doing so, we also reconsider the role of cash flow and other firm-specific variables and test some of the aforementioned empirical regularities.

Our paper builds on Angelopoulou, Balfoussia and Gibson (2014) and Balfoussia and Gibson (2016) who construct and employ this financial conditions index to explore the real macroeconomic effects of changes in credit conditions. They report *inter alia* a significant causal relationship between easing financial conditions and aggregate investment in the euro area. The present study follows on, exploring the aforementioned relationship at the micro level. We relate the same financial conditions index to firm-level data on investment, in order to gain further insight as to how the effect on aggregate investment reported in Balfoussia and Gibson (2016) comes about. In doing so, we are able to study in some detail the impact of economy-wide supply-side financial factors on firm-level investment decisions.

3. Data and methodology

Our data cover over 2400 listed companies in euro area countries for a maximum data period of 1980 to 2013. Data include annual company accounts (items from the balance sheet, profit and loss and cash flow/funding accounts), as well as stock market information on the market value of the company. The data source is Thomsen-Reuters-Datastream.

As an index of financial conditions we use that of Angelopoulou, Balfoussia and Gibson (2014). The index, available over the period 2003-2013[5], is constructed using a wide range of prices, quantities, spreads and survey data along with variables representing the stance of monetary policy. Figure 1 plots the index for the euro area. The figure suggests that the index provides a sensible narrative of financial conditions before and during the crisis. Financial conditions progressively loosened in the euro area from 2003 onwards. In 2007 there was a sharp reversal which intensified with the failure of Lehman Brothers in late 2008. Aggressive intervention by the ECB resulted in a partial improvement, only for conditions to worsen significantly with the outbreak of the euro area sovereign debt crisis at the beginning of 2010. These two large exogenous shocks to financial conditions, exogenous, that is, to firms' investment decisions, allow us to isolate more effectively the impact of supply-side financial factors on firm investment decisions.

The financial conditions index is at a monthly frequency. This allows us to create a variable for financial conditions which matches the period of the company accounts. Thus, in the simplest case, if year-end is end-December and the accounts refer to a calendar year, then financial conditions are the average of the monthly observations for that year. If the year-end is 31 March, we use the monthly average for April of the previous year to March of the current year. If the accounts refer to a

[5] The index begins in 2003 since it uses survey data from the Bank Lending Survey conducted by the ECB each month. We retain company accounts data from 1980 to facilitate the calculation of firm capital stocks. Estimations, by contrast, cover the period from 2003 onwards.

period shorter or longer than a year, we average over the appropriate months. In short, we align the average monthly financial conditions index with the accounting period to which it refers. The use of an average is appropriate since investment is a flow variable.

The dependent variable is the investment rate. Investment is additions to fixed assets over the accounting period. It is converted to a rate by dividing through by the capital stock of the company (see later). As independent variables we use Tobin's Q defined as the market value of the company over the replacement cost of its total assets. If Q is greater than 1, this provides a signal that the company should invest, thus raising total assets; if Q is less than 1, disinvestment should occur, thus lowering total assets. Equilibrium occurs where Q=1.

In calculating Q, the challenge is constructing the replacement cost of total assets (equivalent to the capital stock of the company). Modern international accounting standards require firms to report fixed assets at replacement cost. The EU, for example, adopted IFRS in 2002 and required its implementation by 2005. Some companies switched earlier; others switched later. However, it is also possible to calculate a replacement cost capital stock using the Perpetual Inventory Method, provided we have a long enough series of data on investment[6]. In this paper, we compare both measures. On the one hand, we do not want to lose data from the period around 2003-2004 when some companies had not implemented new accounting standards. On the other hand, we want to check that our calculation of replacement cost is close to that provided in accounts that do report assets at their replacement cost. Indeed the two series are close and the results do not appear to be sensitive to which series we use. Tobin's Q is then calculated as the market value of the company divided by the average of total assets at replacement cost in period t-1 and period t.

Cash flow is defined as profit after interest and tax and is expressed as a proportion of total assets at replacement cost averaged over t-1 and t. All flow variables are adjusted for the duration to which the accounts apply.

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[6] Under the Perpetual Inventory Method, we start with investment at time t-n (the first year of data) and set the capital stock equal to investment. In the following period, we adjust the stock for capital goods inflation (measured by the gross fixed capital formation deflator in each country), depreciation (assumed to be 8.2% per year, in line with estimates for the US) and technical progress (add 2%); this period's investment is then added to the adjusted capital stock to obtain the capital stock measure for the current period. This is repeated until we construct a series for the whole period. With a long enough run of data, the base effect of assuming that investment=capital stock in the initial period falls out.

We distinguish potentially constrained and unconstrained firms on the basis of two measures. First the size of the company, as measured by total assets at replacement cost deflated by the gross fixed capital formation deflator (Aldretsch and Elston, 2002). Size could be endogenous since, while size may affect investment through its impact on the degree of financial constraint that a firm might face, investment also causes firms' size to increase. One way of avoiding this endogeneity is to use the size of the company at the start of the sample period. On this basis, we assign a company to one of 4 size categories throughout its time in the sample. Given the size of the financial shocks faced in the latter part of the sample, we define potentially constrained firms as those in the first three size categories. Thus only firms whose size is greater than the 75th percentile are considered "large" and potentially unconstrained.

We also split our sample into potentially constrained and unconstrained firms on the basis of leverage (Bougheas et al, 2006). Highly leveraged firms may find it more difficult to borrow and thus face financial constraints. We define leverage as total debt divided by total equity. Highly leveraged companies are those whose mean leverage ratio exceeds the 75th percentile across all firms.

