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Financial Development and Financing Constraints

International Evidence from the Structural Investment Model

Inessa Love

Microeconomic evidence from 40 countries shows that financial development aids growth by reducing financing constraints that would otherwise restrict efficient firm investment.

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Summary findings

The relationship between the financial and real sides of the economy has long been a topic of intense interest and debate. Love provides microeconomic evidence that financial development aids growth by reducing financing constraints that would otherwise restrict efficient firm investment.

The author estimates a structural model based on the Euler equation for investment using firm-level data from 40 countries. The results show a strong negative relationship between the extent of financial market development and the sensitivity of investment to the availability of internal funds (a proxy for financing constraints).

Considering size effects, business cycles, and the legal environment as plausible alternative explanations, the author finds the results to be robust in all cases.

This paper—a product of Finance, Development Research Group—is part of a larger effort in the group to study the determinants of access to finance. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Kari Labrie, room MC3-456, telephone 202-473-1001, fax 202-522-1155, email address klabrie@worldbank.org. Policy Research Working Papers are also posted on the Web at http://econ.worldbank.org. The author may be contacted at ilove@worldbank.org. October 2001. (49 pages)

Financial Development and Financing Constraints: International Evidence from the Structural Investment Model.

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1 Introduction

The relationship between the financial and real sides of the economy has long been a topic of intense interest and debate. The potential importance of the financial sector in promoting economic growth was recognized as early as Schumpeter (1912), though this perspective was disputed by numerous economists over the decades that followed (most notably by Lucas (1988)). Proper empirical work in assessing the relationship between financial development and the real economy began only much later, with the work of King and Levine (1993a,b) who reported cross-country evidence which suggested that financial development affects economic growth by fostering productivity improvements. Since then, there has developed a large and growing literature that examines the relationship between financial market development and various economic outcomes, primarily utilizing the cross-country data and methodology pioneered by LLSV[1](1997, 1998, 2000). LLSV argue that the development of financial markets depends on a country's legal origin, which is largely exogenous to the country's future economic growth.[2] However, this body of work is based almost entirely on cross-country analyses which always raises serious concerns about unobserved heterogeneity across data points. Furthermore, these country-level studies cannot properly examine the channels through which finance affects growth, as this requires the micro-level analysis of firm behavior.

The micro-level examination of the link between real and financial decisions of firms has seen considerable work since the pioneering contribution of Modigliani and Miller (1958), who showed that in a world of perfect capital markets, finance is irrelevant for real decisions. This view has been amended and disputed by richer theoretical models, and empirical studies that have found a strong relationship between firms' financial health and investment (see Hubbard (1998) for a recent survey). These

[1]Rafael La Porta, Florencio Lopez-de-Silanes, Andrey Shleifer, and Robert Vishny

[2]See Levine and Zervos (1998), Levine (1999) and Beck, Levine and Loyaza.(2000) for recent cross-country studies. Several recent studies use time-series analysis, for example, Neusser and Kugler (1998) and Rousseau and Wachtel (1998) address the causality issues, and Bekaert, Harvey and Lundblad (2000) look at the effect of financial liberalization on growth.

financing constraints are generally attributed to capital market imperfections, stemming from such factors as asymmetric information and incentive problems, which result in differences between the costs of internal and external financing.

The results contained in this paper lie at the intersection of these two broad literatures. Utilizing firm-level data, while taking advantage of cross-country variation in financial market development, I show that financing constraints, measured by the sensitivity of investment to internal funds, decrease with financial development. These findings are robust to a wide variety of specifications, and to the consideration of a range of alternative explanations. I also report a number of ancillary results that provide further evidence on the importance of financial market development for firm investment. In particular, I find that small firms are disproportionately more disadvantaged in less financially developed countries than are large firms, i.e. they have relatively larger sensitivity of investment to availability of internal funds. Together, these results provide a micro-level foundation for one of the commonly cited explanations for the observed cross-country relationship between financial development and economic growth. Namely, I provide evidence that an improvement in the functioning of financial markets will reduce firms' financing constraints. This will allow for easier access to external funds for firms with good investment opportunities and this improvement in capital allocation will in turn enhance growth.

The methodology used in this paper is based on the established literature on investment with financing constraints, which began with the work of Fazzari, Hubbard and Peterson (1988). The first papers in this field, based on the Q-theory of investment, were based upon models that contained a number of very strong assumptions, such as constant returns to scale, perfect competition, and perfect capital markets. The assumption of perfect capital markets is particularly problematic for my paper, as I explicitly assume that capital markets of the countries in my sample are at different levels of development, and therefore cannot be considered "perfect." I adopt the Euler equation methodology, utilized by more recent contributions to the financing constraints literature, which has less restrictive assumptions than the previous generation of models, including a relaxation of the perfect capital markets assumption.[3] The advantage of using the Euler equation methodology is that it explicitly controls for growth opportunities captured by the marginal product of capital. In this framework, the sensitivity of investment to the level of internal funds is interpreted as evidence of financing constraints. This sensitivity is allowed to vary with the country-specific level of financial development using the interaction of the financial development index and a firm-level measure of internal funds. This interaction is shown to be significantly negative, which implies that financial development reduces financing constraints.

This paper builds upon several recent studies that similarly address issues on the role of the financial system in stimulating economic growth using micro-data. The work that is closest in spirit and methodology to that of my paper is Demirguc-Kunt and Maksimovic (1998), which is the only other firm-level study that examines the link between financial development and growth. In their paper, the authors first calculate the proportion of firms in a country that were growing faster than they could have using only internally generated funds. They find that this proportion is positively related to financial development and to legal system indicators. Although this finding clearly suggests that more developed financial markets improve the availability of external finance in the aggregate, it does not have any bearing on the issue of allocation of capital within a country, as this would require identifying firms that "should" be growing, given their investment opportunities. I am able to address this issue by using a structural model which explicitly controls for growth opportunities at the firm level.

[3]Euler equations for Investment have been estimated by numerous authors, with most studies concentrating on US firms. See Whited (1992), Hubbard and Kashyap (1992), Hubbard, Kashyap and Whited (1995), and Calomiris and Hubbard (1995) among others. The limited work utilizing international data includes Bond and Meghir (1994) for the UK; Jaramilo et al. (1996) for Ecuador; Harris, Schiantarelli, and Siregar (1994) for Indonesia; and Gelos and Werner (1999) for Mexico. The only paper that estimated the Euler equation for several countries is by Bond et al. (1996), which includes observations from Belgium, France, Germany and the UK. A related paper by Kadapakkam et al. (1998) studied investment in six developed countries. They used a reduced form approach combining Q-theory and sales "accelerator" together with cash flow and cash stock measures. Also, they did not compare financing constraints across countries.

Rajan and Zingales (1998) use industry level data to show that industries that require more external finance grow faster in more developed capital markets. Thus, they claim that financial development affects growth by reducing the differential cost of external finance. While their work is very innovative and yields a number of interesting findings, it is based on several strong assumptions. One particularly strong assumption that is implicit in their analyses is that growth opportunities are the same for a given industry in all countries. That is, if an industry is not growing at the same rate as it is in other countries, it is a failure of the financial markets. In other words, the authors do not attempt to control for the growth opportunities available for each industry at every point of time in each country. Again, the structural approach adopted here allows me to address this issue and to explicitly control for such growth opportunities.

Finally, Wurgler (2000) finds that financial development improves capital allocation by increasing the industry-level sensitivity of investment growth to value added growth. Wurgler points out two reasons why firms in less developed financial markets might not undertake the most profitable projects (and thus worsen capital allocation). First, insiders might not be able to distinguish good investment opportunities due to the lack of information. In support of this proposition, he finds that more firm-specific information in returns increases the sensitivity of investment to value added growth. Second, insiders might not have incentives to undertake the most profitable investments if their profits are expropriated; he provides evidence for this hypothesis by showing that state ownership is associated with lower sensitivity and minority rights with higher sensitivity.

Although my study is in a similar spirit to these previous papers, it improves upon them in a number of ways. As noted above, since I use structural model, in the form of investment Euler equations, I am able to control for future growth opportunities by explicitly including the marginal productivity of investment (a measure of growth opportunities). Also, the model identifies the information set available at each decision-making point, which allows for the specification of a valid instrument set and the use of an appropriate estimation technique. In addition, the model allows for the interpretation of estimated coefficients as structural parameters, which provides an additional check on the plausibility of my results. Furthermore, by using firm-level data, rather than industry-level aggregates, I exploit firm heterogeneity in the productivity of capital. Since some firms will be more productive than others within the same industry, allocating capital to the industry as a whole is not as efficient as allocating capital to the most productive firms within each industry.

The rest of the paper is as follows. Section 2 presents the structural investment model based on a dynamic optimization problem and discusses financing constraints. Section 3 discusses the empirical model and estimation methodology, and Section 4 describes the data. Section 5 provides the main results including the analysis of structural parameters. Section 6 presents several tests of alternative explanations, including the size effect, business cycles and legal system. Section 7 presents the auxiliary results using single-country regressions. Finally, Section 8 provides conclusions and directions for future research.

2 The Model of Investment

2.1 The Optimization Problem

The dynamic model of the firm value optimization is reproduced in this section. This model is similar to models used in previous studies (listed in footnote 3), and follows closely the specification in Gilchrist and Himmelberg (1998). The model is simplified here because it ignores the possibility of debt financing. However, this simplification does not affect the resulting first order conditions for investment, which are the focus of this paper.[4] In this model shareholders (or managers) are maximizing the present value of the firm, which is equal to the expected discounted value of dividends subject

[4]Formally including debt into the problem results in a separate Euler equation for debt, see Gilchrist and Himmelberg (1998) for derivation. However, the investment Euler equation is not directly related to the debt Euler equation and is not affected by adding debt into the model.

to the capital accumulation and external financing constraints. The firm value is given by:

$$V_t(K_t, \xi_t) = \max_{\{I_{t+s}\}_{s=0}^{\infty}} D_t + E_t\left[\sum_{s=1}^{\infty} \beta_{t+s-1} D_{t+s}\right] \tag{1}$$

subject to

$$D_t = \Pi(K_t, \xi_t) - C(I_t, K_t) - I_t \tag{2}$$

$$K_{t+1} = (1-\delta)K_t + I_t \tag{3}$$

$$D_t \geqslant 0 \tag{4}$$

Here D_t is the dividend paid to shareholders and is given by the "sources equal uses" constraint (2); β_{t+s-1}, is a discount factor from the period $t+s$ to period t. In the capital accumulation constraint (3) K_t is the beginning of the period capital stock, I_t is the investment expenditure and δ is the depreciation rate. The restricted profit function (i.e. it is already maximized with respect to variable costs) is denoted by $\Pi(K_t, \xi_t)$, where ξ_t is a productivity shock.[5] The adjustment cost of investment is given by the function $C(I_t, K_t)$, and is assumed to result in a loss of a portion of investment. The financial frictions are introduced via a non-negativity constraint on dividends (4), and the multiplier on this constraint is denoted λ_t below. This multiplier equals to the shadow cost associated with raising new equity, which implies that external (equity) financing is costly and this extra cost is due to information or

[5]The profit function depends on the beginning of the period capital, and hence the implicit assumption is that investment becomes productive only in the next period (i.e., a one period time to build lag). I ignore the price of invesment which is replaced by fixed and time effects in the estimation. I also ignore tax considerations due to data constraints.

contracting costs.[6] This shadow cost is used in defining financing constraints, which are discussed below.

