Which Institutions Reduce Financial Frictions and Facilitate Investment?

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Abstract

Using a model-based structural estimation first time in the literature, we investigate which cross-country institutional differences affect financial frictions when firms make investment decisions, and how. We develop a novel estimation procedure as well: To overcome flaws in common investment-cash flow regressions, we use a standard investment model but with explicit financial frictions and impose structural restrictions when measuring the impact of institutions. Our method is also shown to be better suited to use in the empirical investment literature than the methods developed so far (e.g., Erickson and Whited, 2000). We consider two channels: (i) lower financial transaction costs at the individual firm (micro) level; and (ii) a lower required rate of return at the country (macro) level. Using a panel of 75,000 firm-years from 48 countries in the period 1990-2007, we find that corporate governance (shareholder rights) matters more in reducing frictions than the other institutions such as

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creditor rights, rule of law, and product market competition. Moreover, we find that the effect is primarily through less financial discrimination for firms with large financing needs, implying more efficient capital allocation. This result also suggests that important underlying frictions are something more than often-assumed collateral constraints, which should be eased by stronger creditor rights.

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I. INTRODUCTION

Financial frictions have long been identified as key factors driving both short-run economic fluctuations and long-run growth. Many theoretical models imply that, by reducing financial frictions, a country can lower its macroeconomic volatility and enhance its growth potential. Within this context, the natural empirical and policy questions that arise are: which financial frictions matter and which institutional reforms can be expected to reduce them most effectively?

We develop a novel approach for measuring the relationship between institutions and financial frictions and, in turn, the impact of institutions on investment. This approach is specifically designed to overcome the deficiencies of the standard investment-cash flow regression framework. Using a large panel data of listed firms – about 75,000 firm-year observations, from 48 major advanced and emerging market economies over the period 1990-2007 – and applying GMM-like regressions, we find that corporate governance (shareholder rights) matters more in reducing frictions than the other institutions such as creditor rights, rule of law, and product market competition. Moreover, we find that the effect is primarily through less financial discrimination for firms with large financing needs, implying more efficient capital allocation. This result also suggests that important underlying frictions are something more than often-assumed collateral constraints, which should be eased by stronger creditor rights.

Our analytical framework essentially adds structural restrictions to a standard investment model. We start from Tobin's original insight (Tobin, 1969): firms with high market to replacement value of capital (i.e., high Q firms) should add more capital since for them the value of new capital goods exceeds its cost; and low Q firms should shed off capital. With no uncertainty, investment (or disinvestment) brings Q back to its equilibrium level in every period. With shocks to profits, the realized equilibrium value of Q will vary around its expected value. Therefore, the average movements should be predictable given current Q and profits.

We expand this framework and the subsequent investment model of Abel and Eberly (1994) by adding financial frictions in a way similar to Gomes (2001) and Hennessy, Levy, and Whited (2007). Specifically, we assume that institutions affect financial frictions. We then derive a theoretical relation between institutions and the movements in firm-specific Q.

Our model incorporates two channels through which financial frictions operate. The first is firm-specific cost associated with financial transactions, which we allow to vary with firm characteristics (e.g., industry and firm size). Better institutions in a country are hypothesized to reduce these costs and therefore lower the sensitivity of investment to a firm's current cash flow. This, in turn, translates into a smaller movement of Q towards its next-period expected value for any given profitability shock.

The second channel relates to the firm-specific rate of return required by investors, which is the sum of the overall (country-specific) cost of capital plus a firm-specific risk premium. When the current Q is high, it is expected to decline over the next period, which amounts to a capital loss for investors. Because the sum of the capital loss plus current profits (both properly scaled) equals the required rate of return, Q will decline more towards its next-period expected value in countries with lower required rates of return, hypothesized to be brought about by better institutions. Since this effect is opposite from that of the financial transaction cost channel, the overall relation between institutions and adjustments in Q

becomes ambiguous. To the best of our knowledge, this ambiguity has not been identified in the literature so far.

Equipped with this model, we develop a new methodology to estimate the effects of these two frictions. Specifically, differences at the firm level for every year in our sample between predicted and realized values of Q – one-period ahead forecast errors – are used to estimate the structural parameters linking institutions to each type of friction. We show that a simple regression produces an unbiased and consistent estimator. This addresses the identification problems traditionally associated with investment cash-flow regressions.

Using a very large firm-level data set and exploiting the variation in institutional differences across countries, we identify which institutions most importantly drive financial frictions. In this regard, our study is also novel: the existing empirical investment literature with structural models has so far only used firm-level data from a single country (mostly the U.S. and a few other advanced countries) with well-developed institutions.

We find that good corporate governance (shareholder rights) lowers the required rate of return for all firms. We also find that it increases firm-level transaction costs but not much for those firms with large financing needs. These firms pay higher costs than the average and this *large financing premium* is found to be lower in a country with good corporate governance. Together with effects on the required rate of return, good corporate governance brings beneficial effects for almost all firms and in particular for firms with large financing needs.

Better general enforcement of financial contracts (e.g., adherence to the rule of law and well-established property rights) is also found to reduce the *large financing premium* only. This implies that firms with small financing needs appear worse off. This is, however, consistent with more efficient capital allocation among firms given the same supply of capital. Stronger creditor rights do not robustly affect either the financial transaction costs or the required rates of return. Neither do product market competition and financial market depth.

We then show that our methodology is robust to measurement and specification errors. This is important in the literature because *Q* is often considered a "noisy" measure of firm value, for example, due to inefficient stock markets, limited arbitrage in stock prices, or poor accounting information. Measuring institutional differences can also be challenging. In addition, any structural model may be subject to specification errors. We develop a test to identify the size of measurement and specification errors and show that these errors are negligible compared to the one-period-ahead forecast errors. We nevertheless conduct a battery of robustness tests and we find that our results hold.

Through these robustness checks, our approach turns out better suited to estimate the structural investment model with financial frictions than the estimation method developed by Erickson and Whited (2000), which is essentially based on minimization on measurement errors. However, as discussed, measurement errors are shown to be relatively minor if we conduct estimation through minimization on one-period-ahead forecast errors. Moreover, their method does not work well in the presence of fixed effects and heteroskedasticity as pointed out by Almeida, Campello, and Galvao (2010). Obviously, we cannot rule out fixed effects in cross-country panel with firms belongs many different industries.

Our work provides important microeconomic evidence regarding key assumptions often used in models of macro-finance fluctuations, including those trying to explain the recent financial crisis. In this literature, frictions are often used to explain endogenous fluctuations in investment, which in turn create or amplify macroeconomic cycles. Kiyotaki and Moore (1997), assuming a simple collateral constraint, explain that drops (increases) in asset values lead to tighter (more relaxed) credit conditions. Bernanke and Gertler (1989) show how costly-state-verification (in the spirit of Townsend, 1979), an informational friction, amplifies productivity shocks by affecting investment.[1] Motivated by the recent crisis, the theoretical literature has further expanded. Gertler and Kiyotaki (2010) model show how misconduct by bank managers can create principal-agent problems, which, in turn alter firm investment and generate economic cycles. Empirical work has explicitly investigated the validity of these assumptions, albeit largely using aggregate data (e.g., Chari, Kehoe, and McGrattan, 2006; Christiano, Motto, and Rostagno. 2010). We contribute this literature by providing firm-level evidence and by comparing the effects of various frictions.

Our work strongly relates to the large literature on the importance of institutions for economic and financial development. Many studies have documented that institutions, especially those related to financial intermediation, help explain economy-wide development and productivity (see reviews by Morck, Wolfenzon, and Yeung, 2005; Demirguc-Kunt and Levine, 2001; Levine, 2005; and La Porta, Lopez-de-Silanes, and Shleifer, 2008). This line of research typically does reduced-form regressions of a country's growth or level of development on financial and institutional measures (e.g., Beck, Levine, and Loayza, 2000; De Nicolo, Laeven, and Ueda, 2008). There are also industry-level regression studies such as Rajan and Zingales (1998) and many subsequent papers, showing that industries which are

[1] There is a parallel literature on finance and growth. Greenwood and Jovanovic (1990) study the growth implications of costly-state-verification, Banerjee and Newman (1993) look at development with collateral constraints, and Acemoglu and Zilibotti (1997) relate development to incomplete financial markets.

more dependent on external finance tend to grow faster in countries with more developed financial and accounting systems.[2] Innovation that our study brings in this literature is to test an explicit structural causal link between institutions and investment.