The strategy adopted is as follows. We begin by relating investment simply to Q. We then introduce cash flow. If cash flow is significant, then this could indicate that financial constraints operate; for a given value of Q which determines investment opportunities, those firms with more internally-generated funds are able to undertake more investment. However, cash flow could be endogenous. The more investment a firm undertakes, the more cash flow it is likely to generate. Thus we introduce another explanatory variable which interacts cash flow with financial conditions as measured by our index (in fact, we use the change in the index). Does cash flow exercise a larger effect on investment when financial conditions tighten? If so, then this is evidence that the cash flow effect is indeed picking up financial constraints because otherwise we would have no reason to expect that the coefficient on cash flow would vary with financial conditions. Finally, we look at the impact of cash flow in firms which are defined as constrained (using either leverage or size) and how investment reacts when these potentially constrained firms are faced with tighter financial conditions.

4. Results

Table 1 presents the results from the Q and extended Q model. Since Q is endogenous in that the investment strategy of a firm affects both its market value and the replacement cost of its assets, we estimate the model using an instrumental variables fixed-effects estimator. A fixed-effects model is supported by the results of the Hausman test comparing a random effects model with a fixed effects one. In column (1), the results suggest that Q has a positive and significant impact on investment. At the mean, a 10% rise in Q leads to a rise in the investment rate of 2.5%. In column (2) we include cash flow. Cash flow also has a positive and significant impact on the investment rate – given Q, a 10% rise in cash flow raises the investment rate by 1.9%.

In order to investigate whether the significance of cash flow is related to financial constraints, rather than a complementary measure of future profitability (in the presence of Q being imperfectly measured), we test whether the impact of cash flow varies with financial conditions. The results are shown in column (3). We find that tight financial conditions interacted with cash flow both in the current and previous periods significantly affect the investment rate. The significance of the lagged composite variables perhaps reflects lags in the operation of monetary policy which, in part, determines financial conditions. If the coefficient on cash flow is usually 0.145 (implying an elasticity of 0.19), in tight financial conditions, the coefficient rises to 0.183 – an increase of just over 26%).

Table 2 explores further the role of financial constraints in explaining the sensitivity of investment to cash flow. We split companies into constrained and unconstrained based on their size and indebtedness. In Column (1) of Table 2, we present the results of identifying constrained companies on the basis of size. Investment is still affected positively and significantly by q, with the size being equivalent to that of column (3) in Table 1. The impact of cash flow in constrained firms (0.146) is almost three times that of unconstrained firms (0.046). Moreover, during tight financial conditions, the coefficient on cash flow rises to 0.187 (=0.146+0.020+0.021). By contrast, cash flow in unconstrained firms has barely a statistically significant impact on investment – this is what we might expect since, in unconstrained firms, deteriorating financing conditions would manifest themselves through a cost of capital effect (which, in turn, affects q) and not through the quantity of funds available. The χ^2 tests at the bottom of the table clearly show that the coefficients on constrained firms are significantly different statistically from those of unconstrained.

Similar results, if not stronger, are found when we split companies into constrained and unconstrained based on their indebtedness. More specifically we define a constrained firm as being in the upper quartile of the distribution of mean company leverage over the sample (Table 2, column (2)). The coefficient on cash flow for constrained firms is 0.437 compared to 0.052 for unconstrained. In times of financial tightness, the coefficient on cash flow increases to 0.575 (=0.437+0.019+0.119) compared to 0.090 (=0.052+0.027+0.011) for unconstrained firms. These differences are not only statistically significant (as shown by the χ^2 tests at the bottom of the table), they are also economically significant. Table 3 summarises the elasticities across different models. The much higher sensitivity to cash flow observed in constrained firms is clear. Additionally, if financial conditions tighten (we assume by 1 unit of the index), then sensitivity to cash flows rises.

In order to explore the robustness of these results, we undertake a number of sensitivity tests (presented in Table 4)[7]. First, we investigate whether the sensitivity of investment to Q varies depending on whether the firm is constrained or not. The results suggest that if constrained/unconstrained is determined on the basis of size, then the sensitivity of investment to changes in Q is much higher in unconstrained firms, perhaps reflecting the ease with which unconstrained companies can undertake investment.

Second, given the fact that Q is measured with errors, it is advisable not to compound these measurement errors by using lagged values of Q as an instrument. Hence we present results which use lagged sales as instruments. The results appear robust to this change with cash flow sensitivities being higher in constrained firms. Overall, however, using lagged values of sales reduces the significance of all variables in the equation.

Third, we include GDP growth as a measure of aggregate demand. The financial and sovereign debt crises did not only have an impact on financial conditions, they

[7] It should also be noted that the results are robust to including or excluding year dummies.

also caused a sharp reduction in aggregate demand. Accelerator models of investment would suggest that aggregate demand is a crucial determinant of investment. Adding in growth suggests that it does affect investment in a significant positive manner. The results for the impact of financial conditions, however, remain unaffected.

Finally, we examine whether our results are driven by the presence of companies in financial distress in the sample. To this end, we drop companies who disappear from the sample before 2012. 2012 is the last year for which we have a full data set; only a small number of companies had accounts for 2013. Reasons for a company disappearing before 2012 include bankruptcy, acquisition or delisting, all of which are likely to have been associated with financial distress. The results are in the last two columns of Table 4 and confirm that the basic results of Table 2 remain unaffected by the exclusion of companies in financial distress.

5. Interpretation of our results

Our findings are in line with economic intuition. We contribute to the already large body of evidence which suggests that financing constraints are present at the firm level, materially impacting on firms' investment decisions. Moreover, here too the firms most bound by financing constraints appear to be the small ones. These are the ones of which capital market participants are likely to require an additional financing premium in order to compensate for the relative opaqueness surrounding their growth prospects, investment opportunities and overall creditworthiness. Furthermore, firms tend to be more bound by financing constraints in their investment decisions when they are excessively leveraged, in line with both early evidence in the literature as well as more recent work such as that of Ferrando *et al.* (2014).

The novel aspect of our empirical contribution is that we show these two effects become significantly stronger when financial conditions are deteriorating. In other words, for given investment opportunities, when financial conditions deteriorate firms tend to condition investment decisions more on the availability of internal funds, as proxied by cash flow.

