

The effect of financial development on the investment-cash flow relationship: cross-country evidence from Europe

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Abstract We investigate financing constraints in a large cross-country data set covering most of the European economy. Our main finding is that the cash flow sensitivity of investment is lower in countries with better-developed financial markets. The result is not driven by income differences. This effect is weaker in conglomerate subsidiaries, which are likely to have access to internal capital markets and depend less on the outside financial environment. The finding suggests that financial development may mitigate financial constraints and sheds light on the link between financial and economic development.

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The financial development of a country has been found to be correlated with economic growth (e.g. King and Levine (1993)). If this correlation is due to causation from financial development to growth, what is the detailed mechanism – how does financial development help the economy? There are several possible benefits to an economy of having a well functioning financial system. Among the many possible benefits is an efficient allocation of resources to firms. The resource allocation across firms is known to be important: recent productivity research has shown that firm heterogeneity in productivity is substantial, even within narrow sectors, and that productivity variation within industries is important relative to cross-industry differences. Firm- and plant-level evidence shows that the reallocation of capital from less productive to more productive establishments plays a significant role in accounting for aggregate productivity growth.¹

If resource (re-)allocation across firms is an important determinant of aggregate productivity growth, this is a possible channel through which financial development might affect growth. We test this as directly as possible by estimating cash flow sensitivity of investment across countries and testing if the coefficient varies with standard measures of financial development. We compare investment constraints across Europe using a firm-level data set (the data covers 38 countries, of which 21 have the required country-level data and are used in regressions). We adopt the broad methodology suggested by Fazzari, Hubbard and Petersen (1988). They proposed that in a regression of investment on cash flow and market to book, positive coefficient on cash flows indicates financial constraints. Because the sample includes a large number of firms without stock prices (since these are unlisted) and which therefore lack the necessary data for measuring Q , we attempt to control for investment opportunities with alternative controls. Our baseline specifications, based on an Euler Equation derived from a dynamic model of investment behavior, ² are drawn from the literature examining the investment behavior of unlisted firms (and are especially close to the specifications in Bond, Elston, Mairesse and Mulkay (2003)) but with the addition that we allow

¹ See King and Levine (1993) about financial development and growth. See e.g. Bartelsman and Doms (2000) for a survey of research on firm-level productivity differences. See e.g. Davis and Haltiwanger (1996) and Foster, Haltiwanger and Krizan (1998) about productivity growth and reallocation. See Roberts and Tybout (1996) for non-US evidence on reallocation and growth.

the coefficient of firm level cash flow to vary with financial development. Identification is based on the assumption that biases which explain part of the cash flow coefficient (e.g. because cash flow correlated with investment opportunities) do not vary systematically with financial development. If this assumption is valid, we can test directly for whether financial development reduces financing constraints at the firm level.

We find that in our dataset there is a strongly positive coefficient on cash flow, consistent with US studies. This coefficient may be due to financing constraints or to some other factor (we discuss the large literature about such potential biases below). Importantly, we also find that the cash flow sensitivity of investment is lower in countries with better finance, which suggests that investment is less likely to be constrained in countries with better financial development. In other words, better input markets reduce the dependence of firms on internal resources.³

We undertake a number of robustness checks and extensions of our basic results. First, we examine an alternative regression specification based on introducing a dynamic error structure to a static capital demand equation. The results with this alternative specification are very similar to the baseline results; we find that investments are less likely to be constrained when financial markets are more developed.

Second, we examine the cash-flow sensitivity and the role of financial development on the investment behavior of conglomerate firms. We find that conglomerate firms, which have access to internal capital markets, show lower cash flow sensitivities of investment. Further, we find that better financial markets have weaker influence on financial constraints for conglomerate firms. This is what could be expected if conglomerates indeed ameliorate cash flow constraint at their subsidiary firms through reallocation of capital through an internal capital market (though there may still be constraints on group level investment).

Third, we examine if our results are driven by the presence of firms in the financial services and real estate sectors, where measured investment behavior could be driven by a

³ This finding is consistent with Demirgüç-Kunt's and Maksimovic (1998) finding that a higher fraction of firms grow faster than predicted in countries with better financial systems (the prediction is based on accounting data). See the literature section below for more details of how these findings relate to Demirgüç-Kunt and Maksimovic.

number of factors specific to the industry. These firms comprise only a small fraction of our total sample and we find our results robust to the exclusion of these firms.

Fourth, we check if our results are driven simply by broad differences in investment behavior for Eastern European firms, by examining the basic regressions separately for Western and Eastern European firms. The identification of the effects we are interested in is weakened by the reduction of sample sizes, especially for Eastern Europe – we are left with only seven countries in Eastern Europe. Our findings provide no evidence for differences in the importance of financial development between East and West.⁴

Finally, we test whether the weaker dependence of investments on internal cash flows in financially well-developed countries is driven by omitted variables that are correlated with per capita income. The concern is that financial development is generally higher in rich countries. However, many institutional characteristics may differ between rich and poor countries, and investment behavior may be influenced by these other characteristics. We find that unconditionally, dependence on internal resources is indeed lower in richer countries, but our results on the effect of financial development do not weaken when we control for differences in per capita income.⁵

The rest of the paper is organized as follows: Section 1 presents related research, section 2 discusses our theoretical predictions, Section 3 discusses data sources the sample and Section 4 presents the baseline results. In Section 5 we examine extensions of the baseline specifications and conduct some robustness checks. Section 6 concludes.

1. Background and literature

The literatures on financial development and growth, on cash flow constraints and on the role of allocation in growth are all substantial. Without doing any of them justice, we provide a quick survey of the most closely related papers in each area in this section.⁶

⁴ We also undertook a country-by country analysis of investment, and results here confirmed our findings (see Appendix).

⁵ We also do a number of additional tests, results of which are unreported but available from the authors (see discussion in Section 5.6).

⁶ Our results also shed light on research establishing a link between input market frictions and aggregate economic performance (see King and Levine (1993) and Rajan and Zingales (1998)).

1.1. Resource allocation across firms

There is some evidence supporting an allocational advantage of financial development. Some of this comes from quasi-experiments using regulatory changes. For example, Bertrand, Schoar and Thesmar (2007) show that bank deregulation in France changed the allocation of credit toward profitable firms and firms with good investment opportunities.

Across countries, the evidence is more limited. Demirgüç-Kunt and Maksimovic (1998) find that countries with better financial development see relatively more firms growing faster than predicted by internal accounting data. There are several differences between their results and our study. We use firm level data in our main regressions, rather than country averages. This difference in methodology means that we exploit more variation in the data, at the cost of some added complexity. We also make different assumptions on firm growth and investment in order to identify the effect of external finance. Most importantly, we study the effect of internal cash flow on investment, rather than the fraction of firms growing faster than predicted. In that sense, we extend Demirgüç-Kunt and Maksimovic's results: better financial development not only helps some firms grow faster, it also particularly helps firms which are likely to be financially constrained.

Wurgler (2000) shows that the cross-industry allocation of investment is more responsive to sector-level productivity in countries with better developed stock markets. These findings are consistent with our results, but do not concern within-industry allocations (we analyze how investment depends on cash flow and productivity holding industry fixed). In practice, these benefits may well flow from the same aspects of financial development.

1.2. Cash flow sensitivity of investment

We use the sensitivity of investment to cash flow as a measure of the frictions involved in the allocation of resources to firms as suggested by Fazzari, Hubbard and Petersen (1988). They argued that if external financing is available without frictions and at zero cost, a firm's investment should be determined only by its investment opportunities, not by its internal resources. Empirically, Fazzari et al use Q (market value of equity over book value) to capture investment opportunities and cash flow to capture internal resources. They find that cash flow often predicts investment, and that Q often does not. Non-dividend paying firms in the US (Fazzari et al) exhibit higher correlations between cash flows and investment than other firms.

This is consistent with these firms being more constrained than others.⁷ In a related paper, Hoshi, Kashyap Scharfstein (1991) find that firms in Japan not affiliated with a Keiretsu business group also exhibit higher cash flow sensitivities.