The rest of the paper is organized as follows. Section II introduces the model; Section III explains the estimation strategy and empirical approach; Section IV describes the data set; Section V presents the main estimation results; Section VI examines measurement errors. Section VII provides the related literature while section VIII concludes.

II. Theoretical Model

A. Model Setup

We derive a theory-based law-of-motion for Q which incorporates the effect of institutions on capital adjustment. We do so by adapting the well-known investment models of Hayashi (1982), Abel and Blanchard (1986), and Abel and Eberly (1994), and introducing financial frictions, thus generalizing the models of Gomes (2001) and Hennessy, Levy, and Whited (2007).

In each period, the timing structure is as follows. Based on the existing capital stock of the previous period, K^{-}, and the productivity shock ε revealed at the beginning of the current period, investment I is determined, real adjustment costs and financial transaction costs are paid, and the new capital stock K is formed immediately. Using the new capital

[2] For example, Wurgler (2000), using a measure of industry-specific investment opportunities derived from growth in value added, shows that financially more developed countries allocate more capital to growing industries and less to declining sectors.

stock, K, goods are produced with productivity ε. This timing structure is consistent with the continuous time model of Abel and Eberly (1994) as well as with discrete time models that have short lags between investment expenditure and the productive use of new machines.[3]

Profits are denoted by $\pi(K_t, \varepsilon_t)$. Following Hayashi (1982), we model the labor decisions of the firm in a simple manner by assuming that the labor market is competitive with a constant-returns-to-scale production function, f, and a competitive wage o such that: $\pi(K_t, \varepsilon_t) = (1+\varepsilon_t) f(K_t, L_t) - o_t L_t$, with the usual marginal condition: $o_t = (1+\varepsilon_t) f_{Lt}$. Similarly, we assume the product market to be competitive. Shocks, ε, to productivity (or rents) are assumed to have a mean of zero and to be serially correlated with a probability distribution function $P(\varepsilon^{+}|\varepsilon)$, so that a firm which receives a "good" shock in the current period is likely to have higher profits in the next period as well.[4]

The firm's capital stock depreciates at a rate of δ, but increases with investment, I:

$$K_t = (1-\delta)K_{t-1} + I_t. \qquad (1)$$

[3] In this formulation, there is no "time-to-build," meaning that firm managers make their investment decisions after the revelation of productivity shocks. This affects both the theoretical dynamics and the interpretations of the estimated coefficients. In particular, both current and next period's Q matter for investment. This contrasts with Barnett and Sakellaris (1999), which is a special case of the "time-to-build" model, where there is no equilibrium relationship between current and future values of Q. However, our empirical results are robust to different timing assumptions (see Section VI).

[4] This feature is similar to the imperfectly competitive market studied by Abel and Eberly (2008), who show that profits (or cash flows) measure rents or "growth opportunities" in some future periods. This situation happens if, for example, a firm creates a very competitive product (e.g., Apple iPhone).

Investment involves real net adjustment costs, $\hat{\phi}(I_t, K_t; X_t, W, \varepsilon_t)$. The net adjustment costs are lost right after the investment is made due to, for example, costly learning associated with the introduction of new machines. By assumption, these adjustment costs do not enter the law of motion of capital (1). In this specification of $\hat{\phi}$, *X* denotes fundamental characteristics, which can be time-varying but are assumed to be non-stochastic and predictable (e.g., the industry and age of the firm), *W* denotes "institutional quality," which agents assume to be time-invariant and exogenous, in line with the fact that institutional quality is known to be stable over time.

Given the law of motion for capital (1), the *gross* adjustment costs of investment can be expressed solely as a function of capital in the current and previous periods. Note that the *gross* adjustment costs ϕ consist of the net adjustment costs, depreciation, and investment:

$$\begin{aligned} \phi(I\left(K_{t-1}, K_t\right), K_t; X_t, W, \varepsilon_t) &= \hat{\phi}(K_t - (1-\delta)K_{t-1}, K_t; X_t, W, \varepsilon_t) + \delta K + I_t, \text{ if } I_t > 0; \\ &= \delta K_t, \text{ otherwise.} \end{aligned} \tag{2}$$

Following Gomes (2001), we introduce a convex cost function for external finance although our cost function is more general than his. Within-period "working capital" finance (using credit lines or trade credit) is assumed to involve no financial transaction costs. Over-the-period external finance *B* is, however, costly to obtain. Financial transaction costs are denoted by $\hat{\lambda}(B_t, K_t; X_t, W, \varepsilon_t)$ for positive external finance. Overall financial transaction costs λ can also be expressed as a function of the capital stock in the current and previous periods:

$$\begin{aligned} \lambda(B\left(K_{t-1}, K_t, \varepsilon_t\right), K_t; X_t, W, \varepsilon_t) &= \hat{\lambda}(K_t - (1-\delta)K_{t-1} - \pi(K_t, \varepsilon_t), K_t; X_t, W, \varepsilon_t), \text{ if } B_t > 0; \\ &= 0, \text{ otherwise.} \end{aligned} \tag{3}$$

We assume that firm management maximizes the value of capital for all claim holders, that is, both shareholders and creditors. This is in line with most of the investment literature, which does not distinguish between various sources of financing.[5] Consistently, the definition of profit, π, includes the returns to both creditors (interest payments) and shareholders (dividends and retained earnings), as defined in standard microeconomic theory. In the empirical analysis, we add interest payment and depreciation to net income (i.e., "profit" in accounting terms). More detailed explanation on definitions of variables will be given in Section IV.

We distinguish between two types of costs. One is the gross adjustment cost of investment, ϕ, which arises from purely technological issues, not from financing activities. The other is the financial transaction costs. This assumption is consistent with many investment models without financial frictions, as well as with the Gomes (2001) model with financial frictions. It differs, however, from Hennessy, Levy and Whited (2007) who regard the cost of increasing capital K (ϕ in our case) as the adjustment cost of equity finance and who assume a separate cost function for debt finance (corresponding to λ in our case). In contrast, our framework distinguishes between real and financial transactions costs but not between debt and equity. Note that our sample firms are listed. Obviously, it chooses the least costly way of financing, either debt or equity. Even if it can no longer raise debt, a firm can still issue equity in principle, albeit perhaps at very high costs.

Relatedly, we do not distinguish between asset types. We assume that all assets—tangible, intangible, and cash and equivalents—can generate profits and are subject to

[5] Also, in some countries, shareholder value maximization is not always pursued (Allen and Gale, 2000).

financial frictions. In our framework, frictions associated with non fixed capital assets, such as cash also affect the cost of external finance. For example, if outside investors fear the misuse of internal cash, then the cost of external finance would be higher.[6]

Both the real adjustment costs and the financial transaction costs are incurred at the firm level, that is, are *internal* to the firm. In addition, there is also an *external* or a general-equilibrium effect of frictions (Mussa, 1977). We model this effect through the certainty equivalent of the required rate of return, *r*. This rate is affected by macroeconomic factors, θ_t, such as the (international) risk free rate, the inflation rate, and macroeconomic volatility.

The required rate of return may also vary with firm characteristics, *X*. For example, it can differ across industries due to the return covariance structure or across vintages of capital. We therefore include industry dummies and individual firm age in the vector of firm characteristics, *X*.

The required rate of return may also vary across countries because of the quality of the institutional environment, *W*, reflecting, for example, weak bankruptcy procedures or the possibility of nationalization. Indeed, the main hypotheses we test below is that a good institutional environment is associated with a lower required rate of return.