There are several possible interpretations of this finding. It might be an indication that, when financial conditions tighten, the number of firms in the sample that find themselves operating under binding financing constraints increases. This is in line with conventional wisdom resulting from the recent crisis period, as it is well known that throughout it firms reported access to financing as a key problem.

Viewed differently, our findings indicate that, keeping Q constant, for the same cash flow (or availability of internal funds) firms undertake more investment during periods of tightening financial conditions or, equivalently though perhaps more plausibly, they undertake the same investment given lower levels of cash flow. While this finding may seem counterintuitive at first, it essentially reveals that there is likely to be less cash available to firms during periods of deteriorating financial conditions. In other words, while the significance of internal funds as a driving force increases in the presence of tightening financial conditions, this is a time during which firms are obliged to undertake their investment projects with less cash at hand (see Ferrando *et al.*, 2014, and Campello *et al.*, 2010, *inter alia* for recent evidence that firms are forced to use up their cash reserves during periods of crisis). It may also, to some extent, reflect the fact that investment projects require quite a long time to evaluate, contract and implement. Thus, firms may often find themselves implementing projects which they committed to during previous periods, when looser financial conditions might have prevailed. Furthermore, it ties in well with the idea that investment is not continuous but lumpy and hence firms may not always have the option of fine-tuning the size of investment projects in response to cash-flow fluctuations. In any case, the fact that we find firms have a higher cash flow-conditioned propensity to invest when financing conditions deteriorate reassures us that the FCI is not capturing aggregate demand or sales accelerator effects.

Finally, our findings could be an indication that, as financial conditions deteriorate, market valuations of firms' net worth and upcoming investment opportunities are deemed less reliable than during good times (possibly due to higher levels of market volatility), i.e. that q might suffer from more severe measurement errors during such times. As a result, firm-level investment decisions would be expected to depend more on cash flow (as a proxy of investment opportunities) during periods of tightening financial conditions. This interpretation is perhaps corroborated by the occasional decline in the significance of q itself in our estimations, when financial conditions tightening is included.

The finding that size and indebtedness matter also rings true. As aforementioned, it is a standard result in this literature that small firms tend to be more financially constrained and thus are empirically found to exhibit a higher investment – cash flow sensitivity. It is also known that such firms have a higher than average propensity to invest and are more likely to be innovative (Fernando *et al.*, 2014, and Aghion *et al.*, 2014). Given the very high share of SMEs in Europe, the post-crisis buildup of private sector debt and depletion of cash buffers, our results bear important implications for the euro area economy. As non-listed and micro firms, which are also numerous, are not represented in our sample, these results become even more relevant and may go some way towards explaining the exceptionally slow investment trajectory of recent years.

6. Policy implications

Our findings have a number of policy implications. These stem from the macroeconomic significance of individual firms' investment decisions when aggregated across the economy. In the short run, a curtailment of firm-level investment implies a relative decline in aggregate demand. Hence, the immediate effect is recessionary. At longer horizons, the repercussions are even more troubling. The aggregate stock of corporate capital will be relatively lower and thus so will the economy's productive capacity. In other words, the medium and long-run growth path of the economy and its potential output trajectory will be compromised. This effect is likely to be all the more pronounced if the foregone investment projects are R&D related, as is often the case with small innovative start-ups with low asset tangibility for example. Consequently, there is good reason for policy-makers to monitor firm investment and consider ways of encouraging and facilitating it.

Notably, our findings indicate that any such policy intervention should be countercyclical with respect to financial conditions. We find that during periods of deteriorating financial conditions firm investment is even more vulnerable to financing constraints than usual. This result ties in well with recent research on the interplay between financial cycles and real fluctuations. Indeed, there is evidence of a systematic link between house price and credit cycles and the business cycle (Igan et al., 2009, and Claessens et al., 2011).[8] This association becomes more pronounced

[8] The financial cycle can be defined as self-reinforcing interactions between attitudes towards risk and financing constraints, which translate into booms followed by busts (see for example Borio, 2014) and is increasingly thought to have important macroeconomic consequences. The financial system itself is

during downturns and all the more so when we focus on financial crisis episodes.[9] Pronounced peaks in the financial cycle tend to coincide with the onset of financial crises. More to the point, sharp financial cycle downturns are associated with severe recessions (see Kaminsky and Reinhart, 1999, and Claessens et al., 2012). Furthermore a few recent papers show that output losses from financial crises tend to be highly persistent – see for instance the influential paper by Cerra and Saxena (2008).[10] The persistent nature of these output losses is something of a puzzle.[11] Our work provides micro-based evidence on the possible underlying mechanism, indicating that the persistence of post financial crisis output losses may be due, at least in part, to the protracted effects of dampened firm level investment. By implication, policy makers should strive to lean against the financial cycle, with the aim of encouraging firm investment activity at times when it is most constrained, in order to ultimately smooth real output fluctuations and promote economic growth.

Our findings can also be related to the recent literature on credit-less recoveries, i.e. economic rebounds during which credit continues to contract. The phenomenon was initially considered exceptional and limited only to emerging economies. However, the recent financial crisis has brought credit-less recoveries to the forefront, as the majority of advanced economies began recovering from the great recession without a concurrent rebound in credit. One of the stylised facts in this literature is that credit-less recoveries are substantially weaker than credit-supported ones and that aggregate investment often fails to contribute to the growth process (see Bijsterbosch

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thought to be largely procyclical (see e.g. Borio et al., 2001 and Adrian and Shin, 2010) also giving cause for policy intervention.

[9] During banking and financial crises, the sharp decline in financial sector net worth rapidly depresses lending, triggering fire sales. These in turn further lower asset prices and further weaken the net worth of both corporates and lenders, leading to a slowdown in firm investment and TFP growth and to prolonged lower output growth. Business sector R&D investment in particular seems to decline much more during recessions associated with banking crises. Gertler, Kiyiotaki and Queralto (2012) formalise the above dynamics in a theoretical model where credit market frictions and balance sheet constraints limit real investment spending, affecting aggregate real activity.