A large literature has followed these early findings (see e.g. Bond and van Reenen (2006) for a recent survey), attempting to use cash-flow sensitivity as a sign of financial frictions. However, concerns have been raised about the validity of the methodology. In an influential paper, Kaplan and Zingales (1997) make two points. First, they argue that the theoretical predictions are more ambiguous than Fazzari et al suggest. Second, they argue that empirically, dividend payers are not necessarily less constrained than other firms. These critiques have been expanded and developed. For example, Alti (2003) shows that young firms will naturally have less informative Q than more mature firms (because of their skewed future payoffs). Young firms' investment may be correlated with cash flow not because they are constrained but because their cash flow contains information about short term investment opportunities beyond Q. Abel and Eberly (2002) make a related point: small, fast-growing firms may exhibit cash flow sensitivity because their cash flow captures investment opportunities, even if financing is frictionless. Gomes (2001) also suggest that Q will not properly capture underlying shocks. All these papers imply that non-zero coefficients cannot necessarily be interpreted as evidence of constraints.⁸ Finally, it is worth pointing out that a positive cash flow coefficient might reflect managerial empire building, if that empire building is constrained by available resources (see e.g. Stein (2003)).

We take these critiques seriously and will not focus on the existence of positive cash flow coefficients per se, but instead on whether they vary systematically with a country's level of financial development. We hypothesize that cash flow constraints are decreasing in financial development. As long as other causes for the positive cash flow coefficient are *constant across countries* we can disregard them. Even if such other causes vary across countries, but not in a way related to financial development, our identification is still reasonable.

⁷ See also Campello (2004) for more recent evidence from US banks.

⁸ Note, however, that Gomes does find consistently higher cash flow coefficients when constraints are higher (table 5, 9, 15). See also Moyen (2004), who shows that financing constraints may generate data similar to Fazzari et al's and later findings.

We are essentially testing if some countries have higher sensitivity of investment to cash flow because their markets for external capital provision are less well developed. We do not compare firms, as much of the previous literature does, but countries. Interpreting higher cash flow sensitivities in a country as a negative effect of worse financial development is less ambiguous. If some part of cash flow investment sensitivity is due to financial constraints, and some part is due to other factors, only the former is likely to vary with financial development.

Finally, a closely related paper in this group is Bond et al. (2003), which studies the role of cash flow in investment equations for European firms from four countries. Like us, they study the differences in cash flow coefficients across countries. We extend their methodology of comparing countries, but because we have a larger sample with more countries, we can do this more rigorously, i.e. we test formally whether cash flow coefficients are related to measures of financial development.⁹

1.3. Financial development and growth - evidence from Europe

Our paper is related to evidence on how growth, entry and exit depends on financial development and institutions in Europe. Using a similar data set, Klapper, Laeven and Rajan (2003) show that financial development and labor regulation as well as entry regulation affect entry rates across Europe. Scarpetta, Hemmings, Tressel and Woo (2002) also show that rates of entry and exit at the national level are affected by regulation. Since entry and exit decisions take place mostly at the bottom of the size distribution, our results are somewhat different in that they look at investment, i.e. at already existing firms. Desai, Gompers and Lerner (2003) show that political, legal and regulatory variables affect entry and exit in emerging markets (i.e. Eastern Europe) but not in Western Europe. They also show some evidence that these variables impact average size and the skewness of size distributions. Kumar, Rajan and Zingales (2001) find that firm size is increasing in various measures of financial development. Our results concern the determinant of investment, i.e. growth, rather than static size distribution of firms.

⁹ The Bond et al paper also undertakes a careful GMM based estimation of the regression specifications, something we do not.

2. Theory and predictions

In this section, we explain the details of our empirical research design. We analyze investment-cash flow sensitivities and compare their magnitude across countries. First, we test if on average, cash flow has a positive correlation with investment after controlling for industry-time-country interaction fixed effects as well as firm level controls. This would reflect some kind of financing constraints or one or more of the biases mentioned above.

In our tests, we will not use firm level Q (market to book) as a control. Measuring Q is problematic for listed firms, and impossible for non-listed firms. Since our dataset has a very large number of unlisted firms and our intent is to include the largest possible set of firms, we cannot hope to use Q. To some extent we are reassured by the general finding in the literature that firm Q generally has a weak relation with investment. However, we do attempt to mitigate the possible omitted variable bias from not controlling for investment opportunities by including firm level variables, as well as extensive industry, time and country fixed effects.

Our baseline specification is based on an Euler equation derived from a dynamic optimization model presented in Bond et al (2003), which in turn draws on Bond and Meghir (1994). A firm holding rational expectations solves an infinite horizon investment problem with adjustment costs. Let per period profit for the firm i in period t be given by

$$\pi_{i,t} = p_{i,t}F(K_{i,t}, L_{i,t}) - p_{i,t}G(I_{i,t}, K_{i,t}) - w_{i,t}L_{i,t} - r_{i,t}I_{i,t}$$

where $K_{i,t} = (1 - \delta)K_{i,t-1} + I_{i,t}$, and $p_{i,t}$ represents the price of output, $F(K_{i,t}, L_{i,t})$ is the production function gross of adjustment costs, $K_{i,t}$ is capital stock input, $L_{i,t}$ represents labor input, $G(I_{i,t}, K_{i,t})$ is the adjustment costs function (in units of output), $I_{i,t}$ is investment, $w_{i,t}$ is the wage rate per unit of labor input, $r_{i,t}$ is the price of investment goods, and δ is the depreciation rate of the capital stock. The firm maximizes expected present discounted value of cash flows:

$$\begin{aligned} \text{Max} \quad & E_t \left(\sum_{j=0}^{\infty} \beta_{t+j}^t \pi(K_{i,t+j}, L_{i,t+j}, I_{i,t+j}, p_{i,t+j}, w_{i,t+j}, r_{i,t+j}) \right) \\ \text{s.t.} \quad & K_{i,t} = (1 - \delta)K_{i,t-1} + I_{i,t} \end{aligned}$$

The Euler equation characterizing optimal investment path relates marginal adjustment costs in consecutive periods and can be written as:

$$-\left(\frac{\partial \pi}{\partial I}\right)_{i,t} = -(1-\delta)\beta'_{t+1}E_t\left(\frac{\partial \pi}{\partial I}\right)_{i,t+1} + \left(\frac{\partial \pi}{\partial K}\right)_{i,t}$$

Assume that input and output prices are exogenous and that the production function $F(K_{i,t}, L_{i,t})$ exhibits constant returns to scale. Let the adjustment cost function be quadratic and symmetric, as follows:

$$G(I_{i,t}, K_{i,t}) = \frac{b}{2} \left[\left(\frac{I}{K} \right)_{i,t} - c \right]^2 K_{i,t}$$

Then, the Euler equation can be expressed as:

$$\left(\frac{I}{K} \right)_{i,t} - \alpha_1 \left(\frac{I}{K} \right)_{i,t}^2 = \alpha_2 E_t \left(\frac{I}{K} \right)_{i,t+1} + \alpha_3 \left[\left(\frac{M}{K} \right)_{i,t} - J_{i,t} \right]$$

where $M_{i,t} = \pi_{i,t} + r_{i,t}I_{i,t}$ is the gross operating profit and $J_{i,t} = \left(\frac{r_{i,t}}{p_{i,t}} \right) \left[1 - r_{i,t+1}(1-\delta) \frac{\beta_t}{r_{i,t}} \right]$ is the

real user cost of capital.¹⁰ In this model, the parameters α_1 , α_2 and α_3 are positive. The RHS of the Euler equation is increasing in the current investment rate $\left(\frac{I}{K} \right)_{i,t}$.

Thus the current investment rate is positively related to the future expected investment rate and to the current average profits (which equals marginal profitability of capital under the assumption of constant returns to scale), and is negatively related to the user cost of capital.