2.2 The Euler Equation

The Euler equation derived from the above maximization problem (derivations are available from the author) is given by:

$$1+\left(\frac{\partial C}{\partial I}\right)_t=\beta_t E_t\left[\Theta_t\left\{\left(\frac{\partial \Pi}{\partial K}\right)_{t+1}+(1-\delta)\left(1+\left(\frac{\partial C}{\partial I}\right)_{t+1}\right)\right\}\right] \tag{5}$$

Here, $\frac{\partial C}{\partial I}$ is the marginal adjustment cost of investment, $\frac{\partial \Pi}{\partial K}$ is the marginal "profit" of capital, further referred as MPK, (the contribution of an extra unit of capital to the firm's profits), and $\Theta_t=\left(\frac{1+\lambda_{t+1}}{1+\lambda_t}\right)$ is the relative shadow cost of external finance in periods t and $t+1$. I refer to the factor Θ_t as "financing constraints" and discuss it in a separate section below. The intuition behind this Euler equation is that the marginal cost of investing today on the left hand side (given by the adjustment cost and the price of investment goods, normalized to one) is equal to the discounted marginal cost of postponing investment until tomorrow, on the right hand side. The latter is equal to the sum of the foregone marginal benefit of an extra unit in capital, given by MPK, plus the adjustment cost and price of investment tomorrow (again normalized to one).

To arrive at the empirical model, one must identify empirical measures for financing constraints and MPK, specify a functional form for adjustment costs, linearize the Euler equation and eliminate the expectation operator. These issues are addressed in the subsections below.

[6] Several influential papers addressed the sources of information- or contracting-related frictions in detail. See, for example, Jensen and Meckling (1976), Myers and Majluf (1984), Hart (1995) and others. Here, these frictions are exogenous to the firm and are represented by the shadow value of external finance. Another possible way to introduce financial frictions is by exogenously limiting the amount of debt that the firm can raise at any point in time. This will create a shadow value of debt, which has the same effect in the Euler equation as the shadow value of equity.

2.3 Financing Constraints

At the heart of the financing constraints theory is the factor $\Theta_t = \left(\frac{1+\lambda_{t+1}}{1+\lambda_t}\right)$, which is the relative shadow cost of external finance in periods t and $t+1$. If the shadow cost of external funds is higher in period t than it is expected to be in period $t+1$ (i.e. $\lambda_t > \lambda_{t+1}$), then $\Theta_t < 1$ and it acts as an additional discount factor which makes current period funds more expensive to use than the next period funds and therefore induces the firm to postpone or reduce its investment. In this case we say that the firm is "financially constrained," and Θ_t is the (degree of) financing constraints.[7] In perfect capital markets $\lambda_t = \lambda_{t+1} = 0$ for all t and hence $\Theta_t = 1$ and the firm is never constrained. With capital-markets imperfections, λ_t depends on a vector of state variables, including the productivity shock ξ_t. Therefore, λ_t is time-varying and could be identified with some observable firm characteristics.

In the previous work several observable characteristics of the firm's financial health have been used as proxies for the financing constraints. The most commonly used variable was the cash flow. The problem with cash flow is that it is closely related to operating profits and therefore also to MPK and will measure investment opportunities rather than, or in addition to, measuring the availability of internal funds (i.e. the net worth). Using the terminology in Gilchrist and Himmelberg (1998) it could be argued that the change in cash flow would simultaneously reflect a change in "fundamentals" (increase in marginal productivity) and "financials" (increase in the net worth of the firm, which will relax financing constraints).

As a measure of the internal funds, I use the stock of liquid assets, specifically stock of cash and marketable securities scaled by total assets (hereafter referred to as Cash Stock). The cash stock has an intuitive interpretation as "cash on hand" that

[7] If, on the other side, $\Theta_t > 1$, the firm expects to be more constrained tomorrow (time t+1) than it is today and at time t its investment will be unconstrained. In this case the firm is more likely to invest at time t, since the discount factor β is increased by the amount Θ_t (i.e. the interest rate is lowered). Another possibility is that $\Theta_t = 1$, because $\lambda_t = \lambda_{t+1} \neq 0$. But this seems very unlikely in a stochastic model since λ_t depends on a realization of the productivity shock. Even if it is possible for some firms in some years to have $\Theta_t = 1$, in estimating country-wide constraints such a situation is very unlikely.

firms can use for investment if the opportunities arrive. One theoretical justification for the cash stock measure appears in the Myers and Majluf (1984) model, where the amount of cash holdings, which the authors call "financial slack," has a direct effect on investment in the presence of asymmetric information. This slack allows firms to undertake positive NPV projects, which they would pass if they do not have any internal funds. This implies that if external financing is costly, there will be a positive relationship between investment and cash stock, this is the relationship explored in this paper.

Unlike the cash flow measure, the cash stock would proxy for the future growth opportunities only in the presence of financing constraints. That is, firms that expect high investment in the future, would accumulate cash stock to use up when the opportunities arrive. Since holding cash is costly to the firms (because it diverts resources from the productive use and offers zero return), the firms will accumulate cash stock only if they expect to be financially constrained in the future. The evidence consistent with this hypothesis is presented in Opler et al. (1999), among others.[8] They find that firms hold liquid assets to ensure that they can keep investing when outside funds are expensive and the firms that have lower cost of external financing (large, dividend-paying, and firms with credit ratings) hold smaller stocks of liquid assets.

I assume that the firm makes its decision for period t investment at the beginning of that year (or, equivalently, the end of previous year). Therefore the appropriate timing of the cash stock is $t-1$, because the investment decision depends on how much cash a firm has before starting the investment. I parametrize the financing

[8]Kim et al. (1998), Calomiris, Himmelberg and Wachtel (1995) and Calomiris and Himmelberg (1996) also find that firms with lower costs of external finance maintain lower levels of financial working capital. Despite the growing empirical evidence on the "precautionary savings" by financially constrained firms, this hypothesis still remains controversial, see for example Kaplan and Zingales (1997); their view is disputed in Fazzari, Hubbard and Petersen (2000).

constraints as a function of cash stock as

$$\Theta_{it} = a_{0i} + aCash_{it-1},$$

where a_{0i} is a firm-specific level of financing constraints (which enters into the fixed effects) and $Cash_{it-1}$ is the cash stock. The sensitivity of investment to financial health, measured by the parameter a, is the main focus of this paper. Recall from the discussion above that under perfect capital markets, $\Theta_{it} = 1$, hence $a = 0$ (i.e. investment is not related to internal funds). The larger the capital market imperfections, the larger will be the sensitivity of investment to the amount of internal funds.

The main argument of this paper is that if financial development decreases capital market imperfections, it should also decrease the coefficient a. In other words, the coefficient a is allowed to depend on the country-level measure of financial development (hereafter FD), given by:

$$\Theta_{it} = a_{0i} + (a_1 + a_2 FD_c)Cash_{it-1}. \tag{6}$$

Thus, the focus is on the interaction of FD and Cash, i.e. coefficient a_2, and it is expected to be negative, which will imply that financial development reduces the sensitivity of investment to internal funds (i.e. financing constraints).[9]

2.4 Measuring MPK

The measure of MPK, derived from the profit maximization problem (derivations are available from the author), is given by

$$MPK = \theta \frac{S}{K}, \tag{7}$$

[9] In section 6.4 I present auxiliary results which allow for country-specific coefficients a_c.

where $\frac{S}{K}$ is a sales to capital ratio, $\theta = \frac{\alpha_k}{\mu}$, α_k is the capital share in the production function and μ is a markup.[10] This is a sales-based measure. An alternative measure, which has been used in previous work (also derived in Appendix 2) is an operating-profits measure. Although both measures are based on strong assumptions,[11] the sales-based measure is less correlated with cash flow than the operating profits measure (which basically is equal to cash flow). As discussed above, cash flow would simultaneously proxy for change in "fundamentals" and "financials," therefore I prefer to use the sales-based measure. As discussed in the previous section, I assume that the firm makes the period t investment decision at the end of the period $t-1$. Therefore the appropriate timing for the sales to capital ratio is the end of period t.

2.5 Adjustment Costs

The adjustment cost function is given by $C(I_t, K_t) = \frac{\alpha}{2}(\frac{I}{K}_t - g\frac{I}{K}_{t-1} - \nu_i)^2 K_t$. This adjustment cost function is slightly more general than the one used in the traditional models because it includes lagged investment to capital ratio with an additional parameter g. It is added to capture strong persistence in investment to capital ratios present in the data. This extended functional form allows for the more common form with $g = 0$, which could be tested empirically. The intuition for this added term is that it may be easier for the firm to continue investment at some fraction g of the previous period ratio, since, for example, it has hired workers or made some other arrangements which would be costly to cancel. Parameter ν_i could be interpreted as some firm-specific level of investment at which adjustment costs are minimized. The

[10] In the definition used here, the parameter α_k (the capital share) is likely to be industry-specific, and a markup (the measure of the market power) will be either industry or firm-specific. However in the empirical work, the coefficient on sales to capital is assumed to be constant across all firms. This will cause a measurement error, which is likely to bias the coefficient on the sales to capital toward zero. This problem is ameliorated with the fixed effects, which capture the firm-specific level of sales to capital.

[11] The operating-profits measure assumes that there are no fixed costs (i.e., reported Cost of Goods Sold reflects only variable costs) and no quasi-fixed factors of production (such as R&D capital or intangible assets). The sales-based measure assumes a Cobb-Douglas production function; while this is a questionable assumption, the sales-based measure allows for quasi-fixed factors of production and fixed costs.

marginal adjustment cost of investment is given by:

$$\frac{\partial C}{\partial I}_t = \alpha \left(\frac{I}{K}_t - g \frac{I}{K}_{t-1} - \nu_i \right). \tag{8}$$

2.6 Linearization and Expectations

Although the stochastic discount factor introduced by financing constraints, Θ_t enters the Euler equation in a multiplicative form, in empirical work it is often easier to estimate and interpret financing constraints when they enter additively. Similarly, it is convenient to separate the discount factor β_t in a linear term to allow for country- and time-specific discount factors. Following Gilchrist and Himmelberg (1998), I linearize the product of β_t, Θ_t and the marginal benefit of investment (expression in curly brackets in (5), here denoted as $\{.\}_t$) using a first-order Taylor approximation around the means. Since Θ_t could be above or below one, its mean should be a value around one. Denoting the unconditional mean of the expression in curly brackets as γ, and the average discount factor as $\overline{\beta}$, the approximation is given by (ignoring constant terms):[12]

$$\beta_t \Theta_t \{.\}_t = \overline{\beta} \gamma \Theta_t + \overline{\beta} \{.\}_t + \gamma \beta_t. \tag{9}$$

Finally, I assume rational expectations, which allows me to replace expectations with realized values plus an expectation error e_{it}. The error term is orthogonal to any information available at the time when the investment decision is made. I assume that the investment decision for year t is made at the beginning of that year (which is equivalent to end of year $t-1$). Therefore, the information available at the time of decision is dated $t-1$ since year t information does not arrive until the end of year t. Then, the orthogonality conditions for this model are given by $E[e_t | x_{t-s}] = 0$ for $s \geqslant 1$. This is equivalent to the assumption that the regressors are predetermined,

[12]Note that I implicitly assume that the covariance between the financing constraints factor and the marginal benefit of investment (the term in $\{.\}$) is constant (in the empirical model this covariance is captured by country-time dummies and fixed effects).

rather then strictly exogenous, and therefore require special estimation techniques discussed in section 3.1.