Overall, we can write the required rate of return as a function of three groups of variables, $r(\theta_t, X, W)$. In equilibrium, given the current-period value of the firm, the

[6] In order to examine the cost specifically associated with cash holding itself, a more narrowly-focused study would be necessary, for example, from the viewpoint of optimal liquidity (e.g., Greenwood, 2005, and Bolton, Chen, and Wang, 2009) or from the viewpoint of corporate governance (e.g., Dittmar, Mahrt-Smith, and Servaes, 2003, and Almeida, Campello, and Weisbach, 2010). For our purpose, a narrower focus would only make empirical implementation more complex.

required rate of return is equal to this period's expected profits minus investment adjustment and financial transaction costs, plus the next-period expected value of capital:

$$\begin{aligned}\left(1+r\left(\theta,X,W\right)\right)V(K^{-};X,W,\epsilon)=\max_{K}\pi(K,\epsilon)-\phi(I(K^{-},K),K;X,W,\epsilon)\\ -\lambda(B(K^{-},K),K;X,W,\epsilon)+E\left[V(K;X,W,\epsilon^{+})\,|\,\epsilon\right].\end{aligned} \tag{4}$$

Here, we omit time subscripts but add the minus-sign, $^{-}$, to denote one-period past values and the plus-sign, $^{+}$, to denote one-period ahead values. Note that both the real adjustment costs of investment (2) and the financial transaction costs (3) can be expressed as functions of the current and previous periods' capital stocks only. Also, the value function (4) has only two state variables, capital *K* and auto-correlated shock ε, in addition to the predetermined firm characteristics *X* and the time invariant country characteristics *W*. The expectation in the last term is taken over the next-period productivity shocks ε^{+}, given the current-period shock ε.

B. **Marginal Conditions and Equilibrium Law of Motion of Tobin's *Q***

The optimality condition for (4) can be easily derived. Assuming positive investment and external finance, the first-order condition is:

$$\phi_1+\lambda_1=\pi_1+\lambda_1\pi_1-\phi_2-\lambda_2+E\left[V_1\,|\,\epsilon\right],$$

where the terms λ_1 and λ_2 denote the partial derivatives of the financial transaction cost with respect to the first argument (external finance *B*) and the second argument (capital *K*), respectively, and ϕ_2 term denotes the partial derivative of the investment adjustment cost with respect to the second argument (capital *K*). The envelope condition is:

$$(1+r)V_1^{-}=(1-\delta)(\phi_1+\lambda_1).$$

By combining the two conditions, we obtain the Euler equation:

$$\frac{1+r}{1-\delta}V_1^- = (1+\lambda_1)\pi_1 - \phi_2 - \lambda_2 + E\left[V_1 \mid \epsilon\right].$$

The marginal Q is defined as the derivative of firm value with respect to capital,

$$Q\left(K;X,W,\varepsilon^+ \mid \varepsilon\right) \equiv E\left[V_1\left(K;X,W,\varepsilon^+ \mid \varepsilon\right)\right].$$

Using the approximation, $1+r+\delta \approx \frac{1+r}{1-\delta}$, we can simplify the Euler equation to:

$$(r+\delta)Q^- = E\left[Q - Q^- \mid \epsilon\right] + (1+\lambda_1)\pi_1 - \phi_2 - \lambda_2 \,. \qquad (5)$$

This equation describes the equilibrium law-of-motion of Q and is almost exactly the same as the one derived by Abel and Eberly (1994). The left-hand-side is the required rate of return on the beginning-of-period marginal value of capital. The right-hand-side is the sum of expected marginal capital gains and profits, net of the marginal costs associated with investment and external finance. By rearranging (5), we can obtain a formula for our empirical tests:

$$E\left[Q \mid \epsilon\right] = (1+r+\delta)Q^- - (1+\lambda_1)\pi_1 + \phi_2 + \lambda_2 \,. \qquad (6)$$

Recall that the financial transaction costs are paid only when external finance is actually used. When external finance is non-positive, the marginal financial transaction costs, the terms λ_1 and λ_2, vanish from Equation (6). Similarly, when investment is non-positive, investment adjustment costs are zero and the ϕ_2 term drops from (6).[7]

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[7] This assumption is in line with much of the literature, although we omit the potentially important effect of costly disinvestment (Abel and Eberly, 1994; Abel, Dixit, Eberly, and Pindyck, 1996). One reason to make our assumption is that information on fixed-asset sales is not widely available for our cross-country panel data set, in contrast with the U.S., the country typically studied in the literature.

C. **Average versus Marginal *Q***

Our predictions apply to the marginal *Q*, the derivative of firm value with respect to capital. The marginal *Q* can differ from the average *Q*, the ratio of firm value to assets. As in most of the literature, we follow Hayashi (1982) and make assumptions such that the marginal value of *Q* equals the average value of *Q*. Specifically, we assume that the adjustment costs of investment function is linearly homogeneous of degree one in investment and capital. Similarly the financial transaction cost function, λ, is assumed to be linearly homogeneous of degree one in external finance and capital. Under such assumptions, Hayashi's result still holds and marginal *Q* equals average *Q*.[8]

Because of constant returns to scale, firm size should not matter much in this model. Yet, Equation (6) also allows for a sort of size effect, λ_2 (i.e., the derivative of financial transaction costs with respect to capital), as a part of financial transaction costs. Technically, the constant returns to scale always prevails but firms may still need larger financing than the average after drawing a large bad shock or starting with smaller initial capital than the steady state balanced path. We discuss this later more in detail but we expect that firms in need of

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[8] The proof is a special case of the value function based on a system of homogeneous-of-degree-one functions, studied in Alvarez and Stokey (1998). The proof is omitted but the following is a sketch. Given a competitive wage and product price (normalized to one), labor immediately adjusts to its optimal level. Because the production function exhibits constant returns to scale in capital and labor, profits become linear in capital given the wage and product prices. Because adjustment costs are homogeneous of degree one in investment and capital and financial frictions are also homogeneous of degree one in external finance and capital, the optimal amounts of investment and external finance become linearly proportional to capital. The value of the firm becomes therefore linearly proportional to capital as well. Therefore, marginal *Q* equals average *Q*.

large financing relative to their capital stock to pay higher fees and that this *large-financing premium* should be lower in countries with good institutions.

D. Relation to the Speed of Adjustment of Tobin's *Q*

In a world without real and financial frictions, *Q* should quickly converge to one. In our case, *Q* fluctuates with the realization of the productivity shock *ε* around the (conditional) expected value *E[Q|ε]*. The "convergence speed" to the firm-specific expected value depends on the institutional environment, given the current capital stock and the past-period's productivity shock. The relationship between the adjustment speed and the institutional environment is ambiguous, however. To see this, we rewrite Equation (5) as:

$$\frac{Q^{-}-E\left[Q\mid\varepsilon\right]}{Q^{-}}=\frac{(1+\lambda_1)\pi_1-(\phi_2+\lambda_2)}{Q^{-}}-(r+\delta)\,. \qquad (9)$$

Equation (9) shows that the distance of the current-period *Q* to the average of the next-period *Q* depends on key parameters. In particular, "speed of adjustment" of *Q* to its conditional expected value is a function of the required rate of return, *r*, and the marginal financial transaction costs, λ_1. However, these effects have opposite signs. If better institutions are associated with both a lower required rate of return and lower financial transaction costs, then the effect of institutions on the adjustment of *Q* to its next-period expected value is ambiguous.

To see this, imagine starting from a current-period *Q* greater than its next-period expected value and consider the role of better institutions. The left hand side of (9) measures the decline of *Q*. Provided that better institutions ensure more efficient management and less misuse of funds, the required rate of return would be lower in a country with better institutions. In such a country, Q has to decline more on average, *ceteris paribus*. However, if better institutions also reduce the marginal financial transaction costs, λ_1, then Q would decline less for a given level of marginal profits, π_1, in such a country. This is because the distance of the current-period Q from the next-period expected value in countries with low financial transaction costs is small to begin with. These two opposite effects mean that, theoretically, better institutions do not necessarily imply that Q would move "faster."