As noted by Bond et al (2003), an attractive feature of the Euler equation model is that all relevant expectational factors are captured by the one-step-ahead investment forecast in the case of symmetric, quadratic adjustment costs assumed here. To empirically implement the model, the one-step ahead investment rate forecast is replaced by the actual investment rate and an orthogonal forecast error. Rearranging terms, and proxying for the real user cost of capital term using country-industry-year effects, and adding output-to-capital ratio (to control for possible non-constant returns to scale or monopolistic competition in the product market), we obtain a linear regression specification as follows:

$$H_{i,t} = \beta_1 H_{i,t-1} + \beta_2 H_{i,t-1}^2 + \beta_3 (\log Y_{i,t-1} - \log K_{i,t-1}) + \beta_4 ROA_{i,t-1} + \eta_{jt} + \varepsilon_{i,t} \quad (1)$$

¹⁰ For more details on this derivation, see Bond and Meghir (1994).

where $H_{i,t} = \left(\frac{I}{K} \right)_{i,t}$ is gross investment normalized by fixed assets by firm i in period t , ROA is EBITDA/Fixed Assets (same normalization as investment), $Y_{i,t-1}$ is lagged output, $K_{i,t-1}$ is lagged capital and $\eta_{j,t}$ denotes industry-year fixed effects. Note that ROA is based on cash flow before interest and taxes (EBITDA), not net cash flow.

Note also that, under the null of no financial constraints, the coefficient on EBITDA is predicted by the Euler equation to be negative. A positive coefficient can then be interpreted as signifying financial constraints.¹¹ Hereafter we refer to the specification in Equation 1 as the Euler equation model.

We examine the effect of financial development on constraints for investments by interacting the ROA term (in the Euler equation model) with a proxy for financial development. A negative (positive) coefficient on the interaction term would be interpreted as indicating a decrease (increase) in financial constraints with financial development. In Section 5 below, we consider a number of extensions and robustness checks of our basic specifications.

3. Data

3.1. Amadeus

Our firm-level data is taken from Amadeus, a commercial database provided by Bureau van Dijk. It contains at least some financial information on over 7 million private and publicly owned firms across 38 European countries. The database includes up to 10 years of information per company and is created by collecting data from 35 information providers across Europe, generally the office of the Registrar of Companies, and standardizing it. We use a sample of larger firms, for which data quality and coverage is likely to be better than the smallest firms.

We use the 2004 edition of Amadeus for large and medium firms, including all firms with operating revenue of at least €1M, total assets of at least €2M and 20 employees or more (for the UK, Germany, France, Italy, Ukraine and Russia the number are €1.5M, €3M, and 20,

¹¹ Since the EBITDA variable is closely correlated with cash flow measures, the results from this specification could be expected to be similar to those using the more traditional cash flow variable (see specification below).

respectively). This sample contains approximately 1.5M firms. We then limit our sample by imposing the restriction that value added, capital and sales or turnover variables must be available. The database includes firm-level accounting data in standardized format for balance sheet and income statement items. All variables are re-weighted and standardized using data on units and exchange rates. Despite EU harmonization and international convergence in accounting standards and practices, there are differences in the accounting and these transformed accounts should therefore be interpreted with some caution. For the investment rate, we use gross investment, defined as $\{(Fixed\ Assets\ in\ year\ t) - (Fixed\ Assets\ in\ year\ t-1) + Depreciation\ (t)\}$ divided by (Fixed assets in year t-1).

Our cash flow variable (used in the Econometric model specification discussed in section 5.1) is net income plus changes in deferred taxes, normalized by fixed assets (the same normalization as that used for investment). Profits (ROA) is defined as EBITDA normalized by total assets. The cash flow and profits variables were winsorized at 0.5% and 99.5% to eliminate effects from extreme outliers.

In addition to financial information, Amadeus also provides other firm-level information, such as industry and location information which we use in our analysis. Amadeus provides various industry classifications - e.g. national industry codes, 3-digit European industry classification codes (NACE) and US NAICS codes - which we use to classify firms and construct industry dummy variables. In our analysis, we use 4-digit NAICS codes to construct industry dummies, and also categorize all firms by a 2-digit level NAICS code for industry interaction terms (see below). We classify firms as belonging to a conglomerate if Amadeus reports an ultimate holding company id number.¹² We use data on employment and year of incorporation to define size and age groups (used in tests discussed in Section 5.6).

¹² The data set reports ultimate owners as follows: an ultimate owner is indicated as the largest shareholder company, if the largest shareholder company has at least 24.99% shareholding and has no large shareholder itself. If the immediate parent company is in turn owned by other companies, the ownership path is followed upward on the largest shareholding path. The upward trace is stopped when a firm with no known single shareholder is reached. Each trace upward is made only if a single shareholder has at least 24.99% holding. We only consider the existence of an ultimate owner, not that owner's identity.

The regular Amadeus files do not include banks, but it does include other financial firms. As one of our robustness checks, we exclude all firms classified as belonging to NAICS 52 and 53 (finance and real estate respectively).

3.2. Other data sources

Finance. The ideal measure of financial development would capture the ability of firms with good investment opportunities (positive NPV) to find outside financing in case of need. Such a measure is difficult to come by across many countries, so we use two alternative measures, each of which has its strengths and weaknesses. Our two measures focus on banks on the one hand, and banks as well as debt markets on the other. Based on the financial database of Beck, Demirgüç-Kunt and Levine (2001), we calculate the total volume of bank credit to the private sector, divided by GDP. We take an average of this measure over 1995-2003, spanning the period of our study.¹³ We refer to this measure as “PCBank”. Secondly, we use the market value of all outstanding bonds plus private credit, normalized by GDP, as a measure of financial market development. This measure is also from Beck et al (2001). Since data on bond markets is limited in some of the years, we define this measure for 1998, the year within our sample period for which most data is available. Note that by taking these variables to represent finance, we disregard the role of outside equity. However, for almost all firms in our sample, outside equity is likely to be limited. Furthermore, different measures of financial development are highly correlated across countries. We have tried using broader measures of finance, including equity markets, but find that our results are qualitatively similar.

3.3. Sample overview

Following the practice in the literature, we restrict the sample to those with strictly positive investment i.e. drop firm observations for which gross investment is negative. Also, to avoid outliers we eliminate observations for which the cash flows-to-assets ratio is larger than ten.

Table 1 reports financial variables for each country. We report two measures: private credit (later called PCBank) and private credit plus bond market capitalization (PCBB). As expected, richer countries tend to have higher values for both measures. Also, Western

¹³ We believe all the meaningful/useful variation in the financial development measures we use is cross-sectional.

European countries tend to have the highest values. The highest numbers, corresponding to the most developed banking systems, are for Switzerland (1.16), Germany (0.96), and Netherlands (0.96). Including the bond market does not change the rankings much: the correlation between the measures is 0.82 and the rank correlation is 0.92. The PCBB levels are much higher in many countries, however, notably Switzerland (3.96), the UK (2.62) and the Netherlands (2.00).

Table 2 reports summary statistics across firms in our sample. We report three categories of variables: those used throughout, those used for the baseline Euler equation model, and those used for the alternative econometric model (discussed in section 5 below). All-in-all there is about 1.9 million observations, though we often have fewer observations when missing data on all variables is taken into account. The general variables are PCBank and PCBB, the conglomerate dummy, the number of employees, firm age and investment. Investment is 0.50 on average, and the median is 0.22. There is a tail of considerably higher values. This may seem large, but note that the sample excludes all negative investment firms. Average firm age is approximately 17 years and half the firms are less than 12 years old. For the Euler equation model, we use the following additional variables -- squared investment, lagged capital intensity and ROA (EBITDA over fixed assets). The gross profit to asset ratio (ROA) averages 0.78 and has a median of 0.41. For the Econometric model, we also use the variables output growth, capital-output ratio and cash flow (after taxes and interest, normalized by fixed assets). Cash flow averages 0.595 and has a median of 0.305.

4. Results

This section presents the basic regression of investment on contemporaneous cash flow and controls. As pointed out above, we cannot control for Q because most companies in our sample are unlisted. To control for desired investment (in the absence of frictions), we therefore employ the regression specification described in Section 2.