3 Empirical Model and Estimation

I obtain the empirical model by substituting (6), (7), (8), and (9) into (5), and replacing the expectation with the realization plus an error term. It is given by :

$$\frac{I}{K}_{it} = \beta_1 \frac{I}{K}_{i,t+1} + \beta_2 \frac{I}{K}_{i,t-1} + \beta_3 \frac{S}{K}_{it} + \beta_4 Cash_{it-1} + \beta_5 Cash_{i,t-1} FD_c + f_i + d_{c,t} + e_{it}, \tag{10}$$

where the coefficients are related to the structural parameters as:

$$\beta_1 = \frac{\overline{\beta}(1-\delta)}{d}, \beta_2 = \frac{g}{d}, \beta_3 = \frac{\overline{\beta}\theta}{\alpha d}, \beta_4 = \frac{\overline{\beta}\gamma}{\alpha d} a_1, \beta_5 = \frac{\overline{\beta}\gamma}{\alpha d} a_2 \text{ and } d = 1 + \overline{\beta}(1-\delta)g. \tag{11}$$

Here, f_i denotes fixed effects,[13] and $d_{c,t}$ denotes country-time dummies, that capture aggregate shocks, including productivity, prices, and other macro shocks that are allowed to be different for each country.

With respect to the coefficients in equation (10), *the main hypothesis* of this paper is formally stated as:

$$Ho : \beta_4 \geqslant 0 \text{ and } \beta_5 < 0. \tag{12}$$

That is, financing constraints are nonzero (for at least some countries) and they decrease with financial development. (Note that β_4 and β_5 depend on previously

[13]Fixed effects arise in this structural model for several reasons. First, there are firm-specific parameters for adjustment cost ν_i and for financing constraints a_{0i}. Second, the omitted terms that contain prices of investment goods and the conditional covariance of financing constraints and marginal benefit of investment (discussed in 2.6) are replaced by the combination of time and fixed effects. Third, the fixed effects capture a sample selection bias if the firms included in the sample have different investment policy than the rest.

defined structural parameters a_1 and a_2.) The focus is on the interaction of Cash_{it} (the firm-level variable measure of internal funds) and FD_c (the country-level index of financial development).

Hereafter, I refer to equation (10) as the "baseline model." I use the same framework to test whether other measures affect financing constraints by replacing FD with the index of interest (for example legal system indicators). For robustness tests, I add additional interactions to the baseline model to see if the financial development effect is still present when I control for other potential sources of financing constraints (such as firm size or business cycles, described in section 6).

3.1 Estimation Methodology

The first issue in estimating this model concerns the presence of fixed effects. There are several reasons for fixed effects to arise in this model (see footnote 13). The fixed effects are correlated with regressors because the model contains lags and leads of the dependent variable, therefore they need to be removed before the estimation. One common procedure for removing fixed effects is mean-differencing. However, since the regressors are not strictly exogenous (see discussion in section 2.6), mean-differencing would create biased estimates. I use forward mean-differencing, which removes only the forward mean, i.e. the mean of all the future observations available for each firm-year. The forward mean-differencing preserves orthogonality between transformed errors and untransformed original variables, which are used as instruments. Arellano and Bover (1995) show that when moments are formed by summing over firms and periods, as opposed to treating each year as a unique set of moments, and when there is no serial correlation in the error term, the forward mean-differencing is more efficient than the more commonly used first-differencing. In addition, the first-differencing induces serial correlation in the errors and requires appropriate error-correction, while the forward mean-differencing preserves the error structure.[14]

[14]The forward mean-differencing, also referred to as the Helmert procedure, was used to estimate investment models by Bond and Meghir (1994) and Gilchrist and Himmelberg (1998).

The country-time dummies, $d_{c,t}$, are removed by country-time differencing of all variables, i.e. regressors and instruments (the regressors are time-differenced after the forward mean-differencing, but the order of transformations is not important).

As discussed in section 2.6, the expectation error e_{it} is orthogonal to the information available at the time when the investment decision is made, which I assume to be $t-1$. As noted above, after the forward mean-differencing, the transformed errors are still orthogonal to the untransformed original variables dated $t-s$, where $s \geqslant 1$. Therefore, I use the GMM procedure, implemented as IV (instrumental variables), with $t-1$ and $t-2$ lags of instruments. The instruments are all the variables in the regression, plus cash flow, cost of goods sold, industry dummies and the interactions of cash, sales and investment with FD (see Table 2 for variable definitions).

In all regressions I use heteroskedasticity robust estimates of the standard errors, which do not require an assumption of the independence of errors within the firm (implemented with Stata's cluster option). To eliminate influential observations, I exclude 1% on each side of the distribution for each of the variables in the regression prior to transformations.

4 Data

All firm level data come from the Worldscope database, which contains data on large publicly traded firms in which there is an investor interest. Using only large publicly traded firms allows one to compare "apples to apples" across countries and separate the effects of different financial and legal environments, which is the center of attention here. An additional benefit of using these data is the attempt by Worldscope to standardize accounting information to improve cross-country comparability.[15] The drawback of the sample is that it does not have data on large non-public firms. Even

[15]For example, if one company reports sales with included excise tax and another company excludes it, Worldscope corrects this difference and presents both with excluded tax. This is important for my study because I use sales as a measure of MPK and want to have as much cross-country comparability as possible.

though I cannot extend the findings from the large public firms to all firms without the appropriate data, there is a lot to be learned on the cross country differences in this sample.

The firm data are available for 40 countries and cover over 7000 firms for the years 1988-1998 (however the years before 1991 and the year 1998 have fewer observations). Details on the sample selection are given in Appendix 1. The coverage within countries varies widely from as little as 1% of all listed domestic firms included (for India) to as many as 82% (for Sweden), as calculated by LLSV (1997) who use the same sample. Table 1 gives the list of countries in the sample with the number of firms and observations per country. The number of firms in each country varies widely across the countries, and the less developed countries are underrepresented. This creates a problem with pooled cross-country estimation, though it is mitigated using the empirical techniques discussed in the next section. The main firm-level variables are investment and sales, scaled by the beginning of the period capital,[16] and stock of liquid assets (cash stock). Other variables are defined in Table 2.

The main country-level indicator is an index of financial development, FD. It is equal to the sum of the (standardized) indices of the stock market development, STKMKT, and financial intermediaries development, FININT, which come from Demirguc-Kunt and Levine (1996) (they refer to these indices as Index1 and Findex1 respectively). The STKMKT is the sum of three standardized measures: market capitalization over GDP (i.e. the size of the stock market), total value traded over GDP, and total value traded over market capitalization (two measures of liquidity of the market). The FININT is the sum of two standardized measures: the ratio of liquid liabilities (M3) to GDP (i.e. the overall size of the credit market) and the credit going

[16]The model requires one to use the beginning of the period capital stock as a scaling factor for calculating adjustment costs and MPK. One alternative is to use lagged capital stock (i.e. period t-1 used as the beginning of the period t capital stock). However, this would not be appropriate if there are mergers, acquisitions, divestitures or other capital-changing events, which are hard to identify. I use the approximate value given by the ending period capital, minus investment and depreciation in that year, which is more robust to the capital-changing events, as discussed in Love (1999).

to the private sector over GDP (the amount of credit that is relevant to the firm's financing).

Thus the FD index combines five important characteristics of financial markets into a standardized measure, similar to the ones used in other studies. For a robustness check, I also use the real growth of GDP (a country-year variable) as an indicator of the business cycle conditions in each country, which are also thought to affect the financing constraints (discussed in section 6). Table 2 lists the rest of the country-level variables (and their sources), which are discussed in the relevant sections below.

Table 3 reports means and medians of the key variables, by country. Table 4 reports cross-country correlations of the country averages for these variables. Several patterns stand out in these correlations. First, sales to capital, SK, is correlated with investment to capital, IK, which could imply that countries with higher productivity invest more (of course no claim is made about the causality of this relationship). Second, FD appears to be positively correlated with the sales to capital ratio, SK. This seemingly counter-intuitive result is likely due to differences in industry and sample compositions across countries and should not be interpreted causally. Third, FD is positively correlated with IK, although this correlation is not significant, so it is not clear if financial development increases investment on average. Finally, the cash stock is correlated with investment and sales. The interpretation of this relationship is done using the regression analysis below. Most of the country-level institutional characteristics are highly correlated with each other (Panel B, Table 4) and therefore should not be included in the regressions simultaneously.

5 Main Results

As is clear from Table 1, the number of firms included in the sample varies widely across the countries. The US and UK have more than 1000 firms per country, while the rest of the countries have only 136 firms on average (Japan is the third largest with over 600 firms). Such a prevalence of US and UK companies will overweight these countries in the cross-country regressions and prevent smaller countries from influencing the coefficients, especially when the variable of interest is the interaction with the country-level financial development index. To correct for this I use two approaches: the first is the rank-based approach, and the second is the weighted regressions approach, discussed below.

The rank-based approach is based on the reasoning that to have a meaningful test for the financial development effect on financing constraints, one needs to compare apples to apples, i.e., large firms in one country to large firms in another country.[17] Therefore, the regressions include only the largest firms within each country. The inclusion criteria are based on firm ranking, where rank 1 is given to the largest firm in its country. Since there is no a priori criteria to select any specific number of firms, I experiment with different cutoff points and report results for 50, 100, 150 and 200 largest firms.

The weighted regression approach assigns a country-specific weight, which is equal to the inverse of the number of observations in each country. Countries with a lot of observations get a smaller weight and countries with fewer observations get a larger weight, so that the number of observations is equalized across all countries. This method uses all the available observations, which results in efficiency gains.