III. ESTIMATION METHODOLOGY

A. Minimizing One-Period-Ahead Forecast Errors

Both investment adjustment and financial transaction costs are assumed to be linear functions of firm characteristics, X ($n \times k_1$ matrix, with n being the number of firm-year observations), and country institutions, W ($n \times k_2$ matrix). We can then write Equation (6) as:

$$E[Q \mid \varepsilon] = X\gamma_1 + W\gamma_2 + Q^{-}\alpha_1 + (X * Q^{-})\alpha_2 + (W * Q^{-})\alpha_3 + Z\beta_1 + (X * Z)\beta_2 + (W * Z)\beta_3. \quad (10)$$

where $Z = \begin{bmatrix} -\pi_1 & -\lambda_1\pi_1 & \phi_2 & \lambda_2 \end{bmatrix}$ (an $n \times 4$ matrix), (X*Z) is the interaction term between X and Z (an $n \times 4k_1$ matrix), and likewise for the other interaction terms. Taking expectations over the next period's shock, ε^{+}, given the current period's shock, ε, yields the expected values for the next-period Q.

In the data, we observe the realized values of the next-period Q. The difference between the expected and realized values is the one-period-ahead forecast error:

$$\xi = Q - E\left[Q \mid \varepsilon\right]. \quad (11)$$

This one-period-ahead forecast error is serially uncorrelated even if the underlying productivity shocks are serially correlated. Thus, OLS estimates are unbiased and consistent.

While the average value of productivity shocks is zero and they are uncorrelated with institutions; productivity levels may well be correlated with country-specific institutions. For example, R&D outlays may be limited because of credit constraints resulting from poor creditor rights. These level effects should be reflected in the current and future *Q*'*s*. That is, the average level of *Q* and its serial correlations are affected by institutions. However, the expected *forecast errors* of *Q* are *not* affected by institutions and are *not* serially correlated. Nevertheless, the variance of the forecast errors could be affected by institutions, although the direction of the effect is ambiguous: for example, weak institutions may induce low R&D intensity resulting in a small variance, or may cause more frequent booms and busts, resulting in a large variance. Here, we allow for the possibility that observations on firms within a country in the same year are likely to be subject to correlated shocks (e.g., booms and busts) and therefore use robust standard errors with clustering at the country-year level.[9]

[9] Liu, Whited, and Zhang (2009) also use a canonical investment model (without financial frictions) but derive a different orthogonality condition, namely, the equivalence of stock returns and levered investment returns (i.e., a variant of the returns on equity). They show that predictions based on *Q*-theory for stock returns of US firms fit the data much better than previous models (e.g., CAPM, Fama-French four factors, and consumption-CAPM). This supports our use of a similar canonical investment model. However, the error terms they minimize are outside the model and arise from, for example, measurement errors.

B. **Parameterization**

As in most studies, we assume that investment adjustment costs are convex and homogeneous degree one in both investment and capital:[10]

$$\phi(I,K,\varepsilon)=c_1 I+c_2 K+\frac{c_3}{2}\left(\frac{I}{K}\right)^2 K\,. \tag{12}$$

We think it is natural to assume a similar functional form for the financial transaction costs, which can be seen as a generalized version of Gomes (2001):

$$\lambda(B,K,\varepsilon)=b_1 B+b_2 K+\frac{b_3}{2}\left(\frac{B}{K}\right)^2 K\,. \tag{13}$$

The partial derivatives of the investment adjustment and financial transaction cost functions determine the equilibrium law of motion of *Q* as in (6). In particular, the coefficients c_2, c_3, b_1, b_2, and b_3 determine the evolution of *Q*.[11] Next, we assume that each of

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[10] Although there is no "pure" fixed cost in (12), the *K* term can be seen as a cost which is proportional to firm size regardless of the size of investment. Note that the real business cycle literature with representative agents uses a convex adjustment cost for *increases* in investment, not for investment itself, to achieve smooth investment patterns over time. Although aggregate investment movement is smooth, firm level investment is known to vary a lot. Thus, in a firm level study, as in this paper, adjustment costs are commonly defined in terms of investment, not in terms of increases in investment (for a reconciling effort, see Khan and Thomas, 2008).

[11] The partial derivative of the adjustment cost function with respect to capital is: $\phi_2=c_2-\frac{c_3}{2}\left(\frac{I}{K}\right)^2$.

The partial derivatives of the financial friction function with respect to external finance and capital are: $\lambda_1=b_1+b_3\left(\frac{B}{K}\right)$ and $\lambda_2=b_2-\frac{b_3}{2}\left(\frac{B}{K}\right)^2$, respectively.

these coefficients is a linear function of firm-specific characteristics, *X*, and of country-specific institutional factors, *W*.

We explain below in more detail how these coefficients are estimated but it is important to note at this stage that that the estimated coefficient values are: $b_1 \approx 0$, $b_2 \approx 0$, and $b_3 > 0$.[12] This means that the transaction cost function is increasing in the amount of external finance *B* (i.e., $\lambda_1 = b_1 + b_3(B/K) > 0$). It also means that, the lower are b_1 and b_3, the lower are the marginal financial transaction costs.

The coefficient b_2 represents the extent to which the cost function is decreasing in capital *K*, given the size of financing *B* (i.e., $\lambda_2 = b_2 - b_3(B/K)^2 < 0$). Equivalently, this coefficient represents the additional costs borne by firms in need of large financing (where *B* is large relative to *K*). Because the production and cost functions are constant returns to scale, a small capital stock *K* relative to financing needs *B* means that a firm is in an expansionary phase with a low initial capital or after a realization of bad shock.

As illustrated in Figure 1, the larger is b_2, the more do firms in all phases need to pay for external financing. This does not mean that a larger b_2 is bad for every firm. Indeed, the cost increase is very little for firms in need of large financing. That is, the *large financing premium* declines as b_2 becomes larger. In this way, capital is allocated more efficiently among firms, which *hurt* previously privileged firms (i.e., those with small financing needs).

At the same time, the average interest rate that all firms pay may decline in the general equilibrium and the overall effect of good institution for those with large financing

[12] These average estimates are consistent with the average line in Figure 2.

needs may be beneficial even in absolute terms. To see this, we have to look at the effects on not only firm-level transaction costs but also the macro-level required rate of return.

C. **Estimation Equation**

Similar to the assumptions regarding the parameters of the investment adjustment cost function and the financial transaction costs, we assume that the required rate of return, *r*, is a linear function of firm characteristics, *X,* and of country-specific institutional factors, *W*. This is reflected in the coefficients α_1, α_2, and α_3 on lagged *Q* in Equation (10). Here, we re-specify them as a coefficient vector, *a(X, W)*. Similarly, we write the other coefficients, c_2, c_3, b_1, b_2, and b_3, as vector functions.

We can now incorporate all our assumptions into a theoretical description of the movements of *Q* represented by Equation (6). Then, version of Equation (10) which will be estimated can be expressed as follows, where we use *Total Assets* (firm size), *A,* as a broad measure of the firm's capital stock, including cash equivalents, instead of *K.*

$$\begin{aligned} Q_{i,j,k,t} = {} & \kappa\pi_{1,i,j,k,t} + \gamma\left(X_{j,k,t}, W_k\right) + a\left(X_{j,k,t}, W_k\right) Q_{i,j,k,t-1} \\ & - b_1\left(X_{j,k,t}, W_k\right)\pi_{1,i,j,k,t}\chi_{i,j,k,t} + b_2\left(X_{j,k,t}, W_k\right)\chi_{i,j,k,t} \\ & - b_3\left(X_{j,k,t}, W_k\right)\left\{\left(\frac{B_{i,j,k,t}}{A_{i,j,k,t}}\right)\pi_{1,i,j,k,t} + \frac{1}{2}\left(\frac{B_{i,j,k,t}}{A_{i,j,k,t}}\right)^2\right\}\chi_{i,j,k,t} \\ & + c_2\left(X_{j,k,t}\right)\Psi_{i,j,k,t} - c_3\left(X_{j,k,t}\right)\left(\frac{I_{i,j,k}}{A_{i,j,k,t}}\right)^2 \Psi_{i,j,k,t} + \xi_{i,j,k,t}, \end{aligned} \tag{14}$$

where the second term $\gamma\left(X_{j,k,t}, W_k\right)$ controls for level effects, including country and industry fixed effects. The two indicator functions are defined as:

$$\chi_{i,j,k,t} = 1, \text{ if } B_{i,j,k,t} > 0;$$
$$= 0, \text{ otherwise; and}$$

$$\Psi_{i,j,k,t} = 1, \text{ if } =\mathrm{I}_{i,j,k,t} > 0,$$
$$= 0, \text{ otherwise.}$$