Table 3 shows our basic regression: investment regressed on cash flow, firm level controls and country-industry-year dummies. For the Euler equation model, column (1) shows that cash flow enters with a positive and significant coefficient, which we interpret (subject to caveats discussed in Section 1.1) as reflecting financial constraints. The coefficient implies that changing profits from the 25th to the 75th percentile is related to an increase in the right hand side variable by 0.0445, i.e. investment increases by 4.5% of fixed capital. Increasing profits by one standard deviation increases investment by about a tenth of a standard deviation. Column

(2) repeats the same regression for the sample of firms for which we have data on the PCBank financial development variable. Column (3) includes an interaction of financial development and firm level profits. The regressions show that profits have a muted impact on investment in countries with higher financial development: the interaction coefficient is negative and significant. This negative coefficient suggests that financial constraints are less severe when there is better financial development. This is our main finding. The magnitude of this effect is large, and suggests that moving from the 25th to the 75th percentile of financial development (across firms) will reduce the effect of profits by about 53 per cent (from 0.068 to 0.032).

Column (4) repeats column (3), but excludes the countries of Switzerland and Luxemburg, to examine if the results are driven by these two countries which have unusually large banking sectors. The results in column (4) are very similar to those in column (3), suggesting that results are not driven by Switzerland and Luxemburg.

Column (5) represents the regression for the subset for which there is financial development data on the PCBB measure of financial development and column (5) presents a regression with PCBB interacted with firm level profits. The interaction for this measure is also highly significant but lower in magnitude. Here, moving from the 25th to the 75th percentile of financial development is estimated to reduce the effect of profits by approximately 27 per cent (from 0.088 to 0.064). In Column (7), we see that these results are robust to the exclusion of Switzerland (data on PCBB is unavailable for Luxemburg).

5. Extensions and robustness

This section presents a series of extensions and robustness tests.

5.1. Alternative econometric specification

As a check of the robustness of the Euler equation results, we examine a second specification, drawing on Bond et al (2003) and Van Reenen and Bond (2006). This is derived by introducing second order (ADL (2,2)) dynamics into a static capital demand equation (obtained from profit maximization for a firm with a constant returns to scale, CES production function).

The capital demand equation for firm i in period t in the static optimum is:

$$\log K_{i,t} = \sigma_i \log a_{i,k} \left(1 - \frac{1}{\eta_i^D} \right) + \log Y_{i,t} - \sigma_i \log \left(\frac{r_{i,t}}{p_{i,t}} \right)$$

or $k_{i,t} = a_i + y_{i,t} - \sigma h_{i,t}$

where $K_{i,t}$ is the capital stock, $Y_{i,t}$ is output (which is produced using two inputs, capital and labor), σ_i is the elasticity of substitution between capital and labor, η_i^D is the elasticity of demand (assuming an iso-elastic demand curve), $r_{i,t}$ is the rental price of capital, $p_{i,t}$ is the price of output.

Assuming that the firm's optimal capital stock in the presence of adjustment costs is proportional to the static optimum capital stock in the absence of adjustment costs, and assuming that short run dynamics are stable enough to be approximated by distributed lags, a general dynamic regression model can be built from the static regression model above. Introducing second order dynamics using an autoregressive-distributed lag [ADL(2,2)] specification, imposing the restriction that long run elasticity of capital with respect to output be equal to one (as in the static optimum above), and rearranging terms, we get for firm i in period t :

$$\Delta k_{i,t} = b_1 \Delta k_{i,t-1} + b_2 \Delta y_{i,t} + b_3 \Delta y_{i,t-1} - b_4 (k_{i,t-2} - y_{i,t-2}) + d_{j,t} + v_{i,t}$$

where Δ indicates first difference, $d_{j,t}$ represents industry-time specific fixed effects (which captures the effect of elasticity of substitution between capital and labor, and also the real user cost of capital), and $v_{i,t}$ represents the error term. We refer to this model as the "Econometric model".¹⁴

Let $I_{i,t}$ denote gross investment, and δ the rate of depreciation and use the approximation $\Delta k_{i,t} \approx \frac{I_{i,t}}{K_{i,t-1}} - \delta$. Then, to investigate the role of financial variables, Bond, et al (2003) introduce current and lagged cash flow terms leading to the following specification for the investment rate:

¹⁴ Here, the change in (log) capital stock in the current period is decreasing in the term $(k_{i,t-2} - y_{i,t-2})$. Thus a capital stock above its desired level in period $t-2$ reduces investment in the period t . In the literature, $(k_{i,t-2} - y_{i,t-2})$ is referred to as the "error-correction" term, and accordingly the model is sometimes referred to as the error-correction model. We refer to it as the "Econometric model", following Bean (1981) who first introduced this model in the literature.

$$\frac{I_{i,t}}{K_{i,t-1}} = a_1 \frac{I_{i,t-1}}{K_{i,t-2}} + a_2 \Delta y_{i,t} + a_3 \Delta y_{i,t-1} + a_4 (k_{i,t-2} - y_{i,t-2}) + a_5 \frac{C_{it}}{K_{i,t-1}} + a_6 \frac{C_{i,t-2}}{K_{i,t-2}} + d_{j,t} + v_{i,t} \quad (2)$$

While the model is derived easily by introducing dynamics into a simple static optimization framework, one drawback of this model (relative to the Euler equation model) is that the interpretation of the financial variables is ambiguous. As discussed in Bond et al (2003), while a positive coefficient on the cash flow variable could be an indicator of financial constraints, if cash flows contain information about future output, a positive coefficient may also be due to convex adjustment costs.

Given this concern, as discussed in the introduction, we focus on the difference between the coefficients on cash flow variables in countries with good financial development relative to countries with poor financial development. Specifically, we focus on the coefficient on the current cash flow variable interacted with measures of financial development.¹⁵

The results for the Econometric model are presented in Table 3b. The estimated effects of cash flow on investment in this specification is smaller compared to the effect of profits on investment in the Euler equation results in Table 3a, but are also highly significant, suggesting that financial constraints may be significant. More importantly, the interaction with financial development is negative and significant for both the PCBank and PCBB measures.

Using PCBank (column 3), moving from the 25th to the 75th percentile of financial development reduces the effect of cash flow by about 60 per cent (from 0.092 to 0.036). For PCBB (column 6), moving from the 25th to the 75th percentile reduces the effect of cash flow by about 30 per cent (from 0.127 to 0.088)

5.2. Conglomerates

Hoshi, Kashyap, and Scharfstein (1991) find that Japanese firms that form part of a conglomerate have lower cash flow-investment sensitivities.¹⁶ They argue that conglomerate subsidiaries have access to internal capital markets which may reduce their reliance on external

¹⁵ Also, as discussed in Section 5.6, we test whether cash flow is more informative about predicting future output in countries with better financial development. We do not find any evidence that this is the case.

¹⁶ See also Campello (2004) regarding internal capital markets and investment.

capital markets and ease financial constraints.¹⁷ We propose that conglomerate firms should therefore have less to gain from financial development, i.e. their cash flow-investment sensitivities should fall by less than the coefficient of non-conglomerate firms.

We now check the difference between conglomerate and non-conglomerate firms in our sample. Table 4, column (1) to (3), reproduce results from Table 3, i.e. our baseline specification.¹⁸ In columns (4) to (6), we restrict the sample to conglomerate firms, i.e. firms which have a specified large shareholder which is also a firm. Profits and cash flow seem to matter less for these firms, which is consistent with such firms having access to internal capital markets, or facing lower financing constraints for some other reason.

Our results suggest that financial development helps conglomerate firms, but less than non-conglomerate firms. The interactions with financial development are significant in all cases, but always lower than for non-conglomerate firms.¹⁹ One possible function of conglomerates is to finance investment using resources, reallocated through internal capital markets. If this makes individual divisions less dependent on the external finance, we expect financial development to matter less for divisions. Therefore this finding is consistent with the theory that financial development reduces financial constraints for firms that are more dependent on external capital markets.