[10] Cerra and Saxena (2008) systematically document the behaviour of output following financial and political crises for a large set of high-income, emerging market, developing, and transition countries. They show that less than 1 percentage point of the deepest output loss is regained by the end of ten years following a currency crisis, banking crisis, deterioration in political governance, twin financial crises, or twin political crises. Of the large negative shocks examined, a partial rebound in output is observed only for civil wars. The magnitude of persistent output loss ranges from around 4 per cent to 16 percent for the various shocks. See also Cerra and Saxena (2005a) on the effects of the Asian crisis, Cerra and Saxena (2005b) on the Swedish banking crisis in the early 1990s.

[11] Rogoff (2015) and others have argued that post-crisis deleveraging pressures and financial constraints are the main factors behind the weak post-crisis growth in the US and elsewhere. For the euro area in particular, existing bank balance sheet fragilities were aggravated by the sovereign debt crisis that erupted in 2010-11 (see Acharya et al., 2015, Kalemli-Özcan et al., 2015).

and Dahlhaus, 2014, for a review of the related literature).[12] Given that the severest episode of financial conditions tightening in our sample, the great recession, seems to have given its place to a credit-less recovery, our findings can be seen as micro-level empirical evidence on the incidence and underlying mechanism of this phenomenon. This strand of the literature also underlines the need for policy intervention to be countercyclical with respect to financial conditions.

Indeed, following the global financial crisis, policy makers have increasingly tried to address this need. Macroprudential policy is the clearest example, the underlying idea being to ensure the stability and smooth functioning of the financial system as a whole, as a means *inter alia* of achieving macro stability objectives. This was taken a step further with the introduction of the countercyclical capital buffer in Basel III, which constitutes an explicit effort to design macroprudential policy instruments which will respond to cyclical fluctuations, building up buffers in the system during upswings in order to be able to draw on them during downturns (see Drehmann et al., 2011). Indeed, as stated in the relevant documentation, in downturns the countercyclical capital buffer "…should help to reduce the risk that the supply of credit will be constrained by regulatory capital requirements that could undermine the performance of the real economy and result in additional credit losses".[13]

The unprecedented action taken recently by several monetary policy authorities in order to boost the supply of credit to the real economy is another such example. Indeed our findings, in line with those of Balfoussia and Gibson (2016), suggest that the rationale underlying programs such as the ECB's "Targeted Long Term Refinancing Operations" and the Bank of England's "Funding for Lending" programme is solid.

However, the implications of tightening financial conditions for firm investment should arguably also inform fiscal policy. Our findings underline the arguments of Benigno and Fornaro (2016) who formally show that when tight liquidity conditions coincide with low growth, counter-cyclical fiscal policy such as direct subsidies of innovative and growth-enhancing investment may be called for, not only as supply-side measures but also as a means of stimulating aggregate demand. Aghion et al.

[12] Queralto (2013) formally models the mechanics of slow recoveries following a financial crisis, focusing on the impact of tight credit conditions on new firm creation as a proxy for investment in innovation.
[13] https://www.bis.org/bcbs/ccyb/

(2010, 2014) find that credit constraints affect the composition of investment over the business cycle by increasing firms' propensity to substitute long-term productivity-enhancing investment for less productive short-term investment, thus contributing to lower average growth rates. They subsequently use panel data to explore the effects of cyclical fiscal policy on industry growth and show that industries most likely to be innovative (those with a relatively heavier reliance on external financing or with lower asset tangibility and thus limited collateral availability) tend to grow faster in countries that implement more countercyclical fiscal policies. They argue that the interaction between firms’ credit constraints and fiscal countercyclicality is stronger during downturns because that is when credit constraints become more binding. In sum, they show that short-run fiscal policy aimed at smoothing the business cycle can in practice also help policy makers lean against tightening financial conditions, safeguarding investment in innovation and thus boosting long run industry growth. The empirical evidence which was presented in section 4 provides empirical support to this line of argument.

Finally, as we find it is investment by small and highly leveraged firms in particular which is hampered by deteriorating financial conditions, it follows that all efforts to support them (e.g. by facilitating SME investment financing or by setting up effective debt restructuring tools) should be intensified during downturns of the financial cycle. This would help to reduce the economy’s overall vulnerability during financial downturns and to contain real medium-term downside risks. Given the prevalence of micro firms and SMEs in the euro area economy and the buildup of private debt overhang over recent years, this finding is of particular policy relevance.

7. Conclusions

In this paper we try to cast new light on the links between overall financial conditions and corporate investment in the euro area, in view of the recent financial crisis. We explore whether the well-documented investment – cash-flow sensitivity stemming from constrained firms' external financing premium is time-varying and, in particular, whether it varies with overall financial conditions. We find that financial conditions have indeed played a significant role in corporate investment decisions over recent years, rendering financing constraints even more binding. This finding appears to be robust to a number of control variables and robustness tests. Moreover, the impact of credit conditions is not uniform across firms, but rather it varies depending on firm size and leverage, with constrained firms being substantially more likely to condition their investment decisions on overall credit conditions. Our results fit in with recent research on the interplay between financial and real cycle downturns and underline the need for monetary, fiscal and macroprudential policy to be countercyclical with respect to financial conditions.

Bibliography

Acharya, V., I. Drechsel and P. Schnabl, 2015. A Pyrrhic Victory - Bank Bailouts and Sovereign Credit Risk. Journal of Finance 69, 2689-2739.

Adjaoud, F., Charfi, D. and Chourou, L. Corporate Governance and Investment Decisions. In H. K. Baker and P. English (Eds.). Capital Budgeting Valuation: Financial Analysis for Today's Investment Projects. New Jersey, USA: John Wiley & Sons, Inc., 2011.