The main results are based on the model given in (10) and are reported in Table 5. Models 1-4 use the rank-based approach with different cutoff points, and model 5 uses the weighted regression approach. All coefficients have their predicted signs and are significant at conventional levels, with the most significant coefficients resulting in the 150 largest firms regression (model 3) and weighted regression (model 5) where all the coefficients are significant at the 1% level. The main variables of interest are the cash stock and the interaction of cash stock with the financial development index, FD. The main hypothesis, stated in (12), is that the cash coefficient is positive and

[17]It is plausible to argue that some small companies in the US have less access to external finance than the few largest companies in, for example, Malaysia or Thailand, which in the sample period enjoyed more attention from domestic and outside investors than many small US companies.

the interaction is negative. This result is obtained in all the regressions in Table 5. This confirms the main claim of this paper, that financial development decreases the sensitivity of investment to availability of internal funds, measured by the cash stock (this sensitivity is interpreted as a proxy for the financing constraints).

5.1 Structural Parameters

The interpretation of the coefficients magnitudes is best done in terms of the parameters of the underlying structural model, which are given by expressions in (11). To identify the structural parameters I use the minimum-distance estimator, described in Himmelberg (2000) (details on this estimator are available from the author). There are 5 equations and 8 parameters, therefore not all the parameters can be identified. I choose to identify $(\overline{\beta}, g, \alpha, a_1, a_2)$ and assume the values for the remaining parameters. I assume a depreciation rate $\delta = 0.12$, which is the sample average of the depreciation expense to capital ratio. The coefficient θ, which translates sales to capital ratio into MPK in (7), is assumed to be equal to 0.23 (this corresponds to the values for the capital share $\alpha_k = 0.3$ and markup μ =1.3[18]). Finally, I assume the value for the linearization parameter $\gamma = 1.2$, which is equal to the average marginal benefit of investment, discussed in section 2.6.[19] The resulting structural parameters are reported at the bottom of Table 5. Although there is some variation among the estimated parameters, the average values seem plausible. The average discount rate $\overline{\beta}$ is equal to 0.8 (and several models imply a discount rate of 0.9), which seems quite reasonable. Note that country and time specific discount rates are captured by the country-time dummies so the estimated $\overline{\beta}$ represents an "average" discount rate, which is hard to identify in panel data.

The parameters of the adjustment cost function have average values α =6.5 (this

[18]The estimate of markup is taken from Hubbard, Kashyap and Whited (1995), and it corresponds to a demand elasticity of -4.

[19]I assume that MPK is approximately equal to 0.2 (taken from Gilchrist and Himmelberg (1998)) and the marginal adjustment cost term is 0.2. Since the value of γ depends on the values of other parameters, I experimented with an iterative procedure when γ was determined at every stage of minimization using the parameter values at that stage. This produced qualitatively similar results.

excludes insignificant value from model 1) and g=0.23. The parameter g is quite stable and always significant (which confirms the extended functional form for the adjustment costs), while α varies quite a bit and is less significant in general. The marginal adjustment costs function is then given by $c = 6.5(\frac{I}{K}_t - 0.23\frac{I}{K}_{t-1} - v_i)$. Since the average $\frac{I}{K}$ in the data is approximately 0.18, the difference of the first two terms is equal to 0.14. The magnitude of the marginal adjustment cost depends on the parameter v_i, which is not possible to estimate separately since it is included in the fixed effects. For example, if v_i is in the range 0-0.1, the marginal adjustment cost will be in the range 0.25-0.9, which is in line with previous evidence (for example, Hubbard and Kashyap, 1992).

Next, I analyze the financing constraints factor, Θ, which is defined as a function of the structural parameters in (6). The sensitivity of Θ to change in cash stock depends on the country's level of FD. Thus, a firm in a country with high FD (i.e. one standard deviation above the mean of FD) has close to zero sensitivity of Θ to the change in the cash stock.[20] This implies that firms in countries with high financial development, such as US, UK and Japan, are not financially constrained. This is not surprising given that the sample mainly consists of large publicly traded firms. For a firm in a country with an average FD, such as Spain, France and Israel, a one standard deviation change in cash stock results in 6.5% decrease in the financing constraints factor Θ, which could be translated as a change in cost of capital from 11% to 19%. On the other side, for firms in countries with low FD (i.e. one standard deviation below the mean), such as Mexico, Brazil, or Chile, a one standard deviation decrease in cash stock will decrease Θ by 13%, which implies an increase in the cost of capital from 11% to 28%. Although these calculations are rough approximations, and appear a bit on the high side (i.e. imply quite large changes in cost of capital), they suggest that financial development has a very large and economically significant effect on the

[20]For simplicity, in all the calculations I assume that the financial development index has a mean of zero and standard deviation of one. The actual mean and standard deviation are -0.03, and 1.14 respectively. I also use values $a_1 = 1$ and $a_2 = -1$, while the average values from Table 5, ignoring insignificant estimates, are 0.96 and -0.99 respectively.

financing constraints.

6 Tests of Alternative Explanations

6.1 Size Effect

One potential problem with the main results (that financial development decreases financing constraints) is the omitted effect of company's size on its financing constraints. Firm size has been commonly used to identify firms that are more likely to be financially constrained (see Schiantarelli (1995) for a survey). The small firms are more likely to suffer from financing constraints (i.e. have larger coefficients on the financial variables) because information asymmetries are larger. If more financially developed countries have larger firms, as argued by Kumar, Rajan and Zingales (1999), then the estimated FD effect could be attributed to the differences in the firm size rather than financial development. To test this, I add the interaction of size (measured by the log of total assets in US dollars) with cash stock to the baseline model:

$$\begin{aligned} \frac{I}{K}_{it} &= \beta_1 \frac{I}{K}_{i,t+1} + \beta_2 \frac{I}{K}_{i,t-1} + \beta_3 \frac{S}{K}_{it} + \beta_4 Cash_{i,t-1} + \beta_5 Cash_{i,t-1} FD_c \quad (13) \\ &+ \beta_6 Cash_{i,t-1} Size_{i,t-1} + f_i + d_{c,t} + e_{it} \end{aligned}$$

The test now is that the main hypothesis ($\beta_4 \geqslant 0$ and $\beta_5 < 0$) still holds and also $\beta_6 < 0$, i.e. financing constraints are smaller for larger firms.[21] The instruments now include size and interaction of size with investment, cash and sales.

The results with weighted regressions are presented in Table 9. I first test whether size has any effect when included by itself (i.e. in the model (13) only $Cash_{i,t-1} Size_{i,t-1}$

[21]Note that size enters Euler equation only as interaction with the cash stock (proxy for the financing constraints), and not in levels. If there is any level effect, it is captured by the fixed effects. One problem this size test is the nature of the sample, which mainly consists of the large firms. Nevertheless, there is some variation in size among the firms in most countries, which is exploited for this test. At worst, the sample selection creates bias against finding any size effect.

interaction is included). Model 1 in Table 6 shows that there is a significant size effect, that is larger firms have smaller cash coefficients. For example, for the firm with the mean size, the cash coefficient is equal to 0.12, and for the firm with size equal to one standard deviation below the mean the cash coefficient equals 0.3, almost a triple increase in the investment sensitivity. Next, I include the interaction of cash with financial development in addition to the size interaction (model 2, Table 6) and find that both interactions are significant at 1%. This confirms that the financial development effect is not caused by the differences in the size of the firms and that both size and financial development have an independent effect on financing constraints.

This methodology allows me to address another interesting empirical question: Is the size effect equal in all countries, or is it related to financial development? The intuition is that the largest firms in less financially developed countries could still enjoy an abundance of external finance (obtained through access to external capital markets, or political connections), while smaller firms will be comparatively more disadvantaged. I test this with an augmented model:

$$\begin{aligned}\frac{I}{K}_{it} &= \beta_1 \frac{I}{K}_{i,t+1} + \beta_2 \frac{I}{K}_{i,t-1} + \beta_3 \frac{S}{K}_{it} + \beta_4 Cash_{it-1} + \beta_5 Cash_{i,t-1} FD_c \\ &\quad + \beta_6 Cash_{i,t-1} Size_{i,t-1} + \beta_7 Cash_{i,t-1} Size_{i,t-1} FD_c + f_i + d_{c,t} + e_{it}\end{aligned} \qquad (14)$$

The test now is on the triple interaction coefficient, and I expect $\beta_7 > 0$, that is financial underdevelopment has more effect on the small firms (i.e. less negative effect on the large firms), and all previous hypothesis are expected to hold: $\beta_4 \geqslant 0$, $\beta_5 < 0$ and $\beta_6 < 0$.

The results are reported in model 3, Table 6. All 4 coefficients $\beta_4 - \beta_7$ (cash, cash interaction with FD, cash interaction with size, and triple interaction of cash, size and FD) have their predicted signs and are significant at the 1% level. This suggests that financial development has a differential effect on firms of different sizes. That is the small firms are affected significantly more than the large firms are.

For a robustness check of this result, I define a dummy variable, which is equal to one if the size of the firm (measured as the log of total assets) is smaller than the median size in its country (note that this definition reverses the signs on the size interactions). This definition is more robust to differences in firm size across countries, but is less robust to differences in the sample size across countries (because for the countries with the small samples, some of the large firms are classified as small). The results, in model 4, although slightly weaker than in model 3, confirm the above conclusion that small firms are significantly more affected by FD.

To quantify the relative difference in financing constraints of large and small firms I use estimates from the model 3. Thus, in a country with the average FD, the average size firm has cash coefficient of 0.15, while the small firm (i.e. the size of one standard deviation below the average) has the coefficient of 0.38. However, in a country with low FD (i.e. one standard deviation below the average), the average size firm has cash coefficient of 0.19, while the small firm has the coefficient of 0.58. Thus the size effect (the difference in coefficients of firms with different sizes) is about 35% larger for a country with low financial development, relative to a country with an average financial development.

Another way I address this question is by splitting the sample on high and low financial development subsamples (based on the median FD) and estimating cash and size coefficients (β_4 and β_6) from the model in (14) separately for each subsample. These results are presented in Table 7. For the high FD sample, neither cash nor cash interaction with size are significant, while for the low FD sample both are large and very significant. This shows that even in the sample of large publicly traded firms, the financing constraints are a significant issue for the countries with a low level of financial development, which not only have higher financing constraints on average, but have disproportionately larger constraints for the smaller firms.

6.2 Business Cycles

In this section I consider how the differences in the countries business cycles could affect my results on financing constraints. Recall from the discussion above that the main idea behind the financing constraints theory is that the information asymmetry between borrowers and lenders creates the agency costs, which manifest themselves in the wedge between internal and external financing costs. These costs decrease with an increase in the borrower's net worth because, for example, an increase in the personal stake decreases the incentives to misallocate the funds. Since the net worth is likely to be procyclical, the agency costs will decline in booms and rise in recessions. In other words, external financing is easier to obtain during good times (when profits are high and balance sheets are healthy).[22]

One potential concern with my result on the financial development effect is that the sensitivity of investment to internal funds could reflect different stages in the countries' business cycles, rather than the average level of financial development. That is, over the short period covered by my sample, it could happen that countries with low level of financial development happen to be in recessions on average.