5.3. Excluding financial and real estate firms

Financial firms, as well as real estate firms, may have accounting data of a very different nature from other sectors which might affect results. While the Amadeus files do not contain banks, several firms are classified as belonging to NAICS 52 (Financial activities) or 53 (Real estate and rental and leasing). We exclude these firms, to make sure that they do not drive the main results of Table 3. In Table 5, we report profit and cash flow coefficients for the sub-sample without NAICS 52 and 53. The sample size is reduced marginally in both panels. The

¹⁷ As Wolfenzon and Almeida (2006) point out, conglomerates may reduce financial constraints for divisions but still make finance more restricted for the central corporation through equilibrium effects. Our results are quiet about this prediction since we only include divisions in the regression in Table 4.

¹⁸ From this point on, in order to save some space, we suppress the estimated coefficients for control variables and report only the coefficients for cash flow and the cash flow interactions.

¹⁹ The difference between conglomerates and the overall sample is significant at the 10% level in both cases.

coefficients and significance is virtually unaffected by this exclusion, confirming that our results are general to the sample and not driven by the small number of financial firms and real estate firms.

5.4. Western versus Eastern Europe

Our sample covers the much richer Western European countries as well as the poorer Eastern countries. The latter have much lower financial development as well as overall economic, regulatory, and political development. We now turn to a geographical split of our sample, to rule out the possibility that the financial development indicator matters simply because it separates Western European from Eastern European countries (Bulgaria, Croatia, Czech Republic, Hungary, Latvia, Poland, Romania, Slovenia, and Ukraine). We run a specification with a separate dummy variable and interaction terms for Eastern Europe. This effectively tests whether the Portugal-Germany difference or the Latvia-Czech Republic difference affect profitability/cash flow coefficients, ignoring any differences between east and west.

Table 6 reports results allowing financial development to exert different effects in the two parts of Europe separately. Column (1) shows a regression with no interaction, recapping previous results. The rest of the regressions suggest two things. First, this does not change our main inference: in all cases (PCBB as well as PCBank) cash flow exerts a smaller effect on investment when financial development is better, as in our baseline case. Second, there is no statistically significant difference in the effect of profitability on investment or in the effect of financial development on the relationship between profitability and investment for Eastern Europe.²⁰

Overall, we conclude that financial development improves financial constraints on investment for the sub-sample of Western European countries and that Eastern Europe is not significantly different.²¹

²⁰ We get very similar effects of cash flows on investment using the Econometric model. (Results are available on request.)

²¹ Our results from undertaking a country-by-country analysis (see Appendix) confirm the general conclusion that investment constraints are lower in better developed financial markets. Subject to limitations of sample size, the result seems to hold true also for the sub-sample of Western European firms.

5.5. Income effects

In table 7, we examine if the weaker relationship between investment and profitability (cash flows) observed in countries with greater degree of financial development is driven by omitted variables correlated with per capita income. Specifically, the baseline results may be driven by the possibility that the relationship between cash flow and investment differs between rich and poor countries due to omitted institutional and regulatory differences, and that financial development is greater in richer countries.

To rule out this alternative explanation for the baseline results in Table 3a, we control for per capita income in Table 7. The per capita income variable is constructed using GDP (in current dollars) and population data from the World Bank's World Development Indicators database. Column 1 reports the baseline regression (replicating column 3 of Table 3a), which suggest that the positive relationship between profitability and investment (which is suggestive of financial constraints) is weaker in more financially developed countries. In column (2), we find that the relationship between profitability and investment is indeed weaker in richer countries, as reflected in the negative coefficient on the interaction between log per capita income and profitability. However, in column (3) we find that this does not affect the estimated coefficient on the financial development (PCBank) term interacted with profitability. This coefficient has the same magnitude (0.96) and remains highly statistically significant, even when the profitability interacted with log per capita GDP is included as an additional control in the regression.

Similarly, in column (6) we see that the baseline results for the PCBB financial development variable remains largely unchanged when we control for income effects by including log GDP per capita interacted with the profitability variable.

The results in Table 7 lead us to conclude that our results are not driven simply by a spurious correlation between per capita income and measures of financial development.

5.6. Other tests

We undertook a number of additional tests, the results for which are available on request from the authors. The key findings of our additional analysis are summarized below.

First, we redid our analysis restricting the sample to those country-industry-year cells which include 20 observations or more. We found very similar results to those reported here, confirming that our results are not driven by outlier industries, countries or years. Second, we

redid all our analysis using data on domestic credit and bond markets from the IMF's International Financial Statistics (IFS) database and obtained very similar results. Third, we undertook all the analysis in Tables 4, 5, 6 and 7 using the alternative Econometric model. The results were very robust to using the alternative approach.

Finally, we examined if the effect of financial development on the relationship between differs based on three industry/firm characteristics. These were (i) Industry asset liquidity (ii) Firm size (iii) Firm age.

Firms with liquid assets are more likely to be able to use their assets as collateral for external financing. Their financial constraints are therefore perhaps less related to financial development and financial sophistication. On the other hand, Myers and Rajan (1998) suggest that banks may be more reluctant to lend to firms with highly liquid assets as they may fear that managers could more easily manipulate assets in these industries. To test these ideas, we use a liquidity ranking of industries based on US data on asset trades by industry, which we assume is applicable to the same industries in Europe.²² In the baseline Euler equation regressions, we find no significant differences between high and low liquidity industries; however in the Econometric model specifications, we find that the weakening of the relationship between cash flow and investment is less pronounced in high liquidity industries. This suggests, tentatively, that firms in industries with less liquid assets may benefit more from financial development.

As with asset liquidity, one may expect the impact of financial development on financial constraints to vary with firm size or age. The theoretical prediction is unclear; it may be that countries with more developed banking sector channels funds more effectively to smaller firms and younger firms; however banks may also have incentives to continue to lend to older and larger clients, to prevent defaults on existing loans.²³ Our empirical results suggest no

²² Our liquidity measure is defined as sales of PPE (plant, property and equipment) divided by net PPE, aggregated at the industry level (4-digit NAICS).²² In order to make the measure capture time-invariant features of industry asset liquidity, we take averages for 1985-95, the ten years preceding the sample of firm data we use. Alternatively, we have used an average spanning the 1971-2004 period, maximizing the amount of data, which gives very similar results.

²³ The empirical evidence on the role of banks in encouraging industry dynamism is mixed. Bertrand, Schoar and Thesmar, 2007 find that deregulation of banks lead to an increase in entry and exit (suggesting tighter lending to older incumbents and better access to younger entrants). In contrast,

statistically significant difference between large and small firms, or between young and old firms in the impact of financial development on the relationship between profitability and investment.²⁴

6. Conclusions

Across countries, financial development has been shown to relate to growth. Could reduced financial constraints be a mechanism? In frictionless financial markets, investment would not depend on internal cash flows. The fact that cash flow is correlated with investment has been interpreted as a sign that (some) firms are (sometimes) financially constrained. If financial development reduced constraints, the cash flow coefficient would be lower in a country with better developed financial markets.

We test formally if the coefficient on internal resources (cash flow) is related to a country's financial development (using econometric specifications that do not require data on Tobin's Q). We find that the cash flow coefficient is lower in countries with better financial development. This effect is not driven by the East-West differences, or by outliers on the financial development measure such as Switzerland and Luxemburg, which may be special cases. Our interpretation is that financial constraints are strongest or most frequent in countries with low financial development. Several robustness tests give further support to this interpretation.

Caballero, Hoshi and Kashyap, 2003 find that Japanese banks played a role in protecting old incumbent firms that were badly performing.

²⁴ One important source of potential upward bias of the coefficient on cash flows is the possibility that profits/cash flow contain information on future output growth. This biases our results only if the information content of profits in a given country is positively correlated with financial development. Given the limited length of our panel, we do a crude test of whether the lagged cash flow predicts greater growth in countries with better financial development. We used a third order polynomial in lagged cash flow to predict one year as well as three year output growth. We then tested whether a one standard deviation change in lagged profits (around the mean) predicts a bigger increase of future short run or long run output growth in countries with better financial development. We did not find any significant positive relationship between changes in long run output growth predicted by a change in profits and financial development, suggesting that our baseline results may not be driven by higher information content in profitability/ cash flows about future growth opportunities

The effect is weaker inside conglomerates, which is consistent with the idea that conglomerates ease internal financial constraints. Also, the effect is not driven by spurious correlation between measures of financial development and per capita income. Richer countries do not have lower cash flow coefficients when we control for financial development.