Adrian T., and H. S. Shin, 2010. The changing nature of financial intermediation and the financial crisis of 2007-2009. Staff reports 439, Federal Reserve Bank of New York.

Ağca, S. and A. Mozumdar, 2008. The impact of capital market imperfections on investment–cash flow sensitivity. Journal of Banking & Finance, 32, 2, 207–216.

Aggarwal, R., and S. Zong, 2006. The cash flow–investment relationship: International evidence of limited access to external finance. Journal of Multinational Financial Management, 16, 1, 89–104.

Aghion, P., G.-M. Angeletos, A. Banerjee and K. Manova, 2010. Volatility and growth: Credit constraints and the composition of investment. Journal of Monetary Economics, 57, 246–265.

Aghion. P., D. Hémous and E. Kharroubi, 2014. Cyclical fiscal policy, credit constraints, and industry growth. Journal of Monetary Economics, 62, 41–58.

Allayannis, G., and A. Mozumdar, 2004. The impact of negative cash-flow and influential observations on investment-cash flow sensitivity estimates. Journal of Banking & Finance 28, 901-930.

Almeida, H., Campello, M., Laranjeira, B., Weisbenner, S. 2012. Corporate debt maturity and the real effects of the 2007 financial crisis. Critical Finance Review, 1, 3–58.

Angelopoulou, E., Balfoussia, H. and H.D. Gibson, 2014. Building a financial conditions index for the euro area and selected euro area countries: What does it tell us about the crisis? Economic Modelling, 38(C), 392-403.

Angelopoulou, E. and H. D. Gibson, 2007. The Balance Sheet Channel of Monetary Policiy Transmission: evidence from the United Kingdom. Economica, 76, 675-703.

Ascioglu, A., S.P. Hegde and J.B. McDermott, 2008. Information asymmetry and investment–cash flow sensitivity. Journal of Banking & Finance, 32, 6, 1036–1048.

Atanassov, J., 2013. Do hostile takeovers stifle innovation? Evidence from antitakeover legislation and corporate patenting. Journal of Finance, 68, 3, 1097-1131.

Aivazian, V.A, Ge. J., and J. Qiu, 2005. The Impact of Leverage on Firm Investment: Canadian evidence. Journal of Corporate Finance, 11, 277-91.

Balfoussia, H. and H. D. Gibson, 2016. Financial conditions and economic activity: the potential impact of the targeted longer-term refinancing operations (TLTROS). Applied Economics Letters, 23, 6, 449-56.

Barkbu, B., P. Berkmen, P. Lukyantsau, S. Saksonovs and H. Schoelermann, 2015. Investment in the Euro Area; Why Has It Been Weak? IMF Working Papers 15/32, International Monetary Fund.

Benigno G. and L. Fornaro, 2016. Stagnation traps. Center for Macroeconomics, Discussion paper CFM-DP2016-06.

Bertrand, M. and S. Mullainathan, 2003. Enjoying the Quiet Life? Corporate Governance and Managerial Preferences. Journal of Political Economy ,111, 1043-1075.

Bokpin, G.A., and J.M. Onumah, 2009. An Empirical Analysis of the Determinants of Corporate Investment Decisions: Evidence from Emerging Market Firms. International Research Journal of Finance and Economics, 33, 134-141.

Bond, S., J. Elston, J. Mairesse and B. Mulkay, 1997. Financial Factors and Investment in Belgium, France, Germany and the UK:A Comparison Using Company Panel Data, NBER working paper 5900.

Bond, Stephen and Van Reenen, John, 2007. Microeconometric models of investment and employment. In: Heckman, James J. and Leamer, Edward E., (eds.) Handbook of Econometrics. Handbooks in Economics, 6A. North Holland, London, UK, 4417-4498. ISBN 0444506314.

Borio, C., 2014. The financial cycle and macroeconomics: what have we learnt? Journal of Banking & Finance, 45, 182-198.

Borio, C., C. Furfine and P. Lowe, 2001. Procyclicality of the financial system and financial stability: issues and policy options. In: *Marrying the macro- and micro- prudential dimensions of financial stability,* vol. 1, Bank for International Settlements.

Brainard, W. C. and J. Tobin, 1968. Pitfalls in Financial Model Building. American Economic Review 58 (2): 99–122.

Buca, A. and P. Vermeulen, 2015. Corporate investment and bank-dependent borrowers during the recent financial crisis. Working Paper Series 1859, European Central Bank.

Calomiris, C. W. and G. R. Hubbard and R. Glenn, 1995. Internal Finance and Investment: Evidence from the Undistributed Profits Tax of 1936-37. The Journal of Business, 68, 4, 443-82.

Campello, M., E. Giambona, J.R. Graham, and C.R. Harvey, 2012. Access to Liquidity and Corporate Investment in Europe during the Financial Crisis. Review of Finance, 16, 323–346.

Campello, M., J. Graham, and C. Harvey, 2010. The real effects of financial constraints: evidence from a financial crisis. Journal of Financial Economics, 97, 470-487.

Carpenter, R. E. and A. Guariglia, 2008. Cash flow, investment, and investment opportunities: New tests using UK panel data. Journal of Banking & Finance, 32, 9, 1894-1906.

Cerra, V., Panizza, U. and S.C. Saxena, 2013. International evidence on recovery from recessions. Contemporary Economic Policy, 31, 2, 424-439.

Cerra, V. and S. C. Saxena, 2008. Growth Dynamics: The Myth of Economic Recovery. American Economic Review, 98, 1, 439–457 .

Cerra, V. and S. C. Saxena, 2005a. Did Output Recover from the Asian Crisis? IMf Staff Papers, 52, 1, 1–23.

Cerra, Valerie, and Sweta Chaman Saxena, 2005b. Eurosclerosis or Financial Collapse: Why Did Swedish Incomes Fall Behind? International Monetary Fund Working Paper 29.