The marginal return to capital is approximated by:

$$\pi_{1,i,j,k,t} = \frac{\pi_{i,j,k,t} - \pi_{i,j,k,t-1}}{A_{i,j,k,t} - A_{i,j,k,t-1}}.$$

The effects of institutions on the financial transaction cost function and on the required rate of return can be identified from the interaction terms. Institutional variables are assumed to be time invariant and therefore all the level effects associated with institutions are absorbed in the country fixed effects. The coefficients for investment and external finance are identified because their magnitudes differ.[13] In addition, investment adjustment cost is not assumed to be influenced directly by current profits but financing is, and therefore only external finance is interacted with profits (coefficients b_1 and b_3). We also assume that institutional factors do not affect the technological adjustment of investment, although we revisit this issue below.

The higher is the marginal cost of external finance (i.e., the higher are b_1 and b_3), the higher is the current-period Q. This reflects tighter financing constraints and the associated lower level of investment, given the expected next-period Q (see Equation (5)). Equivalently, this means that the expected next-period Q is lower, given the current-period Q (see Equation (6) and (14)). This is similar to what is implicitly assumed about cash flow sensitivity in a

[13] For example, positive investment does not require positive external finance, as firms may finance investment internally. Also, firms with negative profits and no investment may still seek external funds for working capital needs or in order to maintain capital.

typical investment regression, except that the theoretical model in this paper allows for a more precise way of measuring financial frictions.

IV. Data Description

All variable definitions, data sources and some sample statistics are provided in Table 1. We use firm level data from the Worldscope database of Thomson Reuters. The data cover the period 1990 to 2007 for 48 countries, and the sample contains about 380,000 firm-year observations for which Q can be constructed.[14] We eliminate some observations for a number of reasons, with each criterion applied sequentially to the remaining data set. First, we eliminate observations if values are economically not meaningful, such as when values for capital expenditures are negative. Second, on a statistical basis, observations in excess of three standard deviations from the mean for that variable in the U.S. sample are eliminated. Third, we eliminate countries having less than 15 non-financial companies per country with non-missing values for Q in the year 2000 (this concerns Egypt, Morocco, Slovakia, Slovenia and Zimbabwe). And fourth, 2-digit SIC industries with less than five firms with non-missing values for age and Q in 2000, as well as all unclassified companies (SIC 99) are deleted.

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[14] The number of original firm-year observations, including those for which Q cannot be constructed, is about one million, although those without Q may well include inactive firms. The 48 sample countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Finland, France, Germany, Greece, Hong Kong, Hungary, India, Indonesia, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Russia, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, and Venezuela.

After these deletions, about 300,000 firm-year observations with *Q* remain. For the regression results, because of the unavailability of lagged *Q* and other variables, the sample shrinks further, to about 75,000 firm-year observations in the benchmark regression.[15]

Marginal profit, π_I, is proxied by the increase in earnings divided by the increase in total assets. For earnings we use a cash flow measure, defined as *Net Income before Extraordinary Items and Preferred Dividends + Interest Expense on Debt + Depreciation and Amortization* (variable names correspond to those of Worldscope unless otherwise noted). Although this measure can be susceptible to tax and other accounting adjustments hiding the true performance of a firm, some adjustments (e.g., tax credits for R&D expenditures or future losses) are legitimate. Also, taxation matters for firm valuation. Nevertheless, for robustness, we also use a before-tax measure, namely *Operating Income + Depreciation and Amortization*.

For investment, *I*, we use the usual definition of investment - *Capital Expenditure* in our benchmark regressions. Our broader definition of capital stock also includes cash and equivalents, e.g., holdings of bonds and equity investments in other companies. As a robustness check, we therefore use *Capital Expenditure + Change in Cash and Short-Term Investment*. Both are assumed to be subject to adjustment costs.

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[15] The firm age variable, described below, reduces the sample size considerably, from about 150,000 to 75,000. Even though firm age can be constructed for about 270,000 observations out of the original one million, the sample for which both *Q* and age are available is much smaller. We check below the robustness of our results by excluding firm age and using a bigger sample. Lack of other variables halves the sample size from 300,000 to 150,000. Only when it is appropriate due to common accounting practices, we replace missing data with zeros (for example, *Net Proceeds from Sale/Issue of Common and Preferred Stocks*).

External finance, *B*, is defined in line with Rajan and Zingales (1998) and others as *Capital Expenditure + Change in Cash and Short-Term Investment – Cash Flow from Operation – Decrease in Inventory – Decrease in Receivables – Increase in Payables*. We add the change in cash to the original Rajan and Zingales (1998) definition, in line with our broad concept of investment. For robustness, we use a narrower external finance concept excluding trade credit, defined as the net increase in *Total Debt + Net Proceeds from Sale/Issue of Common and Preferred Stocks*.

We define *Q* as the *Market Capitalization + Total Assets – Total Equity* over *Total Assets*. *Q* is measured at fiscal-year end, usually right after the ex-dividend date. This measure of *Q* is commonly used in cross-country empirical studies in the corporate finance literature. As noted, we use *Total Assets* as our broad measure of capital. The short time dimension of our data—our data set includes only 16 years—renders more elaborate capital stock calculations based on the permanent inventory method (Blanchard, Rhee, and Summers, 1994) not feasible. Also, debt is valued at par since corporate bond prices are not available for most firms in our sample.

As for firm characteristics, we include industry dummies and firm age (using the variable *Founded Date*). Firm size is not included as a control variable, because it is endogenous, and depends on financial frictions and investment adjustment costs. Also, several measures of firm size are related to the firm's capital stock, which is used in the regressions as an important variable to identify the effects of institutional and real factors on financial frictions and investment adjustment costs.

The required rate of return is the sum of the risk free rate and an unobservable risk premium. Our measure of the country-specific real short-term risk free rate is the short-term government Treasury bill rate minus the CPI inflation. To capture country-specific macroeconomic risks factors possibly reflected in the "risk free" rate, we include the CPI inflation rate and macroeconomic volatility, measured as the standard deviation of real GDP growth for the period 1995-2006. CPI and real growth rates come from the World Development Indicators, while short-term Treasury bill rates come mainly from the IMF's International Financial Statistics. We also allow these macroeconomic variables to affect financial frictions (e.g., a higher GDP volatility may lead to a higher cost of external finance).

To capture country-level institutions, *W*, we use several measures, covering both the *de jure* and *de facto* characteristics. Specifically, we use five measures with several indicators for each institutional measure (Table 1). In the benchmark regression, we use for the quality of corporate governance (*CorpGov)* the shareholder (anti-director) rights (La Porta et al., 1998), a measure commonly used in the literature on investor (shareholder) protection. For creditor rights (*Creditor*), we use the strength of legal protection for lenders and borrowers (World Bank, 2008a). For general institutional quality (*Institution),* we use the property rights measure of La Porta et al. (1998). For product market competition (*Compet*), we use a measure of trade barriers (World Economic Forum, 2007). For financial market development (*FinMkt)*, we use stock market-capitalization-to-GDP for 2005 (World Bank, 2008b).