Our findings suggest that firm level financial frictions decrease with a developed financial system. Specifically, financial development is beneficial because it relaxes the correlation between internal resources and investment.

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Table 1 – Financial development across countries

This table summarizes two measure of financial development for sample countries. The private credit measure (PCBank) is averaged across available years for 1995-2003, and is taken from the Structural Database (Beck 2001). PCBank is the total value of credit from banks to the private sector, divided by GDP. The private credit & private bonds measure (PCBB) is for 1998 and is also taken from Beck, 2001. PCBB is the sum of private credit and total private bond market capitalization divided by GDP.

Country	Country Code	Private credit 1995-2003 average (PCBank)	Private credit plus private bonds 1998 (PCBB)
Austria	AT	0.54	.
Belgium	BE	0.31	.
Bulgaria	BG	-0.25	1.35
Switzerland	CH	1.16	3.96
Cyprus	CY	0.94	.
Czech Republic	CZ	0.08	0.86
Germany	DE	0.69	1.57
Denmark	DK	0.30	0.86
Estonia	EE	-0.23	0.24
Spain	ES	0.44	1.37
Finland	FI	0.12	1.34
France	FR	0.40	.
United Kingdom	GB	0.78	2.62
Greece	GR	0.00	0.75
Croatia	HR	-0.07	0.54
Hungary	HU	-0.18	0.43
Eire	IE	0.44	1.47
Iceland	IS	0.27	0.93
Italy	IT	0.22	0.93
Luxemburg	LU	0.60	.
Latvia	LV	-0.29	0.17
Malta	MT	0.60	.
Netherlands	NL	0.96	2.00
Norway	NO	0.38	1.25
Poland	PL	-0.21	0.30
Portugal	PT	0.63	1.31
Sweden	SE	0.47	2.26
Slovenia	SI	-0.14	0.38
Slovak Republic	SK	-0.01	0.46
Ukraine	UA	-0.37	0.05

Table 2 – Summary statistics

Summary statistics for key variables for the basic models, the Euler equation model and the Econometric model. Investment is normalized by fixed assets in the previous year. PCBank is private credit and PCBB is private credit plus bond market capitalization, both divided by GDP. Cash flow is defined by Amadeus (the data sources) and corresponds to net income plus depreciation plus changes in deferred taxes.

Variable	N	Mean	St. Dev.	p10	p25	Median	p75	P90
PCBank	2,471,186	0.418	0.276	0.084	0.312	0.400	0.687	0.785
PCBB	1,879,691	1.454	0.661	0.750	0.930	1.370	1.570	2.620
Conglomerate dummy	1,834,346	0.165	0.371	0.0	0.0	0.0	0.0	1.0
Number of employees	2,111,396	172.665	2280.105	9.0	15.0	30.0	73.0	210.0
Firm age	2,401,227	17.198	17.917	3.0	6.0	12.0	22.0	37.0
Investment	1,128,506	0.500	0.908	0.029	0.083	0.220	0.518	1.132
Lagged Investment	813,475	0.511	0.914	0.031	0.089	0.230	0.535	1.156
Variables used in the Euler equation model								
Square of lagged investment	813,475	1.097	5.623	0.001	0.008	0.053	0.286	1.336
Lagged output to capital ratio	1,416,846	1.933	1.748	-0.063	1.016	1.986	2.990	3.930
Lagged ROA	1,292,322	0.778	1.453	0.016	0.174	0.412	0.930	2.091
Variables used in Econometric model								
Change in output	1,702,836	0.098	0.492	-0.163	-0.025	0.051	0.177	0.391
Lagged change in output	1,151,905	0.112	0.471	-0.139	-0.015	0.060	0.187	0.400
Twice lagged capital to output ratio (error correction)	955,021	-1.953	1.705	-3.908	-2.990	-2.002	-1.048	-0.011
Cash flow/capital	1,310,297	0.595	1.302	0.000	0.121	0.305	0.694	1.606
Lagged cash flow/capital	1,255,536	0.589	1.297	-0.001	0.120	0.304	0.689	1.589

Table 3a – Investment and cash flow: the effect of financial development using the Euler equation model

Dependent variable in all regressions is gross investment (normalized by assets). ROA is defined as operating cash flow over fixed assets, and cash flow is defined as cash flow after taxes and interest over fixed assets. PCBank is the average for the 1995-2003 period of the ratio of the total stock of credit to the private sector to GDP. PCBB is the sum of private credit and total private bond market capitalization divided by GDP for 1998. Column 1 uses all observations and clusters errors by country-industry-year. Column 2 and 6 uses observations only for countries for which the relevant financial development variable is available (in column 2, PCBank, in column 6, PCBB). Column 4 and 7 exclude Switzerland. All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country-industry-year in column 1 and by country in other columns. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Sample	(1) All obs.	(2) PCBank sample	(3) PCBank Sample	(4) Excluding CH & LU	(5) PCBB sample	(6) PCBB sample	(7) Excluding CH
Lagged investment	0.161 [0.003]**	0.161 [0.011]**	0.16 [0.011]**	0.16 [0.011]**	0.159 [0.014]**	0.158 [0.014]**	0.158 [0.014]**
Lagged investment squared	-0.017 [0.001]**	-0.017 [0.001]**	-0.017 [0.001]**	-0.017 [0.001]**	-0.017 [0.002]**	-0.017 [0.002]**	-0.017 [0.002]**
Lagged output-capital ratio	0.131 [0.002]**	0.132 [0.006]**	0.129 [0.007]**	0.129 [0.007]**	0.134 [0.008]**	0.131 [0.009]**	0.131 [0.009]**
Lagged ROA	0.059 [0.002]**	0.059 [0.010]**	0.098 [0.013]**	0.098 [0.013]**	0.062 [0.015]**	0.122 [0.018]**	0.122 [0.018]**
Lagged ROA x PCBank			-0.096 [0.026]**	-0.096 [0.026]**			
Lagged ROA x PCBB						-0.037 [0.011]**	-0.037 [0.011]**
R-squared	0.12	0.12	0.12	0.12	0.13	0.13	0.13
Observations	639,208	636,642	636,642	636,053	468,832	468,832	468,345
Number of clusters	12,220	26	26	24	21	21	20

Table 3b – Investment and cash flow: the effect of financial development using the Econometric model

Dependent variable in all regressions is gross investment (normalized by assets). ROA is defined as operating cash flow over fixed assets, and cash flow is defined as cash flow after taxes and interest over fixed assets. PCBank is the average for the 1995-2003 period of the ratio of the total stock of credit to the private sector to GDP. PCBB is the sum of private credit and total private bond market capitalization divided by GDP for 1998. Column 1 uses all observations. Column 2 and 6 uses observations only for countries for which the relevant financial development variable is available (in column 2, PCBB, in column 6, PCBank). Column 4 and 7 exclude Switzerland. All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country-industry-year in column 1 and by country in other columns. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Sample	(1) All obs.	(2) PCBank sample	(3) PCBank Sample	(4) Excluding CH & LU	(5) PCBB sample	(6) PCBB sample	(7) Excluding CH
Lagged investment	0.005 [0.002]*	0.005 [0.006]	0.005 [0.006]	0.005 [0.006]	0.001 [0.007]	0.001 [0.007]	0.001 [0.007]
Change in output	0.26 [0.010]**	0.261 [0.031]**	0.258 [0.030]**	0.258 [0.030]**	0.24 [0.027]**	0.236 [0.026]**	0.236 [0.026]**
Lagged change in output	0.194 [0.005]**	0.195 [0.006]**	0.192 [0.006]**	0.192 [0.006]**	0.199 [0.007]**	0.195 [0.006]**	0.195 [0.006]**
Error correction	-0.135 [0.002]**	-0.135 [0.007]**	-0.134 [0.008]**	-0.134 [0.008]**	-0.141 [0.008]**	-0.139 [0.009]**	-0.139 [0.009]**
Lagged cash flow	0.017 [0.002]**	0.017 [0.006]**	0.018 [0.006]**	0.018 [0.006]**	0.014 [0.007]+	0.015 [0.007]*	0.015 [0.007]*
Cash flow	0.079 [0.004]**	0.079 [0.022]**	0.138 [0.030]**	0.138 [0.030]**	0.087 [0.030]**	0.183 [0.042]**	0.183 [0.043]**
Cash flow x PCBank			-0.148 [0.044]**	-0.148 [0.044]**			
Cash flow x PCBB						-0.060 [0.019]**	-0.060 [0.019]**
R-squared	0.130	0.130	0.130	0.130	0.140	0.140	0.140
Observations	503,660	501,167	501,167	500,725	370,675	370,675	370,298
Number of clusters	9,542	25	25	23	20	20	19