To test this possibility, I include the interaction of the real GDP growth rate, grGDP_{ct}, a measure of the economic conditions in the country, with the firm-level measure of the internal funds, the cash stock. Since the effect of the economic growth is expected to manifest itself in the same time period as investment, i.e. growth at time t is expected to affect investment at time t, the interaction timing is $\text{Cash}_{it-1}\text{grGDP}_{ct}$, where as before the cash stock represents available liquid assets at the beginning of the period t (i.e. end of period $t-1$). If the economic boom periods (i.e. periods with high GDP growth) are associated with the lower level of financing constraints, this interaction is expected to be negative.

The results are presented in Table 8. The interaction of GDP growth with cash

[22]This intuition has been formalized and tested on US data by Bernanke and Gertler (1989), Gertler and Hubbard (1988), Kashyap, Lamont and Stein (1994) and Gertler and Gilchrist (1994), among others.

stock is indeed negative and significant at the 5% level in three out of 4 models (it is only marginally significant, at 17%, in model 3). This implies that favorable economic conditions do improve financing constraints, in line with previous evidence on US data. The effect of financial development on financing constraints is not significantly affected by the addition of the GDP growth interaction: the FD interaction remains significant at 1% in model 2 and at 2% in model 4. This robustness check confirms that the overall level of the country's financial development is a significant predictor of the firm's financing constraints, even after controlling for the business cycle effects.

6.3 Legal System Indicators

The distinguishing feature of the modern corporation is the large set of laws that create the environment in which it operates (Zingales, 2000). The firm's financing activity is largely based on the financial contracts or securities and the defining feature of these securities are the rights that they bring to their owners (Hart, 1995). The differences in these rights and their enforcement across the countries have been a focus of recent developments in the literature, pioneered by LLSV (1997, 1998). They argue that "the [legal] protection investors receive determines their readiness to finance firms," and show that the legal environment has large effects on the size and breadth of capital markets across countries. LLSV also point out that the legal systems of most countries could be categorized into several broad legal families, which come from the English, French, German, and Scandinavian origin. The countries inherited these legal traditions from their colonizers, and the consequent development of the legal system largely depends on this "origin." The apparent exogeneity of this legal origin to subsequent economic development has been used to reinforce the arguments about the causality from the financial development to economic growth (see Levine, 1999 and Beck et al., 1999).

It is easy to argue that better legal protection of investors should allow for more efficient contracts and their enforcement, which in turn should reduce the cost of external finance. The goal here is to test whether the legal variables are associated with decreasing sensitivity of investment to availability of internal funds. This will imply that better legal protection has the "real" consequences, i.e. allows for more efficient capital allocation by diminishing financing constraints. The previous research (LLSV and others) identified several legal system indicators such as the efficiency of the legal system, the rule of law, the risk of expropriation, corruption, and legal origin dummies (see Table 2 for variable definitions and original sources of this data). These indicators measure different aspects of the legal environment. For example, efficiency and the rule of law measure the quality of the law enforcement, i.e. how well the laws on the books are enforced by the courts. Corruption measures the distortions introduced by the courts and the government into the functioning of the financial and real sectors of the economy. The accounting standards measure the quality of information available to investors and should therefore reduce the external financing costs associated with information availability.

I use the baseline model in (10) and replace FD with each of the legal indicators. As shown in the Table 9, each indicator has a negative effect on the cash coefficient when included by itself (all models with odd numbers). The results for legal origin are also consistent with the previous evidence: French origin increases financing constraints (model 11) and English origin decreases the constraints (model 13). However, when any of these indicators are included together with FD, they become insignificant, while FD continues to be highly significant (all models with even numbers). Given these results, it appears that the index of financial development is a better summary measure of the differences in the cost of external finance than the individual legal indicators are. In other words, the legal system differences are already reflected in the level of financial development, and so the legal system affects the capital allocation only indirectly, through better functioning capital markets.

6.3.1 Legal Origin as Instrument for Financial Development

The causality of the financial development and growth correlation has been debated since the first empirical study of this relationship by King and Levine (1993). Sceptics of the finance-growth link have pointed out that the financial systems simply responds to the demands of the growing economies and therefore is endogenous to growth (Lucas, 1988). Others argued that the financial development could be a leading indicator of growth as financial markets anticipate the increased economic activity and develop in anticipation of this activity (Rajan and Zingales, 1998). The potential endogeneity of the financial development is a valid concern in the country-level or even in the industry-level study (as financial markets could respond to the anticipated growth of some individual industries). However, this endogeneity becomes less likely in the firm-level study and financial development could safely be considered exogenous to the growth of any given firm. Nevertheless, the test with legal origin as instrument for the financial development could provide a useful robustness check on the results and it is the goal in this section.

I use the baseline model (10) and include FD interaction with cash as a regressor. However, now I do not include FD interactions in the instruments list and replace them with legal origin dummies and their interactions with the firm level variables. Thus, only the component of financial development that is explained by the legal origin is allowed to influence the investment sensitivity. The results presented in the Table 10 are remarkably similar to the main results in the Table 5, with slight decrease in the significance of the cash coefficients, but the FD interaction continues to be significant at 1% level in all the regressions (except "rank 50," which was only significant at 10% before and now is significant at 5%).[23] The conclusion of this section is that the main result is unchanged with the use of legal origin as instrument for the financial development.

6.4 Single Country Regressions

This section describes an alternative way to address the relationship between financial development and financing constraints. Recall that with the cross-country

[23]It is also interesting to note that the Hansen test of overidentifying restrictions is not rejected at 1% level in the models that use legal origin as instrument for FD.

regressions the financing constraints are parametrized as a linear function of the index of financial development, FD, given by equation (6). An alternative approach is to allow each country to have different levels of financing constraints (measured by the coefficient on cash stock), given by $\Theta_{it} = a_{0i} + a_c Cash_{it-1}$. The country-specific cash coefficient, a_c, is obtained in the first stage regressions, where the Euler equation is estimated separately for each country using the model:

$$\frac{I}{K}_{it} = \beta_1 \frac{I}{K}_{it+1} + \beta_2 \frac{I}{K}_{it-1} + \beta_3 \frac{S}{K}_{it} + a_c Cash_{it-1} + d_t + f_i + e_{it}. \tag{15}$$

As before, f_i denotes fixed effects (see footnote 13), and d_t denotes time dummies. Then, I estimate the second-stage regression, in which the coefficients $\widehat{a}_c$ are regressed on the country-level index of financial development (FD) using the model:

$$\widehat{a}_c = b_0 + b_1 FD_c + e_c. \tag{16}$$

The main hypothesis now is that $b_1 < 0$, that is, the first stage estimates of the cash coefficients, $\widehat{a}_c$, are negatively related to the index of financial development, FD_c. The second stage regression in (16) is estimated by OLS.[24]

The single-country regressions are not as efficient as cross-country regressions because they require estimating 200 coefficients (5 per country for 40 countries) rather than estimating only 6. However, this approach has a few advantages: first, it is completely unrestricted in a sense that all the coefficients are allowed to vary across countries. Second, it allows one to estimate the average level of financing constraints for each country, while the cross-country regressions leave a "black box" feeling because only the slope, b_1, is estimated.

Table 11 reports the results of estimating (15) separately for each country. The

[24]Since the dependent variable is estimated in stage 1, for proper inference the generated regressors adjustment is required. However, due to the nature of this methodology, such an adjustment proves to be quite complicated and it is ignored in this version of the paper. Therefore, the errors reported in stage 2 are not asymptotically correct and are used as an approximation.

cash stock coefficients range from zero (25^{th} percentile) to 0.35 (75^{th} percentile), with a mean of 0.17 and a median of 0.11. These statistics are in line with the cash coefficients estimated in the cross-country regressions (which were varying from 0.10 to 0.17, Table 5). However, most of the cash coefficients are not significant at conventional levels, often due to the small sample size in the individual countries.[25] Despite the problem with low efficiency, the coefficients are consistent and present interesting patterns, analyzed below.

Using the model in (16), I regress the country-level cash coefficients on the FD index. This results in a coefficient of -0.18, significant at 1% level (the standard error is 0.05 and R squared is 0.35). The scatterplot of cash coefficients and financial development, with predicted values from the above regression (the straight line) are given in Figure 1. It shows that cash sensitivities exhibit a clear negative relationship with financial development. This confirms the result obtained in section 5, which found negative coefficients on the interaction of cash stock and FD.

There is one visible outlier on the plot, Korea (KR), and for a robustness check I ran the above regression without it, which results in a coefficient of -0.16, significant at 1% (the standard error is 0.04 and R squared is 0.37). It is also interesting to note that the effect of the financial development on the cash coefficient, given by the interaction term in cross-country regressions (which varied from 0.08 to 0.15, Table 5), is similar to the effect found here in the single country regressions (the slope of 0.16-0.18 in the second stage). This make the single-country regressions a useful robustness test, despite the problem of low efficiency of individual coefficients.

7 Conclusions

This paper shows that financing constraints, measured by the sensitivity of investment to the availability of internal funds, are significantly negatively related to

[25]This problem is exacerbated by the fact that less developed countries, that are expected to have larger coefficients, have a small number of observations, while more developed countries (which have more observations) are expected to have coefficients close to zero.

financial development. This negative effect remains after controlling for firm size and the country's business cycles, which also affect financing constraints. I also find that small firms are disproportionately more disadvantaged in less financially developed countries than are large firms. I also find that legal system indicators (the efficiency of the legal system, the risk of expropriation, corruption, or legal origin) are negatively related to investment sensitivity (the measure of financing constraints). However, they lose significance when financial development is added to the regressions. This implies that the legal system affects financing constraints indirectly, through better developed financial markets. The impact of FD on financing constraints is unchanged when legal origin is used as an instrument for financial development.

The paper makes contributions to two strands of literature. First, it contributes to the investment literature by estimating a structural investment model and confirming the presence of financing constraints for a broad range of countries. This paper extends the only existing cross-country study, in Bond et al. (1997), which studies investment in four developed countries. Second, and more important from a policy perspective, this paper contributes to the economic development and growth literature by showing that financial development diminishes financing constraints by reducing information asymmetries and contracting imperfections. The decrease in financing constraints allows firms to invest according to their growth opportunities and therefore improves capital allocation.

Appendix 1. Sample Selection

All countries in the Worldscope database (May 1999 Global Researcher CD) with at least 30 firms and at least 100 firm-year observations are included in the sample (the exception is Venezuela (VE) which is included with 80 observations only); former socialist economies are excluded. This results in a sample of 40 countries. The sample does not include firms for which primary industry is either financial (one digit SIC code of 6) or service (one digit SIC codes of 7 and above).

In addition I delete the following (see Table 2 for variable definitions):

- All firms with 3 or less years of coverage;
- All firm-years with missing CAPEX, PPENT, Sales, and cash;
- Observations with zero PPENT (200 obs);
- Observations with negative KBEG (277 obs), Cash/Ta or COGS (27 obs);
- Observations with IK > 2.5 (1% of all obs);
- Observations with SK > 20 (5% of all obs);[26]
- Observations with Cogs/K > 20 (80 obs.);
- Observations with Cash/Totass >0.6 (1% of all obs);
- 50% of all US firms with at least 4 years of data available was selected by random sample.[27]

The resulting dataset has about 59,500 observations, the number of observations by country is given in Table 1.