Altogether, the interaction terms with lagged *Q* become:

$$\begin{aligned} a(X_{j,k,t,}W_k) = \sum\nolimits_j a_{1j} IndustryDummy_j + a_2 Age_{i,j,k,t} \\ + a_3 RiskFreeRate_k + a_4 Inflation + a_5 Macro \\ + a_6 CorpGov + a_7 Creditor + a_8 Institution + a_9 Compet + a_{10} FinMkt. \end{aligned} \tag{15}$$

The coefficients on the other, interaction terms (***b₁, b₂, b₃, c₂,*** and ***c₃***) take the same form. The level effect **γ** (which includes country fixed effects) is defined similarly as:

$$\begin{aligned}\gamma(X_{j,k,t,}W_k) = {} & \sum\nolimits_k \gamma_{0k} CountryDummy_k \\ & + \sum\nolimits_j \gamma_{1j} IndustryDummy_j + \gamma_2 Age_{i,j,k,t} \\ & + \gamma_3 RiskFreeRate_k + \gamma_4 Inflation + \gamma_5 Macro \\ & + \gamma_6 CorpGov + \gamma_7 Creditor + \gamma_8 Institution + \gamma_9 Compet + \gamma_{10} FinMkt.\end{aligned} \quad (16)$$

V. Estimation Results

A. Benchmark Regression

Table 2 shows the benchmark regression results. Specifically, it shows by column the estimated coefficients of the interaction terms of interest, where each cell represents the interaction term between the corresponding row (e.g., *Corporate Governance*) and column (e.g., lagged *Q* representing *Required Return*).[16] That is, in the first column, the coefficient on lagged *Q* captures the effects of institutions and firm variables on the required rate of return.

Good corporate governance (shareholder protection) is associated with a significantly lower required rate of return, with a coefficient of -0.0433. The magnitude of the effect can be interpreted as follows: a one-standard-deviation improvement (increase of 1.3) in the anti-director rights index would lower *Q* in the next period by 0.08 for the average firm (with a *Q* of 1.5), that is, 5 percent more adjustment in stock price due to more investment—recall that more investment leads to lower *Q* towards more efficient level. More intense product market

[16] Because the number of coefficients for the benchmark regressions with all the institutional variables is large, we do not show the other coefficients (e.g., country and industry fixed effects) or interaction terms involving industry dummies. However, we can provide them upon request.

competition is associated with a higher required rate of return but this coefficient is only significant at the 10 percent level. Higher firm age is also associated with a higher rate of return but the effect is negligible. Other factors do not change the required rate of return.

The second to fourth columns present the effects of institutions and other variables on firm-level financial transaction costs. The second column shows the effect of institutions on the slope of the financial transaction cost function, or equivalently, the intercept of the marginal cost curve for raising external finance. The third column captures the differential effect of firm capital (i.e., the *large financing premium*). And, the fourth column shows the effect on the curvature of the financial transaction cost function, or equivalently, on the slope of the marginal cost curve. Note that the second and fourth columns are expected to have negative signs according to Equation (14).

Good corporate governance increases the intercept of the marginal financial transaction cost curve (column 2), but the effect is very small and significant only at the 10 percent level. Importantly, better corporate governance reduces the extra premium paid by firms in need of large financing (column 3). A one standard deviation improvement in investor protection (1.3) lowers the *large financing premium* by about 3 percent of assets.[17] Also, a one-standard-deviation improvement in general institutional quality (0.8) lowers the *large financing premium* by about 5 percent of assets. Good creditor rights seem to increase the premium but the statistical significance of this result is low and it is not robust to other specifications. Other factors do not have statistically significant effects on firm-level financial transaction costs.

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[17] More precisely, the cost increase of 3 percent of assets is faced by very large firms which are affected almost one to one by a change in $\boldsymbol{b_2}$ (i.e., approximately the same as the change in the asymptote in Figure 1).

Figure 2 illustrates the financing-size effects on the financial transaction cost curves arising from the quality of corporate governance and general institutions. On average, firms with a large capital stock, *K*, pay less for a given amount of external finance *B* (the solid line). In a country where corporate governance and general institutional quality are both one-standard-deviation better, the financial transaction cost curve becomes higher but flatter (the dashed line). The steeper (dotted) line depicts the cost curve where corporate governance and general institutional quality are one-standard-deviation worse.[18]

These findings imply that, with better corporate governance and institutional quality, firms with large financing needs relative to their capital stocks (expanding firms) enjoy more equal access to finance compared with those with small financing needs. Moreover, the decline in the required rate of return associated with better corporate governance implies that better corporate governance is beneficial in absolute terms for firms with large financing needs. This beneficial effect also exists for other firms as well albeit smaller. This is due to a more efficient capital allocation.

Figure 3 shows that the overall effect varies with the capital level *K* (given financing needs *B*) for a hypothetical average firm that can borrow at the average risk free rate (6.9 percent). When *K/B* is small (around 0.5), financing needs are twice as large as the size of the capital stock. For these firms, the *premium* is large and it is declining with better corporate governance. When *K/B* is larger than 1.5, the premium is essentially zero—the figure shows

[18] To draw the average line, we run a separate regression in which, instead of institutional factors, simple country dummies are used. The average line is drawn based on the average of the estimated coefficients on the country dummies. The two one-standard-deviation lines are then drawn using the benchmark regression result of how institutional factors affect financial transactions costs.

that the overall cost (required rate of return plus transaction costs) is around 7 percent, the same as the average risk free rate. For these firms with small financing needs, improvements in corporate governance have little effect on overall financial frictions.

These results can also be interpreted in terms of the adjustment speed of Q, as described in Equation (9). Specifically, the results imply that Q is expected to be less distant from its expected next-period value for firms in countries with better corporate governance because of the lower required rate of return. Institutional environments do not materially affect the marginal transaction cost of external finance (and the cash flow sensitivity). However, they do alter the shape of financial transaction costs with respect to firm size: Differences between small and large firms in the adjustment of Q are smaller in countries with good shareholder protection and with good general institutional environments.

B. **Robustness Checks**

To verify that the results are not driven by the specific measures we use, we examine a number of alternative variables and proxies. We start with different measures for some of the firm level variables. In Table 3a, we use before-tax income rather than after-tax income. In Table 3b, we use a broader concept of investment, which includes, in addition to fixed capital investment, financial investments. In Table 3c, we use a narrower concept of external finance, excluding trade credit from the benchmark specification.

The regressions with these different accounting measures (Tables 3a–c) essentially replicate the benchmark results. A slight difference is observed when we use the narrower concept of external capital (Table 3c): here, the effects become less significant, except for the reduction in the *large financing premium* associated with better corporate governance. The effects of real factors are not tabulated here (or in any following table) as they hardly differ from their effects in the benchmark regression.

Next, we check if the effects of any individual institutional measure are affected because other factors are correlated with it. We therefore estimate the effects of each institutional factor without including any other factors. Each row of Table 4 shows the corresponding one-by-one regression. The results are virtually the same as in the benchmark regression, except that the effects of product market competition and financial market development are significant, unlike in the benchmark regressions that include all the institutional factors at once. This suggests that the correlations among the institutional variables do not generally lead to an over- or under-estimation of the effects. In what follows, we continue to always include all five institutional factors, as in the benchmark regression.

We next examine alternative proxies for the institutional factors in Table 5—each row presents the effect of one alternative institutional variable. The difficulty of coding the laws and regulations has led researchers to construct *de facto*, rather than *de jure* variables of corporate governance. When we use the anti-self-dealing index of Djankov, La Porta, Lopez-de-Silanes, and Shleifer (2008), which is based on surveys of lawyers and is meant to reflect actual practices rather than law on the books (and is also more up-to-date), the benchmark results are mostly replicated, except that corporate governance no longer matters for the required rate of return. We also examine the De Nicolo, Laeven, and Ueda (2008) measure of *de facto* corporate governance quality (CGQ) at the country level reflecting actual disclosure practices and transparency of firms.[19] The benchmark results are, again, broadly replicated,

[19] This index measures country-level corporate governance using firm-level data in three dimensions: disclosure (number of accounting items disclosed), transparency (disparity of earnings between before and after

(continued)

except for the effect on the required rate of return.[20] Other corporate governance measures thus broadly support the conclusion that good corporate governance reduces financial discrimination for firms with large financing needs.