Chirinko, R.S. and H. Schaller, 1995. Why does liquidity matter in investment equations? Journal of Money, Credit and Banking, 27, 527-48.

Claessens, S., M. Kose and M. Terrones, 2012. How do business and financial cycles interact? Journal of International Economics, 87, 1, 178-190.

Claessens, S., H. Tong and S-J. Wei, 2012. From the financial crisis to the real economy: Using firm-level data to identify transmission channels. Journal of International Economics, 88, 375–387.

Cleary, S., 1999. The relationship between firm investment and financial status. Journal of Finance, 54, 673–692.

Czarnitzki, D. and H. L. Binz, 2008. R&D Investment and Financing Constraints of Small and Medium-Sized Firms. Discussion Paper No. 08-047, Centre for European Economic Research.

Dagher, J.C. 2013. Sudden Stops, Output Drops, and Credit Collapses. Macroeconomic Dynamics, 1-26.

Davies, R., A. G. Haldane, M. Nielsen and S. Pezzini, 2014. Measuring the costs of short-termism, Journal of Financial Stability, 12, 16-25.

Drehmann M., C. Borio and K. Tsatsaronis, 2011. Anchoring countercyclical capital buffers: the role of credit aggregates. BIS working paper No 355.

Duchin, R., O. Ozbas, and B. Sensoy, 2010. Costly external finance, corporate investment, and the subprime mortgage credit crisis. Journal of Financial Economics, 97, 418-435.

Fazzari, S.M., R.G. Hubbard, and B.C. Petersen, 1988. Financing constraints and corporate investment. Brookings Paper on Economic Activity, 141–195.

Fazzari, S.M., R.G. Hubbard, and B.C. Petersen, 2000. Investment-Cash Flow Sensitivities Are Useful: A Comment on Kaplan and Zingales. Quarterly Journal of Economics, 115, 695–705.

Ferrando, A., M.T. Marchica and R. Mura 2014. Financial Flexibility Across the Euro Area and the UK. ECB Working Paper No. 1630.

Franzoni, F. 2009. Underinvestment vs. overinvestment: Evidence from price reactions to pension contributions. Journal of Financial Economics, 92, 3, 491-518.

Gaiotti, E. 2013. Credit availability and investment: Lessons from the ‘great recession’. European Economic Review, 59, 212–227.

Gertler, M., N. Kiyotaki and A. Queralto, 2012. Financial crises, bank risk exposure and government financial policy. Journal of Monetary Economics, 59, S17-S34.

Hansen, B.E., 1999. Threshold effects in non-dynamic panels: estimation, testing and inference. Journal of Econometrics, 93, 345-368.

Hayashi, F. 1982. Tobin's marginal q and average q: A neoclassical interpretation. Econometrica, 50, 1, 213-224.

Hayashi, F. and T. Inoue, 1991. The relation between firm growth and Q with multiple capital goods: Theory and evidence from panel data on Japanese firms. Econometrica, 59, 731-753.

Heaton, J. B., 2002. Managerial optimism and corporate finance. Financial Management, 31, 33–45.

Hubbard, R. G., 1998. Capital-market imperfections and investment. Journal of Economic Literature 36, 193–225.

Hubbard, R. G., A. Kashyap and T.M. Whited, 1995. International Finance and Firm Investment. Journal of Money, Credit and Banking, 27, 3, 683-701.

Igan, D., A. Kabundi, Alain and Nadal-De Simone, Francisco and M. Pinheiro and N. T. Tamirisa, 2009. Three Cycles: Housing, Credit, and Real Activity. IMF Working Paper No. 09/231.

Kalemli-Özcan, S., L. Laeven and D. Moreno, 2014. Debt Overhang in Europe: Evidence from Firm-Bank-Sovereign Linkages. Working Paper, University of Maryland.

Kaminsky, G. L. and C. M. Reinhart, 1999. The Twin Crises: The Causes of Banking and Balance-of-Payments Problems. American Economic Review, 89, 3, 473–500.

Kaplan, S.N., and L. Zingales, 1997. Do investment-cash flow sensitivities provide useful measures of financing constraints? Quarterly Journal of Economics, 112, 169–215.

Kaplan, S.N., and L. Zingales, 2000. Investment-cash flow sensitivities are not valid measures of financing constraints. Quarterly Journal of Economics, 115, 707–712.

Malmendier, U., & Tate, G., 2005. CEO overconfidence and corporate investment. The Journal of Finance, 60, 6, 2661-2700.

Modigliani, F. and M. Miller, 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. American Economic Review, 48, 3, 261–297.

Moyen, N., 2004. Investment-cash flow sensitivities: Constrained versus unconstrained firms. Journal of Finance, 59, 2061-2092.

Queralto, A., 2013. A Model of Slow Recoveries from Financial Crises. Board of Governors of the Federal Reserve System, International Finance Discussion Paper No. 1097.

Rogoff, K., 2015. Debt Supercycle, Not Secular Stagnation. VoxEU.

Shiller, R., 1987. Ultimate Sources of Aggregate Variability. American Economic Review, Papers and Proceedings, 77, 2, 87–92.

Stein, J. C., 2003. Agency, Information and Corporate Investment. In Handbook of the Economics of Finance, edited by G.M. Constantinides, M. Harris and R. Stulz, Elsevier, 111-165.

Tobin, J. 1969. A General Equilibrium Approach to Monetary Theory. Journal of Money, Credit and Banking, 1, 15–29.

Ughetto, E., 2008. Does internal finance matter for R&D? New evidence from a panel of Italian firms. Cambridge Journal of Economics, 32, 6, 907-925.