[26] This rules excludes firms for which capital is not a big factor in production. Half of these were in the US and UK; Japan, France and Denmark totaled 25%.

[27] The original sample for the US had over 25,700 observations (firm-years) while for all other countries at most there are 12,000 for the UK, 5,000 for Japan, less then 1,000 for most countreis (see Table 1). Even after the sampling, the US has the most data available.

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Table 1. Sample Coverage Across Countries

Country	Country code	Number of observations	Percent of total observations	Number of firms	Average number of years per firm
Argentina	AR	198	0.003	28	7.1
Austria	AT	454	0.008	55	8.3
Australia	AU	1571	0.026	197	8.0
Belgium	BE	561	0.009	71	7.9
Brazil	BR	687	0.012	94	7.3
Canada	CA	3382	0.057	391	8.6
Switzerland	CH	1043	0.017	132	7.9
Chile	CL	411	0.007	55	7.5
Colombia	CO	150	0.003	20	7.5
Germany	DE	3970	0.067	468	8.5
Denmark	DK	1045	0.018	126	8.3
Spain	ES	947	0.016	114	8.3
Finland	FI	747	0.013	84	8.9
France	FR	3274	0.055	402	8.1
United Kingdom	GB	9931	0.166	1129	8.8
Hong Kong	HK	969	0.016	142	6.8
Indonesia	ID	531	0.009	84	6.3
Ireland	IE	427	0.007	47	9.1
Israel	IL	152	0.003	29	5.2
India	IN	1507	0.025	269	5.6
Italy	IT	1149	0.019	132	8.7
Japan	JP	4646	0.078	624	7.4
South Korea	KR	1264	0.021	187	6.8
Mexico	MX	502	0.008	69	7.3
Malaysia	MY	1476	0.025	205	7.2
Netherlands	NL	1280	0.021	147	8.7
Norway	NO	680	0.011	84	8.1
New Zealand	NZ	315	0.005	43	7.3
Peru	PE	101	0.002	17	5.9
Philippines	PH	271	0.005	43	6.3
Pakistan	PK	418	0.007	72	5.8
Portugal	PT	254	0.004	42	6.0
Sweden	SE	1162	0.019	137	8.5
Singapore	SG	841	0.014	122	6.9
Thailand	TH	1045	0.018	177	5.9
Turkey	TR	145	0.002	23	6.3
Taiwan	TW	405	0.007	83	4.9
USA	US	10422	0.175	1247	8.4
Venezuela	VE	81	0.001	11	7.4
South Africa	ZA	1151	0.019	135	8.5
Total		59565		7537	
Average number of firms per country				188	
Average number of firms per country, excluding US and GB				136	
Median number of firms per country, excluding US and GB				114	

Table 2. Variable Definitions:

Abbreviation	Description
Firm Level variables (from Worldscope)	
PPENT	Property Plant and Equipment, net of depreciation
CAPEX	Capital expenditure
DA	Depreciation and Amortization expense
K	Beginning period capital = PPENT-CAPEX+DA
IK, I/K	Investment to Capital ratio = CAPEX / K
SK, S/K	Sales to Capital ratio = Sales / K
Cash	Cash plus equivalents scaled by Total Assets (or scaled by K for robustness checks)
CF	Cash Flow (Net income + DA), scaled by K
COGS	Cost of goods sold, scaled by K
Size	Log of total assets in US dollars
Rank	Ranking based on size of PPENT (first, ranked by year, then averaged over the years), largest firm in each country has rank equal to one (described in section 5.1).
Weight	Weight is a country-level variable equal to one over the number of valid observations per country (described in section 5.1).
Industry dummies	For manufacturing industries the dummies are on a two digit SIC level and for the rest of industries they are on a one digit level.
Country-Level variables	
STKMKT	Stock market development is Index1 from Demirguc-Kunt and Levine (1996), equals to the sum of (standardized indices of) market capitalization to GDP, total value traded to GDP, and turnover (total value traded to market capitalization).
FININT	Financial intermediary development is Findex1 from Demurguc-Kunt and Levine (1996), equals to the sum of (standardized indices of) ratio of liquid liabilities to GDP, and ratio of domestic credit to private sector to GDP.
FD	Financial Development = STKMKT+FININT.
Legal Origin	Country's legal origin categorized into 4 groups: English, French, German or Scandinavian, from LLSV (1998).
Efficiency, Rule of Law	Efficiency of legal system and Rule of Law are two measure of the quality of law enforcement, from LLSV (1998).
Expropriation	Risk of expropriation is the risk of outright confiscation or forced confiscation by the government, from LLSV (1998).
Corruption	The measure of corruption, from LLSV (1998).
GNP PC	Log of GNP per capita in US dollars in 1994, World Development Report 1996.
grGDP	Annual real growth rate of GDP, IFS

Table 3. Descriptive Statistics for Key Variables

Summary statistics by country for main variables. Variables definitions are given in Table 2. Outliers (far away Max or Min) are underlined.

	Cash		I/K		S/K		Financial Development		
Country	mean	median	mean	median	mean	median	FD	FININT	STKMKT
Argentina	0.08	0.04	0.19	0.13	1.6	1.2	-1.38	-0.79	-0.59
Austria	0.10	0.07	0.25	0.20	4.4	3.0	-0.27	-0.12	-0.15
Australia	0.08	0.05	0.26	0.18	3.3	2.3	0.42	0.23	0.19
Belgium	0.10	0.08	0.25	0.20	4.0	3.7	-0.82	-0.35	-0.47
Brazil	0.08	0.04	0.12	0.09	1.7	1.0	-1.04	-0.75	-0.29
Canada	0.07	0.02	0.23	0.18	3.1	1.5	0.03	-0.06	0.09
Switzerland	0.14	0.11	0.23	0.15	3.9	2.6	2.2	1.45	0.75
Chile	0.07	0.04	0.21	0.16	1.6	1.3	-0.75	-0.29	-0.46
Colombia	0.08	0.04	0.26	0.14	3.6	1.9	-1.6	-0.72	-0.88
Germany	0.08	0.05	0.31	0.25	5.5	4.8	1.68	0.3	1.38
Denmark	0.15	0.14	0.24	0.21	4.4	3.7	-0.49	-0.12	-0.37
Spain	0.06	0.04	0.14	0.09	2.8	1.8	-0.14	0.11	-0.25
Finland	0.09	0.08	0.38	0.21	5.0	3.2	-0.41	0.12	-0.53
France	0.12	0.09	0.27	0.21	6.5	6.0	0.1	0.31	-0.21
UK	0.09	0.06	0.22	0.17	4.6	4.0	1.68	0.45	1.23
Hong Kong	0.16	0.11	0.25	0.16	3.5	2.1			2.01
Indonesia	0.14	0.10	0.37	0.23	3.9	2.6	-1.17	-0.46	-0.71
Ireland	0.15	0.12	0.26	0.17	4.4	3.1		-0.45	
Israel	0.11	0.10	0.30	0.24	3.7	3.0	0.01	-0.07	0.08
India	0.04	0.03	0.27	0.19	3.5	2.6	-0.7	-0.44	-0.26
Italy	0.12	0.09	0.26	0.17	4.4	3.0	-0.64	-0.13	-0.51
Japan	0.19	0.17	0.22	0.19	4.1	3.3	3.3	1.31	2.02
South Korea	0.08	0.06	0.31	0.23	3.9	3.0	0.84	-0.21	1.05
Mexico	0.08	0.06	0.11	0.10	1.6	1.3	-0.85	-0.71	-0.14
Malaysia	0.08	0.05	0.23	0.16	2.7	1.8	1.19	0.29	0.9
Netherlands	0.10	0.05	0.24	0.20	5.1	3.8	0.66	0.34	0.32
Norway	0.14	0.12	0.33	0.22	3.6	2.1	-0.15	0.03	-0.18
New Zealand	0.04	0.02	0.17	0.13	3.3	2.8	-0.53	-0.2	-0.33
Peru	0.09	0.04	0.22	0.14	1.5	1.3			
Philippines	0.12	0.07	0.37	0.22	2.6	1.4	-1.15	-0.61	-0.54
Pakistan	0.11	0.04	0.26	0.19	4.8	2.5	-1.28	-0.46	-0.82
Portugal	0.06	0.03	0.22	0.13	3.3	2.0	-0.67	-0.06	-0.61
Sweden	0.12	0.08	0.31	0.19	4.7	3.8	-0.31	-0.21	-0.1
Singapore	0.19	0.15	0.28	0.22	3.6	2.5	1.6	0.56	1.04
Thailand	0.06	0.03	0.40	0.23	4.5	2.5	0.36	-0.02	0.38
Turkey	0.13	0.07	0.56	0.50	7.5	5.8	-1.2	-0.59	-0.61
Taiwan	0.13	0.09	0.20	0.14	2.5	1.8		0.64	
US	0.09	0.04	0.24	0.19	4.8	3.8	1.35	0.14	1.21
Venezuela	0.09	0.06	0.21	0.13	1.5	1.1	-1.26	-0.52	-0.74
South Africa	0.09	0.06	0.22	0.19	4.7	3.8	0.25	-0.23	0.48
Mean	0.10	0.07	0.26	0.19	3.74	2.73	-0.03	-0.06	0.09
Median	0.09	0.06	0.25	0.19	3.78	2.60	-0.29	-0.12	-0.18
Std	0.04	0.04	0.08	0.06	1.33	1.20	1.14	0.51	0.79

Table 4. Correlations

Correlations of country-level means and medians of the firm level variables and country's institutional characteristics. Variables definitions are in Table 2. *Panel A:* below the diagonal are Pearson correlation coefficients, with two outlier countries excluded: JP (Japan) and TR (Turkey). Above the diagonal are Spearman correlations (robust to outliers) with all observations included. Including outliers for Pearson correlations results in significant correlation for FD and Cash (due to JP which is an outlier on both of these) and nonsignificant correlation for SK and FD (due to TR, which has very high SK and low FD). *Panel B:* pearson correlations with all countries. (Excluding Japan makes correlaitons of GDP PC with FD and FININT significant at 6% and 2 % respectively; also correlation between FININT and Log GDP becomes insignificant.) P-values are in parenthesis; bold are significant at 5% or better, underlined are significant at 10%.