Table 4 – Conglomerates

Dependent variable is gross investment (normalized by assets). Column 1-3 use all observations, columns 4-6 conglomerate firms only. Coefficients for control variables (see table 3) are not reported. All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	All	All	All	Congl.	Congl.	Congl.
Lagged ROA	0.059 [0.010]**	0.098 [0.013]**	0.122 [0.018]**	0.024 [0.005]**	0.05 [0.012]**	0.056 [0.015]**
Lagged ROA x PCBank		-0.096 [0.026]**			-0.043 [0.017]*	
Lagged ROA x PCBB			-0.037 [0.011]**			-0.014 [0.007]+
R-squared	0.12	0.12	0.13	0.16	0.16	0.17
Observations	636,642	636,642	468,832	91,525	91,525	71,182
Number of clusters	26	26	21	25	25	21

Table 5 – Excluding finance and real estate

Dependent variable is gross investment (normalized by assets). Firms with primary industry classification NAICS 52 or 53 are excluded. Coefficients for control variables (see table 3) are not reported. All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country-industry-year in column 2 and 3 and by country in other columns. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Sample	(1)	(2)	(3)
	Non-financial, non-real estate firms		
Lagged ROA	0.059 [0.010]**	0.097 [0.013]**	0.121 [0.019]**
Lagged ROA x PCBank		-0.095 [0.026]**	
Lagged ROA x PCBB			-0.037 [0.012]**
R-squared	0.12	0.12	0.13
Observations	616,623	616,623	454,130
Number of clusters	26	26	21

Table 6 – Geographical subsamples

Dependent variable is gross investment (normalized by assets). Coefficients for control variables (see table 3) are not reported. All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country-industry-year in column 1 and 4 and by country in other columns. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Sample	(1)	(2)	(3) All	(4)	(5)
Lagged ROA	0.059 [0.010]**	0.098 [0.013]**	0.100 [0.016]**	0.122 [0.018]**	0.120 [0.020]**
Lagged ROA x PCBank		-0.096 [0.026]**	-0.100 [0.031]**		
Lagged ROA x PCBB				-0.037 [0.011]**	-0.036 [0.012]**
Lagged ROA x East			0.042 [0.046]		-0.015 [0.041]
Lagged ROA x PCBank X East			0.292 [0.184]		
Lagged ROA x PCBB X East					0.048 [0.036]
R-squared	0.12	0.12	0.12	0.13	0.13
Observations	636,642	636,642	636,642	468,832	468,832
Number of clusters	26	26	26	21	21

Table 7 – Controlling for income effects

Dependent variable is gross investment (normalized by assets). Coefficients for control variables (see table 3) are not reported. Log GDP_PC is the logarithm of per capita GDP obtained from the World Bank’s World Development Indicators database (in current dollars). All regressions include fixed effects for country-year-industry interactions. Standard errors are clustered by country-industry-year in column 1 and 4 and by country in other columns. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

	(1)	(2)	(3)	(4)	(5)	(6)
Sample	PCBank	PCBank	PCBank	PCBB	PCBB	PCBB
Lagged ROA	0.098 [0.013]**	0.382 [0.139]*	0.107 [0.143]	0.122 [0.018]**	0.366 [0.156]*	0.156 [0.112]
Lagged ROA x PCBank	-0.096 [0.026]**		-0.095 [0.031]**			
Lagged ROA x PCBB				-0.037 [0.011]**		-0.036 [0.012]**
Lagged ROA x Log GDP_PC		-0.033 [0.014]*	-0.001 [0.015]		-0.031 [0.017]+	-0.004 [0.011]
R-squared	0.12	0.12	0.12	0.13	0.13	0.13
Observations	636,642	636,642	636,642	468,832	468,832	468,832
Number of clusters	26	26	26	21	21	21

**Appendix: results from running the Euler equation model and Econometric model
separately by country**

Table A.1: Country wise results for the Euler equation model

Dependent variable in all regressions is gross investment (normalized by assets). ROA is defined as operating cash flow over fixed assets. All regressions include the firm level variables and industry-year fixed effects used in the Euler equation model specifications in Table 1 (see text). Standard errors are clustered by industry-year. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Country Name	Lagged ROA Coefficient	Lagged ROA Standard Error
Austria	0.056	[0.114]
Bosnia And Herzegovina	0.208	[0.232]
Belgium	0.049**	[0.006]
Bulgaria	0.077**	[0.022]
Switzerland	-0.015	[0.037]
Serbia And Montenegro	0.12**	[0.040]
Czech Republic	0.092*	[0.038]
Germany	0.013	[0.022]
Denmark	0.026	[0.022]
Estonia	0.077**	[0.019]
Spain	0.087**	[0.005]
Finland	0.06**	[0.008]
France	0.053**	[0.004]
United Kingdom	0.019**	[0.003]
Greece	0.073**	[0.007]
Croatia	0.132**	[0.016]
Hungary	-0.127	[0.205]
Italy	0.095**	[0.005]
Luxembourg	-0.063	[0.049]
Latvia	0.235	[0.377]
Netherlands	0.036*	[0.014]
Norway	0.048**	[0.007]
Poland	0.045**	[0.012]
Portugal	0.033	[0.039]
Sweden	0.071**	[0.007]
Ukraine	0.089**	[0.028]

Figure A.1: Constraints versus financial development (Euler equation model)

This figure plots the coefficients on lagged ROA from the Euler equation model versus PCBB, for countries where the coefficient is significant. PCBB is the sum of private credit and total private bond market capitalization divided by GDP.