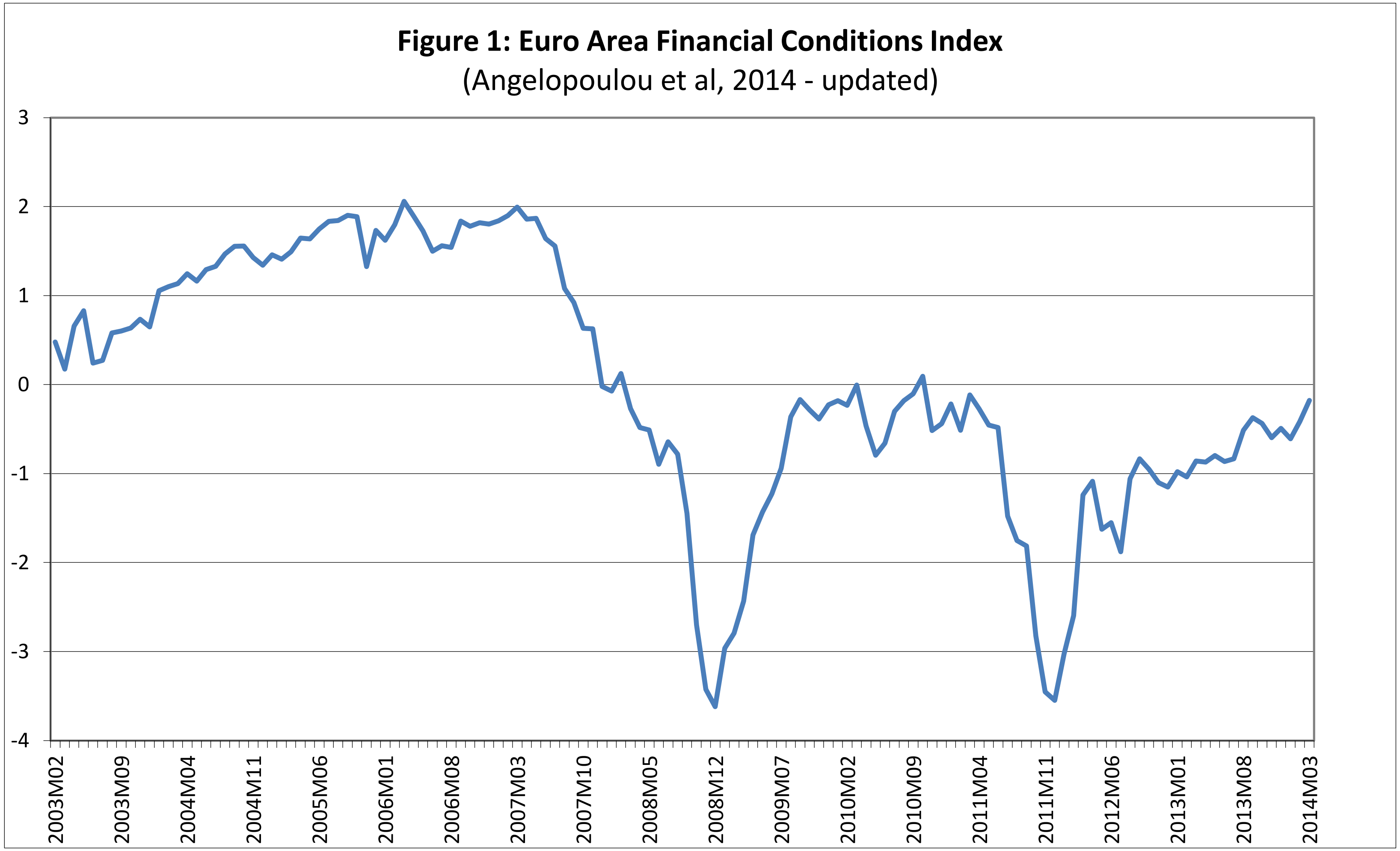
Figure 1: Euro Area Financial Conditions Index
(Angelopoulou et al, 2014 - updated)
3
2
1
0
-1
-2
-3
-4
2003M02
2003M09
2004M04
2004M11
2005M06
2006M01
2006M08
2007M03
2007M10
2008M05
2008M12
2009M07
2010M02
2010M09
2011M04
2011M11
2012M06
2013M01
2013M08
2014M03

Table 1: the Q model and its extensions			
Dependent variable: rate of gross investment in fixed assets	(1)	(2)	(3)
Constant	0.033 (0.004)	0.032 (0.004)	0.022 (0.008)
Q	0.015 (0.003)	0.009 (0.003)	0.003 (0.002)
Cash flow		0.146 (0.004)	0.145 (0.004)
Cash flow * dummy indicating tight financial conditions			0.018 (0.003)
Cash flow * dummy indicating tight financial conditions (lagged)			0.020 (0.003)
No. of observations	11771	11766	11141
No. of companies	1643	1643	1642
Wald test	$Chi^2(11)=5949.41$ (0.00)	$Chi^2(12)=8453.46$ (0.00)	$Chi^2(12)=8442.36$ (0.00)
F-test for significance of fixed effects	F(1642,10117)=2.87 (0.00)	F(1642,10111)=3.05 (0.00)	F(1641,9487)=3.05 (0.00)
Joint significance of year dummies	$Chi^2(10)=96.5$ (0.00)	$Chi^2(10)=105.7$ (0.00)	$Chi^2(8)=78.7$ (0.00)
Hausman specification effect	$Chi^2(11)=30.95$ (0.00)	$Chi^2(12)=115.43$ (0.00)	$Chi^2(12)=149.80$ (0.00)

NOTES: The dependent variable is gross investment in fixed assets divided by the average replacement cost of total assets. Q is the average market value of the firm divided by the average replacement cost of assets. Cash flow is profits after tax and interest payments divided by the average replacement cost of assets. Prob is probability. We estimate using instrumental variables where instruments include 2 lags of Q and the cash flow variables (applicable for columns (2) and (3)). The results presented here do not differ significantly if we exclude the year dummies. Figures in brackets are standard errors.