Panel A. Cross-Country Correlations of Firm Level Variables

	Country Means				Country Medians			
	FD	Cash	IK	SK	FD	Cash	IK	SK
FD		0.15	0.02	0.34		0.21	0.21	0.44
		(0.35)	(0.87)	**(0.04)**		(0.22)	(0.22)	**(0.006)**
Cash	0.21		0.32	0.36	0.21		0.36	0.32
	(0.23)		**(0.04)**	**(0.02)**	(0.22)		**(0.02)**	**(0.04)**
IK	0.09	0.27		0.55	0.29	0.35		0.59
	(0.59)	(0.099)		**(0.0002)**	(0.096)	**(0.03)**		**(0.0001)**
SK	0.41	0.24	0.49		0.45	0.23	0.56	
	(0.015)	(0.14)	**(0.002)**		**(0.008)**	(0.15)	**(0.0003)**	

Panel B. Correlations of Country-Level Institutional Characteristics

	FD	FININT	STKMKT	Efficiency	Corruption	Expropr.	Accounting	GNPPC
FININT	0.90							
	(0)							
STKMKT	0.95	0.73						
	(0)	**(0)**						
Efficiency	0.52	0.52	0.45					
	(0.001)	**(0.001)**	**(0.005)**					
Corruption	0.51	0.55	0.40	0.83				
	(0.001)	**(0.001)**	**(0.01)**	**(0)**				
Expropriation	0.57	0.64	0.39	0.72	0.83			
	(0.001)	**(0)**	**(0.02)**	**(0)**	**(0)**			
Accounting	0.34	0.28	0.34	0.31	0.41	0.36		
	(0.05)	(0.09)	**(0.04)**	(0.06)	**(0.01)**	**(0.03)**		
GNP PC	0.56	0.61	0.46	0.74	0.87	0.84	0.46	
	(0)	**(0.0)**	**(0.004)**	**(0)**	**(0)**	**(0)**	**(0.005)**	
GDP US	0.54	0.41	0.49	0.20	0.26	0.46	0.15	0.42
	(0)	**(0.01)**	**(0.002)**	(0.22)	(0.11)	**(0.003)**	(0.39)	**(0.01)**

Table 5. Main Results on Financial Development and Financing Constraints

The dependent variable is IK_t, the model is given in (10); variable definitions are in Table 2. The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS, interactions of FD with IK, SK and Cash, and industry dummies. The firms are ranked based on the size of PPENT (described in Section 5). In the weighted regression, weights are equal to a value of one divided by the number of observations per country. Structural parameters as functions of estimated coefficients are given in (11). They are identified using minimum distance estimator (see Section 5.1). The Hansen test is a test of overidentifying restrictions; reported are p-values (this test is not available for weighted regressions). Heteroskedasticity adjusted standard errors in parentheses; ***,**,* and [a] represent significance at 1%, 5%, 10% and 15% respectively.

Model:	1	2	3	4	5
	50 largest	100 largest	150 largest	200 largest	All, weighted
I/K_{t+1}	0.688	0.671	0.543	0.571	0.273
	(0.171) ***	(0.137) ***	(0.132) ***	(0.125) ***	(0.135) **
I/K_{t-1}	0.201	0.200	0.208	0.204	0.203
	(0.022) ***	(0.016) ***	(0.014) ***	(0.014) ***	(0.018) ***
S/K_t	0.011	0.018	0.020	0.020	0.042
	(0.011)	(0.007) ***	(0.007) ***	(0.006) ***	(0.009) ***
$Cash_{t-1}$	0.132	0.081	0.124	0.102	0.174
	(0.064) **	(0.051) [a]	(0.046) ***	(0.048) **	(0.062) ***
$Cash_{t-1}*FD_c$	-0.119	-0.136	-0.110	-0.082	-0.149
	(0.046) *	(0.039) ***	(0.035) ***	(0.034) **	(0.046) ***
Constant	0.000	0.000	-0.001	-0.001	-0.003
	(0.001)	(0.001)	(0.000)	(0.000)	(0.002) *
N obs	6488	10477	12474	13922	21278
N firms	1436	2335	2791	3111	4794
R^2	0.000	0.010	0.103	0.086	0.208
Root MSE	0.127	0.128	0.121	0.123	0.130
Hansen test	0.340	0.001	0.001	0.002	NA
Structural parameters:					
beta	0.935	0.908	0.708	0.750	0.331
	(0.288) ***	(0.227) ***	(0.201) ***	(0.193) ***	(0.173) *
g	0.240	0.238	0.238	0.235	0.215
	(0.034) ***	(0.024) ***	(0.020) ***	(0.019) ***	(0.022) ***
alfa	16.825	9.719	7.069	7.600	1.718
	(20.454)	(5.195) *	(3.978) *	(4.091) *	(1.135) [a]
a1	2.371	0.855	1.189	1.000	0.802
	(2.428)	(0.601) [a]	(0.589) **	(0.572) *	(0.341) **
a2	-2.129	-1.448	-1.052	-0.798	-0.685
	(2.139)	(0.666) *	(0.525) **	(0.458) *	(0.266) ***

Table 6. Size Effect

The dependent variable is IK_t; the models are described in section 6.1. The Size is equal to the (log of) total assets in US dollars in models 1-3 and "Small" dummy in model 4 (dummy is equal to one if total assets are less than the country's own median level of total assets). The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CF, COGS, size and size interactions with Cash, IK and SK, interactions of FD with IK, SK, Cash, and size, and industry dummies. All the regressions are weighted regressions, weights are equal to a value of one divided by the number of observations per country. Heteroskedasticity adjusted standard errors in parentheses; ***,**,* and [a] represent significance at 1%, 5%, 10% and 15% respectively.

Model:	1	2	3	4
I/K_{t+1}	0.484	0.310	0.295	0.348
	(0.121) ***	(0.137) **	(0.137) **	(0.129) ***
I/K_{t-1}	0.201	0.202	0.202	0.203
	(0.018) ***	(0.019) ***	(0.019) ***	(0.018) ***
S/K_t	0.035	0.039	0.040	0.036
	(0.009) ***	(0.009) ***	(0.009) ***	(0.009) ***
$Cash_{t-1}$	0.616	0.721	0.870	0.081
	(0.194) ***	(0.204) ***	(0.233) ***	(0.075)
$Cash_{t-1}*Size_{t-1}$	-0.095	-0.105	-0.134	0.200
	(0.032) ***	(0.034) ***	(0.040) ***	(0.110) *
$Cash_{t-1}*FD_c$		-0.146	-0.700	-0.048
		(0.047) ***	(0.201) ***	(0.060)
$Cash_{t-1}*Size_{t-1}*FD_c$			0.099	-0.206
			(0.032) ***	(0.095) **
Constant	-0.001	-0.002	-0.002	-0.002
	(0.001)	(0.002)	(0.002)	(0.002)
N obs	21777	21278	21278	21348
N firms	4934	4794	4794	4794
R^2	0.137	0.198	0.1998	0.1865
Root MSE	0.136	0.131	0.131	0.133

Table 7. Sample Splits

The dependent variable is IK_t; variable definitions are in Table 2. High FD and Low FD are samples split on the median FD (reported in Table 3). The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS and industry dummies. All the regressions are weighted regressions, weights are equal to a value of one divided by the number of observations per country. Heteroskedasticity adjusted standard errors in parentheses; ***,**,and * represent significance at 1%, 5% and 10% respectively.

	High FD		Low FD	
Model:	1	2	3	4
I/K_{t+1}	0.505	0.472	0.427	0.424
	(0.190) ***	(0.175) ***	(0.126) ***	(0.122) ***
I/K_{t-1}	0.209	0.211	0.198	0.198
	(0.018) ***	(0.018) ***	(0.030) ***	(0.029) ***
S/K_t	0.025	0.025	0.048	0.048
	(0.008) ***	(0.008) ***	(0.015) ***	(0.015) ***
$Cash_{t-1}$	0.014	0.197	0.262	1.124
	(0.051)	(0.180)	(0.104) ***	(0.364) ***
$Cash_{t-1}*Size_{t-1}$		-0.033		-0.165
		(0.030)		(0.061) ***
Constant	0.000	0.000	-0.003	-0.003
	(0.002)	(0.001)	(0.003)	(0.003)
N obs	18106	18106	3671	3671
N firms	3930	3930	1004	1004
R^2	0.131	0.147	0.171	0.169
Root MSE	0.128	0.127	0.141	0.142

Table 8. Business Cycles and Financing Constraints

The dependent variable is IK_t, the model is given in (10) with added interaction of cash stock with country-year real GDP growth rate; variable definitions are in Table 2. The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS, interactions of FD and GDP growth with IK, SK and Cash, and industry dummies. The firms are ranked based on the size of PPENT (described in Section 5). In the weighted regression, weights are equal to a value of one divided by the number of observations per country. Heteroskedasticity adjusted standard errors in parentheses; ***,**,* and [a] represent significance at 1%, 5%, 10% and 15% respectively.

	150 largest		All, weighted	
Model:	1	2	3	4
I/K_{t+1}	0.705	0.517	0.427	0.360
	(0.145) ***	(0.135) ***	(0.116) ***	(0.125) ***
I/K_{t-1}	0.198	0.202	0.193	0.194
	(0.014) ***	(0.014) ***	(0.018) ***	(0.018) ***
S/K_t	0.018	0.021	0.026	0.025
	(0.006) ***	(0.006) ***	(0.006) ***	(0.007) ***
$Cash_{t-1}$	0.117	0.186	0.203	0.232
	(0.043) ***	(0.048) ***	(0.062) ***	(0.068) ***
$Cash_{t-1}*grGDP_{ct}$	-1.720	-1.827	-1.578 [1]	-2.424
	(0.881) **	(0.870) **	(1.150)	(1.228) **
$Cash_{t-1}*FD_c$		-0.108		-0.117
		(0.037) ***		(0.049) **[2]
Constant	-0.001	-0.002	-0.002	-0.003
	(0.001)	(0.001) [a]	(0.001) *	(0.002) **
N obs	12923	12411	22061	21549
N firms	2935	2794	4973	4832
R^2	0.000	0.126	0.145	0.167
Root MSE	0.131	0.122	0.136	0.136

[1] is significant at 17%

[2] in model IV the FD interaction is significant at 2% and grGDP interaction is significant at 5%

Table 9. Legal System Indicators and Financing Constraints

The dependent variable is IK_t, the "baseline" model is given in (10) with FD interactions replaced or supplemented with each of the Indicator variable interactions (the rest of coefficients are not reported). Variable definitions are in Table 2. The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS, interactions of FD and appropriate Indicator with IK, SK and Cash, and industry dummies. All the regressions are weighted regressions, weights are equal to a value of one divided by the number of observations per country. Heteroskedasticity adjusted standard errors in parentheses; ***,**,*, [a] and [b] represent significance at 1%, 5%, 10%, 15% and 20% respectively.