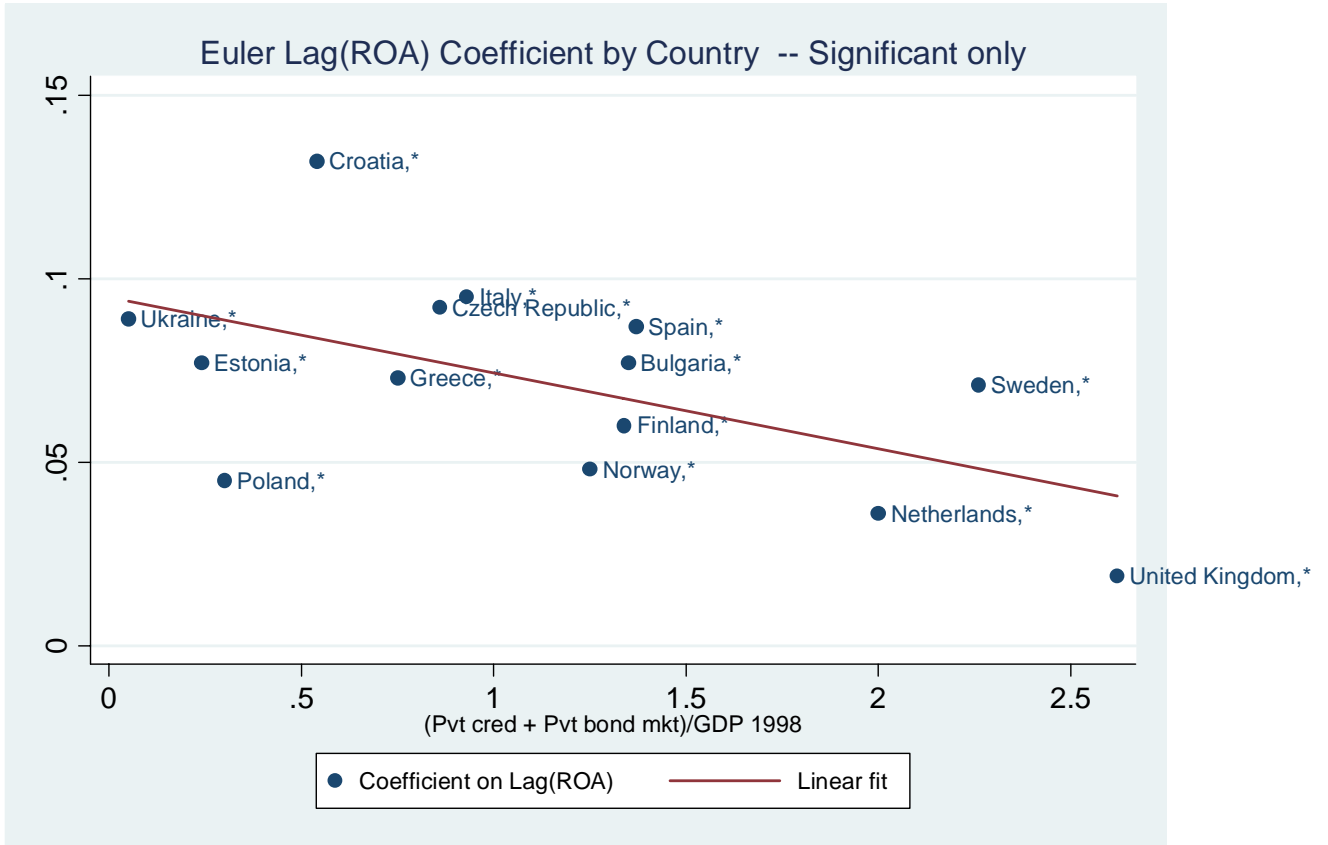


Table A.2: Country wise results for the Econometric model

Dependent variable in all regressions is gross investment (normalized by assets). Cash flow is defined as cash flow after taxes and interest over fixed assets. All regressions include the firm level variables and industry-year fixed effects used in the Econometric model specification in Table 1 (see text). Standard errors are clustered by industry-year. A plus sign (+) denotes a significant coefficient at the 10% level, one star (*) denotes significance at the 5% level, two stars at the 1% level.

Country Name	Lagged Cash flow Coefficient	Lagged Cash flow Standard Error
Austria	-0.028	[0.215]
Bosnia And Herzegovina	0.147	[0.140]
Belgium	0.071**	[0.012]
Bulgaria	0.058+	[0.030]
Switzerland	0.083	[0.122]
Serbia And Montenegro	0.309**	[0.078]
Czech Republic	0.227**	[0.037]
Germany	0.079+	[0.041]
Denmark	0.061+	[0.031]
Estonia	0.133**	[0.021]
Spain	0.098**	[0.009]
Finland	0.053**	[0.017]
France	0.055**	[0.005]
United Kingdom	0.014*	[0.006]
Greece	0.062**	[0.010]
Croatia	0.266**	[0.026]
Hungary	-0.781	[0.627]
Italy	0.199**	[0.010]
Luxembourg	0.255**	[0.058]
Latvia	-0.197	[0.225]
Netherlands	0.032	[0.035]
Norway	0.017	[0.014]
Poland	0.082**	[0.023]
Portugal	0.002	[0.071]
Sweden	0.102**	[0.013]
Ukraine	0.063	[0.043]

Figure A.2: Constraints versus financial development (Econometric model)

This figure plots the coefficients on lagged ROA from the Econometric equation model versus PCBB, for countries where the coefficient is significant. PCBB is the sum of private credit and total private bond market capitalization divided by GDP.

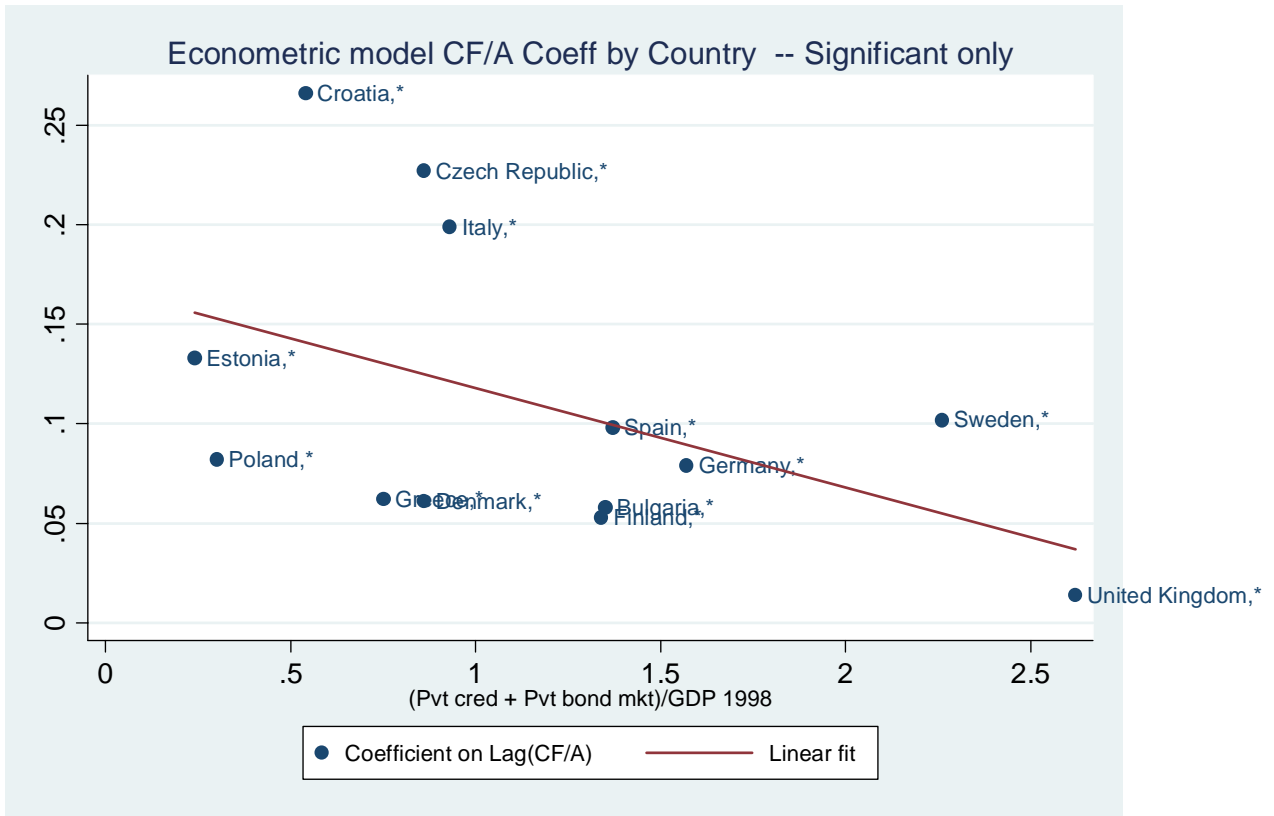


Table A.3: Regression of country-wise coefficients on financial development

Column (1) reports results from regression of the country-wise coefficients on Lagged ROA (reported in Table A.1) on PCBB. Column (2) reports results from regression of the country-wise coefficients on Cash flow (reported in Table A.1) on PCBB. PCBB is the sum of private credit and total private bond market capitalization divided by GDP. To account for the standard errors of the coefficients, each observation is weighted by the inverse of the estimated variance of the dependent variable.

	(1)	(2)
	Euler Equation Model	Econometric Model
PCBB	-0.032** [0.006]	-0.050** [0.0151]
Constant	0.109** [0.011]	0.155** [0.027]
R-squared	0.629	0.380
Observations	20	20