For creditor rights (*Creditor*), we alternatively use a measure that more narrowly captures the ability of creditors to secure and retrieve collateral (Djankov, McLiesh, and Shleifer, 2007). We find that this measure is associated with a higher large financing premium. This contrasts with most of the other regression results where a broader measure of creditor rights has low or little statistical significance. These differences could suggest that an increase in narrowly-defined creditor protection leads to more bargaining power for banks. In contrast, an increase in more broadly-defined creditor rights, which include aspects of borrower protection, would not necessarily mean stronger power for banks. Using a de facto, survey-based measure of the overall efficiency of bankruptcy procedures drawn from Djankov, Hart, McLiesh, and Shleifer (2008) we find that the benchmark results hold, that is, there is no effect of creditor rights on the dynamics of *Q*.

As alternative measures of general institutional quality (*Institution*), we use the rule of law (from Kaufman, Kraay, and Mastruzzi, 2003) and trust in people (from the World Values Survey, www.worldvaluessurvey.org). Using either variable as a measure of general institutional quality reduces the *large financing premium* as in the benchmark regression.

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accounting ad hoc adjustments), and stock price comovement. In line with Doidge, Karolyi, and Stulz (2007) who find that country-level corporate governance matters much more than firm-level corporate governance, only country-level corporate governance measures are used here.

[20] Note that the mean of the *CGQ* index is five times smaller than the mean of anti-director rights. Correcting for this, the magnitudes of the coefficients are much higher than in the benchmark regression.

There is also an effect contributing to a higher curvature of the financial transaction cost function but this effect is not robust to different accounting definitions (as in Tables 3a-c), one-by-one regressions (as in Table 4), and other untabulated specifications.

As alternative measures of product market competition (*Compet*), we use the degree of new business entry (World Development Indicators*,* 2008) and the cost of business start-ups (World Bank Doing Business, 2008). Easier entry is associated with a lower large *financing premium* and low start-up cost is associated with a low curvature of the financial transaction cost function. The effects are similar to those for corporate governance. Indeed, these *de facto* measures may reflect the effects of corporate governance, product market competition and other characteristics (e.g., financial development) that facilitate new firm entry and lower start-up costs.

As alternative measures of financial development (*FinMkt*), we use private credit to GDP and the absence of foreign ownership restrictions (both from World Economic Forum, 2007). These different measures of financial market development hardly alter the benchmark regression results.

We also conduct robustness checks for our measure of macroeconomic volatility (*Macro*). When we use the coefficient of variation of the exchange rate and the standard deviation of inflation rate, both from World Development Indicators, we find that the regression results are unchanged from the benchmark results (not tabulated).

Next, we check robustness to sample selection. Because *Age* is often missing, we exclude the *Age* variable from our regression and rerun the regressions with a sample that is almost double in size, 147,711 instead of 74,272 observations. The results are broadly similar to the benchmark results, except that corporate governance no longer matters for the required rate of return (not tabulated). The results remain unchanged when using either all firms or manufacturing firms only (not tabulated), rather than non-financial firms.

Overall, the benchmark results are broadly replicated in most regressions (including those not reported). Good corporate governance and general institutional quality consistently lower the small firm premium in the financial transaction costs function. In addition, good corporate governance lowers the required rate of return in many specifications. Other factors do not show robust effects on either financial transaction costs or the required rate of return.

C. **Real Adjustment of Investment and Institutions**

Institutional factors may affect the adjustment of investment not only by affecting financial frictions but also by changing real investment adjustment costs.[21] We therefore investigate also how institutional variables affect the coefficients that characterize the real adjustment costs of investment. The results (Table 6) confirm that good corporate governance lowers the rate at which real costs increase with size (c_2), where the size effect itself is presumably due to technological and managerial diseconomies of scale. However, this is somewhat offset by an increased slope of the marginal real adjustment cost curve: small new investments appear to cost less but big new investments cost more. Also, unlike for financial frictions, the intercept term is not identified econometrically. Overall, the effect on investment is unknown.

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[21]Managerial entrenchment (e.g., Myers and Majluf, 1984, Gaudet, Lasserre, and Van Long, 1998) or worker sabotage (Parente and Prescott, 2000) may give rise to institutions affecting real investment adjustment costs.

As for the results on financial transactions costs and the required rate of return, all the effects of corporate governance, general institutional quality, and other factors remain virtually unchanged relative to the benchmark regressions.

VI. Measurement Errors

A. Sources of Measurement Errors for Tobin's *Q*

Stock Price Movements

Stock markets may not always reflect fundamental values (see e.g., Duffie, 2010). For the U.S., Abel and Blanchard (1986) address this issue by constructing a time series for *Q* based on a long time series of past marginal products of capital. Philippon (2009) utilizes a long time series of corporate bond prices, also for US firms. Because our cross-country data are short in the time dimension, we cannot utilize these strategies. Note that because stock prices are quite volatile, measurement errors in *Q*, if any, should have little auto-correlation.

Accounting Issues

Accounting items are subject to some measurement errors. As noted, we run robustness checks using different measures for the major variables other than *Q* (Table 3a – c). As for the mismeasurement of debt (in the numerator of *Q*) and the replacement cost of capital (in the denominator), country fixed effects should help address some of the persistent measurement errors to the extent that they are due to country-specific accounting conventions.

Average *Q* versus Marginal *Q*

Ever since Hayashi (1982), the theoretical difference between the marginal and average values of Q has been recognized in the literature. As noted above, we follow conventional modeling assumptions so that the two values should coincide. However, as Hayashi (1982) shows, monopoly power in product markets may create a disparity between marginal and average Q. Moreover, as Abel and Eberly (2008) show, movements in Q can become larger with monopoly power and with decreasing returns to scale. In our estimations, the coefficients on product market competition are not robustly related to changes in Q. This suggests that, on average at the country level, the effect of monopoly power is small compared to other factors affecting the evolution of Q. Note that industry-specific movements, to the extent that they are due to monopolistic power, are controlled for since we include industry interaction terms. And within industry, any short-lived rents or monopolistic profits from innovative products are captured by serially correlated productivity shocks.

Different Timing Assumptions

Timing assumptions are critical. Without the time-to-build assumption (i.e., with immediate use of capital after investment), investment would always adjust fully to the revelation of productivity shocks. In the special case of the "time-to-build" assumption, there would be no relationship between the last period's Q^{-} and the current Q, so that the coefficient a would be zero (Barnett and Sakellaris, 1999). As can be seen from our regression results, this is not the case empirically.

Nevertheless, we can consider different timing assumptions regarding the revelation of productivity shocks. So far, we have assumed that the productivity shock is revealed at the beginning of the current period, so that the last period's Q^- can be observed together with information on the current shock. As such, the setup is non-stochastic from the point of the view of the beginning of the current period. It may be the case, though, that the shock is not revealed at the beginning of the current period. In this case, investment decisions will still be made after the realization of the shock, but then we really observe $E[Q^-|\varepsilon^-]$, not Q^- itself. If so, there will be no observation errors in next period's Q, as we can observe $E[Q|\varepsilon]$ in the data. However, there will be another form of forecast errors in Q, which could be classified broadly as a measurement error: decisions are made on the basis of the realized value of Q^- but we only observe its forecast value $E[Q^-|\varepsilon^-]$. Since these errors are one-period-ahead forecast errors, however, they should not exhibit any auto-correlation.

B. **Testing for Measurement Errors**

All four forms of measurement errors possibly affect the observed values of Q. If sizable measurement errors do indeed exist, then the OLS errors will exhibit serial correlation. To see this, suppose the observed Q (denoted with hat) is the sum of the true Q and the measurement error, that is, $\hat{Q} = Q + \nu$. Using Equation (10), the OLS errors can then be expressed as:

$$u_{OLS} = (\xi + \nu) - \left\{ \nu^- \alpha_{1OLS} + (X * \nu^-)\alpha_{2OLS} + (W * \nu^-)\alpha_{3OLS} \right\}, \tag{17}$$

where the measurement errors v are assumed to have a mean of zero and be serially uncorrelated, that is, $E[\nu] = 0$ and $E[\nu'\nu^-] = 0$. In this case, the OLS errors have serial correlation equal to:

$$E[u_{OLS}{}'u^+_{OLS}] = -\left\{ E[\nu'\nu]\alpha_{1OLS} + E[\nu'(X*\nu)]\alpha_{2OLS} + E[\nu'(W*\nu)]\alpha_{3OLS} \right\}. \tag{18}$$

This is expected to be non-zero in the presence of measurement errors. If the measurement errors, v, are also serially correlated, more terms would enter into (18) and the serial correlation of the OLS errors is likely to be larger.