Model:	Indicator:	$Cash_{t-1}$	$Cash_{t-1}$*$Indicator_c$	$Cash_{t-1}$*FD_c
1	Efficiency	0.587 ***	-0.052 **	
		0.234	0.027	
2	Efficiency	0.338 [b]	-0.021	-0.123 ***
		0.245	0.030	0.050
3	Rule of Law	0.633 ***	-0.060 **	
		0.245	0.027	
4	Rule of Law	0.455 *	-0.037 [b]	-0.111 ***
		0.240	0.028	0.045
5	Corruption	0.670 ***	-0.066 **	
		0.254	0.029	
6	Corruption	0.479 *	-0.041 [b]	-0.100 **
		0.260	0.031	0.045
7	Expropriation	1.208 ***	-0.119 **	
		0.480	0.051	
8	Expropriation	0.850 *	-0.078 [a]	-0.097 **
		0.495	0.054	0.045
9	Accounting	0.793 *	-0.010 [a]	
		0.437	0.006	
10	Accounting	0.364	-0.003	-0.118 ***
		0.448	0.006	0.042
11	French	0.089 [a]	0.191 *	
		0.060	0.114	
12	French	0.189 **	-0.044	-0.163 ***
		0.078	0.132	0.052
13	English	0.230 ***	-0.191 **	
		0.080	0.100	
14	English	0.177 ***	-0.037	-0.141 ***
		0.072	0.096	0.046

Table 10. Legal Origin as Instrument for Financial Development

The dependent variable is IK_t, the model is given in (10); variable definitions are in Table 2. The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS, interactions of Legal Origin dummies with IK, SK and Cash, (note that Legal Origin replaces FD in the intsrument set). The firms are ranked based on the size of PPENT (described in Section 5). In the weighted regression, weights are equal to a value of one divided by the number of observations per country. The Hansen test is a test of overidentifying restrictions, reported are p-values (this test is not available for weighted regressions). Heteroskedasticity adjusted standard errors in parentheses; ***,**,* and [a] represent significance at 1%, 5%, 10% and 15% respectively.

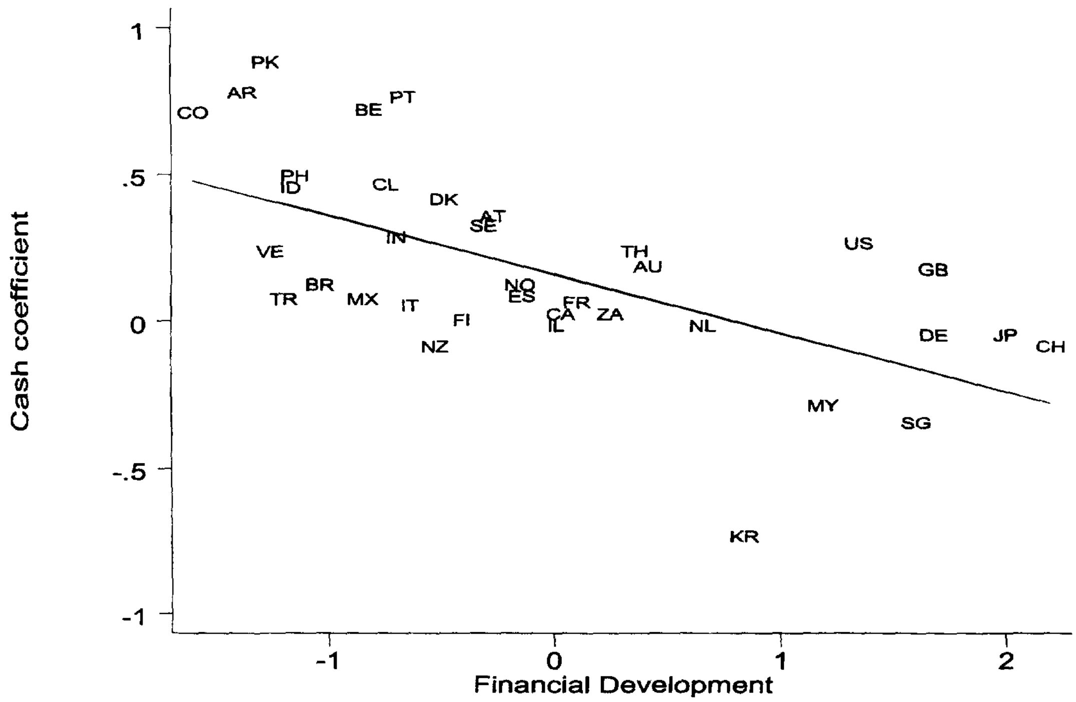
Model:	1	2	3	4	5
	50 largest	100 largest	150 largest	200 largest	All, weighted
I/K_{t+1}	0.627	0.692	0.665	0.670	0.473
	(0.109) ***	(0.095) ***	(0.090) ***	(0.084) ***	(0.100) ***
I/K_{t-1}	0.207	0.205	0.209	0.204	0.202
	(0.020) ***	(0.016) ***	(0.014) ***	(0.014) ***	(0.019) ***
S/K_t	0.016	0.017	0.015	0.016	0.029
	(0.008) ***	(0.006) ***	(0.006) ***	(0.005) ***	(0.007) ***
$Cash_{t-1}$	0.118	0.078	0.109	0.093	0.144
	(0.058) **	(0.049) [a]	(0.048) **	(0.049) *	(0.059) **
$Cash_{t-1}*FD_c$	-0.108	-0.133	-0.118	-0.099	-0.148
	(0.051) **	(0.043) ***	(0.041) ***	(0.039) ***	(0.058) ***
Constant	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
N obs	6499	10502	12498	13961	21348
N firms	1433	2332	2788	3108	4794
R^2	0.042	0.004	0.026	0.020	0.133
Root MSE	0.124	0.129	0.127	0.129	0.137
Hansen test	0.197	0.019	0.029	0.036	N/A

Table 11. Single Country Regressions

The dependent variable is IKt; the model is given in (15), Section 7.1; variable definitions are in Table 2. The estimation is by GMM (IV), country-time and fixed effects are removed prior to estimation (see Section 3.1). Instruments are first and second lags of IK, SK, Cash, CFK, COGS, and industry dummies. Constants are included, but not reported since they are very close to zero and never significant. Heteroskedasticity adjusted standard errors in parentheses; ***, **, * and [a] represent significance at 1%, 5%, 10% and 15% respectively.

	I/K_{t+1}		I/K_{t-1}		S/K_t		$Cash_{t-1}$		Number
Code	Coeff.	St.error	Coeff.	St.error	Coeff.	St.error	Coeff.	St.error	of obs.
AR	0.96	0.318 ***	0.21	0.096 **	-0.097	0.057 *	0.77	0.600	69
AT	0.40	0.467	0.17	0.051 ***	-0.004	0.018	0.34	0.230 [a]	199
AU	0.80	0.321 ***	0.26	0.042 ***	-0.001	0.009	0.17	0.131	654
BE	0.26	0.178 [a]	0.14	0.097 [a]	0.087	0.032 ***	0.71	0.336 **	215
BR	0.46	0.120 ***	0.36	0.076 ***	0.003	0.007	0.11	0.055 **	206
CA	0.62	0.130 ***	0.28	0.044 ***	0.033	0.011 ***	0.01	0.102	1500
CH	0.41	0.304 [a]	0.22	0.083 ***	0.047	0.018 ***	-0.10	0.113	438
CL	0.51	0.211 ***	0.37	0.184 **	0.033	0.048	0.45	0.411	162
CO	0.33	0.089 ***	0.00	0.116	0.030	0.025	0.70	0.612	35
DE	0.97	0.107 ***	0.18	0.036 ***	0.000	0.006	-0.06	0.099	1825
DK	0.23	0.209	0.18	0.039 ***	0.028	0.016 *	0.40	0.195 **	462
ES	0.78	0.100 ***	0.25	0.061 ***	-0.002	0.016	0.07	0.185	386
FI	0.76	0.243 ***	0.23	0.049 ***	0.021	0.015 [a]	-0.01	0.349	297
FR	0.63	0.125 ***	0.16	0.037 ***	0.012	0.008 [a]	0.05	0.121	1358
GB	0.58	0.157 ***	0.15	0.024 ***	0.022	0.006 ***	0.16	0.062 ***	4084
HK	0.56	0.316 *	0.18	0.081 **	0.053	0.027 **	0.25	0.162 *	245
ID	0.12	0.295	-0.06	0.078	0.040	0.042	0.44	0.282 *	149
IE	0.72	0.136 ***	0.20	0.062 ***	0.014	0.014	0.08	0.258	167
IL	0.37	0.143 ***	0.09	0.077	0.054	0.047	-0.03	0.477	32
IN	0.46	0.145 ***	0.08	0.067	0.035	0.016 **	0.27	0.653	315
IT	0.63	0.177 ***	0.25	0.056 ***	0.029	0.018 *	0.04	0.106	521
JP	0.83	0.143 ***	0.28	0.040 ***	0.005	0.009	-0.06	0.086	1263
KR	0.39	0.205 **	0.27	0.089 ***	0.027	0.018 *	-0.75	0.558	136
MX	0.76	0.137 ***	0.14	0.056 ***	0.033	0.020 *	0.06	0.236	187
MY	0.86	0.284 ***	0.19	0.072 ***	0.028	0.020 [a]	-0.30	0.233	450
NL	0.50	0.119 ***	0.29	0.066 ***	0.017	0.009 *	-0.03	0.152	589
NO	0.65	0.114 ***	0.24	0.094 ***	-0.003	0.009	0.11	0.227	262
NZ	0.32	0.255	0.15	0.095 *	0.021	0.026	-0.10	0.226	117
PE	0.49	0.128 ***	0.49	0.108 ***	0.071	0.043 *	-0.05	0.414	25
PH	0.60	0.271 **	0.39	0.087 ***	0.040	0.032	0.48	0.428	65
PK	0.34	0.268	0.23	0.086 ***	0.020	0.025	0.87	0.928	103
PT	-0.15	0.180	0.05	0.072	0.062	0.041 [a]	0.75	0.367 **	48
SE	0.81	0.152 ***	0.23	0.058 ***	0.024	0.013 *	0.31	0.162 *	473
SG	0.90	0.214 ***	0.18	0.079 **	0.018	0.012 [a]	-0.36	0.324	229
TH	0.18	0.184	0.14	0.085 *	0.013	0.014	0.22	0.229	236
TR	0.19	0.141	0.40	0.224 *	0.045	0.015 ***	0.06	0.597	17
TW	0.60	0.255 ***	0.05	0.181	0.100	0.045 **	0.39	0.535	69
US	0.55	0.114 ***	0.28	0.036 ***	0.030	0.007 ***	0.25	0.069 ***	3942
VE	0.34	0.189 *	0.60	0.099 ***	0.081	0.021 ***	0.22	0.537	22
ZA	0.48	0.123 ***	0.26	0.065 ***	0.007	0.005	0.01	0.104	516
Mean	0.53	0.19	0.22	0.08	0.027	0.02	0.17	0.30	552
Quartiles:									
25%	0.36	0.13	0.15	0.05	0.013	0.01	-0.01	0.13	114
50%	0.53	0.18	0.21	0.07	0.027	0.02	0.11	0.23	233
75%	0.73	0.25	0.27	0.09	0.040	0.03	0.35	0.42	484

Figure 1. Cash Coefficients and Financial Development



Regression line: -0.18, significant at 1% (the standard error is 0.05 and R squared is 0.35)
Without KR: -0.16, significant at 1% (the standard error is 0.04 and R squared is 0.37)

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