Table 2: cash flow and financial conditions: constrained versus unconstrained firms		
	Sample split on:	
	Size	Leverage
Constant	0.024 (0.008)	0.021 (0.007)
Q	0.003 (0.003)	0.004 (0.002)
Cash flow (constrained firms)	0.146 (0.004)	0.437 (0.008)
Cash flow (unconstrained firms)	0.046 (0.030)	0.052 (0.004)
Cash flow in periods of tight financial conditions in constrained firms (current period)	0.020 (0.003)	0.019 (0.007)
Cash flow in periods of tight financial conditions in constrained firms (lagged)	0.021 (0.003)	0.119 (0.007)
Cash flow in periods of tight financial conditions in unconstrained firms (current period)	-0.007 (0.011)	0.027 (0.003)
Cash flow in periods of tight financial conditions in unconstrained firms (lagged)	0.003 (0.011)	0.011 (0.003)
No. of observations	11141	11141
No. of companies	1642	1642
Wald test	$Chi^2(15)$=8476.49 (0.00)	$Chi^2(7)$=14304 (0.00)
F-test for fixed effects	F(1641,9484)=3.01 (0.00)	F(1641,9484)=3.70 (0.00)
Joint significance of year dummies	$Chi^2(8)$=86.07 (0.00)	$Chi^2(8)$=83.20 (0.00)
Hausman specification effect	$Chi^2(15)$=173.14 (prob>chi^2=0.000)	$Chi^2(15)$=88.05 (0.00)
X^2 test of equality of coefficients		
Cash flow	$Chi^2(1)$=10.94 (0.00)	$Chi^2(1)$=2024.05 (0.00)
Cash flow * Financial conditions	$Chi^2(1)$=18.92 (0.00)	$Chi^2(1)$=1627.62 (0.00)
Note: Investment and cash flow are as defined in Table 1. The size dummy takes a value of 1 (large) when a firm's starting total assets are below the 75^{th} percentile. The leverage dummy takes a value of 1 (highly leveraged) when a firm's average leverage is over the 75^{th} percentile. The results are qualitatively similar if we exclude year dummies.		

Table 3: Elasticity of investment to cash flow based on results in Tables 1 and 2

	No split (Table 1)	Sample split on (Table 2):	
		size	Leverage
Cash flow	0.19		
Cash flow during periods of tight financial conditions	0.24		
Cash flow in constrained firms		0.19	0.56
Cash flow in unconstrained firms		0.06*	0.07
Cash flow in periods of tight financial conditions in constrained firms		0.24	0.74
Cash flow in periods of tight financial conditions in unconstrained firms		0.08*	0.09

* insignificant

Note: the means of the variables are as follows:

mean(investment)=0.048

mean(q)=0.784

mean(cash flow)=0.062.

Table 4: cash flow and financial conditions: sensitivity tests								
	Split Q		Sales as instrument		Including growth		Excluding firms in financial distress	
	size	leverage	size	leverage	size	leverage	Size	leverage
Constant	0.029 (0.00)	0.029 (0.002)	-0.014 (0.030)	-0.002 (0.020)	0.030 (0.002)	0.029 (0.002)	0.027 (0.002)	0.028 (0.002)
Q			0.071 (0.041)	0.052 (0.027)	0.010 (0.003)	0.010 (0.002)	0.012 (0.003)	0.010 (0.002)
Q (constrained)	0.008 (0.003)	0.014 (0.006)						
Q (unconstrained)	0.024 (0.009)	0.008 (0.002)						
Cash flow (constrained firms)	0.150 (0.004)	0.448 (0.008)	0.119 (0.016)	0.419 (0.013)	0.145 (0.004)	0.437 (0.008)	0.162 (0.005)	0.454 (0.008)
Cash flow (unconstrained firms)	0.008 (0.040)	0.054 (0.004)	-0.094 (0.104)	0.034 (0.013)	0.043 (0.030)	0.052 (0.004)	0.048 (0.031)	0.057 (0.005)
Cash flow with tight financial conditions in constrained firms (current period)	0.026 (0.003)	0.029 (0.007)	0.015 (0.005)	0.017 (0.009)	0.025 (0.003)	0.025 (0.007)	0.026 (0.003)	0.032 (0.007)
Cash flow with tight financial conditions in constrained firms (lagged)	0.020 (0.003)	0.119 (0.007)	0.034 (0.010)	0.124 (0.009)	0.022 (0.003)	0.120 (0.007)	0.014 (0.003)	0.126 (0.007)
Cash flow with tight financial conditions in unconstrained firms (current period)	0.020 (0.011)	0.033 (0.003)	0.013 (0.013)	0.025 (0.004)	0.019 (0.011)	0.032 (0.003)	0.018 (0.011)	0.034 (0.003)
Cash flow with tight financial conditions in unconstrained firms (lagged)	0.010 (0.011)	0.010 (0.003)	0.023 (0.019)	0.020 (0.008)	0.008 (0.011)	0.012 (0.003)	0.003 (0.011)	0.008 (0.003)
Growth					0.050 (0.023)	0.052 (0.020)		
No. of observations	10148	10148	11680	11680	11141	11141	9799	9799
No. of companies	1629	1629	1674	1674	1642	1642	1394	1394
Wald test	$X^2(8)$=7713.2	$X^2(8)$=14128	$X^2(7)$=5788.7	$X^2(7)$=10638	$X^2(8)$=8269.3	$X^2(8)$=14003	$X^2(7)$=7382	$X^2(7)$=13450
F-test for fixed effects	F(1628,8511) =2.82	F(1628,8511) =3.60	F(1673,9999) =2.21	F(1673,9999) =2.99	F(1641,9491) =3.02	F(1641,9491) =3.64	F(1393,8398) =3.64	F(1393,8398) =3.72
Hausman specification effect	$X^2(8)$=183.7	$X^2(8)$=117.0	$X^2(7)$=80.81		$X^2(8)$=161.4	$X^2(8)$=82.2	$X^2(7)$=210.5	$X^2(7)$=78.7
Equality of coefficients on Q	$X^2(1)$=2.73 (0.098)	$X^2(1)$=0.61 (0.436)						

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