By testing for serial correlation in the OLS errors, we can check if the magnitude of the measurement error problem is large or small. When we do so, we find that the null hypothesis of zero serial correlation in (18) cannot be rejected.[22] Hence, measurement errors, if any, are very small compared to one-period-ahead forecast errors.

C. **Measurement Errors for Institutional Indicators**

Measuring institutional quality is difficult and often subjective. In addition to checking the robustness of our results to alternative institutional indicators, we consider measurement errors in the institutional variables W (in addition to those in Q).

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[22] Note that, with the fixed effect estimation we have assumed so far, theoretically the regression errors u have an additional autocorrelation (see Wooldridge, 2002, p.275). If we use only the last year sample in our dataset, we need to test for autocorrelation in (18) against the theoretical null hypothesis, $-1/(T-1)$, where the time dimension is $T=18$ in our case. We conduct this test correcting for potential heteroskedasticity and find the AR(1) coefficient of the fixed effect residuals to be 0.200 with a standard error of 0.162. The theoretical autocorrelation is – 0.059 (= – 1/17) and the t-statistic is 1.64, not significant. Alternatively, if we use all the observations, we have to test for autocorrelation in (18) against the null of zero with robust errors to correct both for the theoretical possibility of varying serial correlations due to the fixed effect estimation, and for potential heteroskedasticity (again, see Wooldridge, 2002, p.275). We conduct this alternative test as well: the AR (1) coefficient is 0.050 with a standard error of 0.054 and the t-statistic is 0.91, not significant again. Note that the Durbin-Watson test for serial correlation does not work when the lagged dependent variable is used as a regressor. A generalized version, the Breusch-Godfrey test, does not work either with heteroskedastic errors.

Suppose the observed institutional indicators (denoted with hat) are measured with measurement errors ω, that is, $\hat{W} = W + \omega$ with $E[\omega] = 0$, $E[\omega' \nu] = 0$ and $E[\omega' \nu^{-}] = 0$. Then, the OLS errors are slightly different from (17):

$$u_{OLS} = (\xi + \nu) - \{\nu^{-} \alpha_{1OLS} + (X * \nu^{-}) \alpha_{2OLS} + ((W + \omega) * \nu^{-}) \alpha_{3OLS}\}. \quad (19)$$

In this case, again, the OLS errors are serially correlated even more than before:

$$E[u_{OLS}' u_{OLS}^{+}] = -\{E[\nu' \nu] \alpha_{1OLS} + E[\nu'(X * \nu)] \alpha_{2OLS} + E[\nu'(W * \nu)] \alpha_{3OLS} + E[\nu'(\omega * \nu)] \alpha_{3OLS}\}. \quad (20)$$

As discussed above, the presence of the serial correlation in the OLS errors is rejected and hence measurement errors in the institutional variables are unlikely to be large enough to affect the coefficient estimates.

D. **Instrumental Variable Estimation for Tobin's *Q***

While measurement errors are likely to be small, we can still check the robustness of our findings against measurement errors by using instrumental variable estimation for *Q*. Given the very small measurement errors, it is likely that all measurement errors combined exhibit little auto-correlation, if any.[23] This is plausible given that large swings in stock prices likely dominate other sources of measurement errors for *Q*. Based on (10), the one-period-ahead forecast errors including measurement errors for *Q* can be expressed as:

[23] If our test had indicated the presence of large measurement errors and the possibility of autocorrelation in the measurement errors themselves, the best estimation technique would have been the measurement-error-robust GMM estimation developed by Erickson and Whited (2000). But, this is not the case. Also, their estimation technique does not work well with fixed effects and heteroskedasticity (Almeida, Campello, and Galvao, 2010). Therefore we use the simpler IV estimation strategy described below.

$$\tilde{\xi} = (Q+\nu) - \{ X\gamma_{1IV} + W\gamma_{2IV} \\ +(Q^{-}+\nu^{-})\alpha_{1IV} + (X*(Q^{-}+\nu^{-}))\alpha_{2IV} + (W*(Q^{-}+\nu^{-}))\alpha_{3IV} \\ +Z\beta_{1IV} + (X*Z)\beta_{2IV} + (W*Z)\beta_{3IV} \}. \tag{21}$$

Then, using *S* to denote instrumental variables, we can write the estimation equation as the orthogonality condition with respect to this one-period-ahead forecast errors including measurement errors:

$$E\left[S'\tilde{\xi} \right] = 0. \tag{22}$$

The usual requirement for instrumental variables, *S*, is that they need to be orthogonal to the original one-period-ahead forecast errors ξ. Here, in addition, they also need to be orthogonal to the measurement errors to remove the bias. We use twice-lagged *Q* as the instrumental variable for lagged *Q*. This is a legitimate choice because the twice-lagged *Q* is well correlated with the lagged *Q*, but orthogonal to the one-period-ahead forecast error in the current period and has a measurement error which is (empirically) orthogonal to the one associated with lagged *Q*. For the interaction terms, $(X*(Q^{-}+\nu^{-}))$ and $(W*(Q^{-}+\nu^{-}))$, other instrumental variables are necessary for identification. Following Wooldridge (2002, p.237), we construct them using the fitted value of lagged *Q* (i.e., lagged *E[Q]* in the limit), that is, $(X*E[Q^{-}])$ and $(W*E[Q^{-}])$. These fitted values are obtained by OLS estimation. Otherwise, the procedure is a standard two-stage-least-squares estimation using lagged values as in many other studies (e.g., Almeida and Campello, 2010).[24]

[24] By construction, the equation is just-identified and the error term is not subject to serial correlation. Hence, the two stage least square procedure is both consistent and efficient. We do allow for potential heteroskedasticity (i.e., correlation in error terms) among firms in each country and each year, and correct for this by clustering at the country-year level. Theoretically, any *n*-times lagged *Q*'s (n>2) can also be used as

(continued)

Table 7 shows the results for the benchmark specification using instrumental variables.[25] The results broadly replicate those of the OLS-fixed effects estimations. A notable difference is that the required rate of return is no longer affected by corporate governance but, instead, the curvature of financial frictions, $-b_3$, is now reduced significantly by better corporate governance. This means that the marginal cost is lowered for all firms and the total cost is lowered for most firms except firms with very small or very large financing needs. At the same time, as previously, the *large financing premium* represented by $-b_2$ is lower in counties with good corporate governance and good general institutional quality. Creditor rights do not have any significant effects. More product market competition increases the required rate of return, possibly because it reduces monopolistic rents (which can make a firm safer to lend to), and more developed financial markets raise

instrumental variables to form an over-identified system (Arellano and Bond, 1991). As we have a not-so-small time dimension and a very large cross-section of firms, because of the computational burden we use only the twice lagged Q with the just-identified system.

[25] The instruments include approximation errors, because they are not perfectly correlated with the original variables (weak instruments). There are no well-established tests for the weak instrument problem in the case of heteroskedasticity but, following Baum, Schaffer, and Stillman (2007), we conduct two tests. The Kleinbergen-Paap *rk* Wald test statistic is 5.14, which is not large enough to suggest that our instruments are not weak. However, the Anderson-Rubin F-statistic is 165, rejecting the null hypothesis of under-identification, suggesting that the instruments are not weak. Note that the latter test is considered stronger than the former. In addition, in our case, approximation errors may exacerbate multicollinearity problems because the new error, the difference between the lagged Q and the twice lagged Q, may be correlated with other regressors, X (if X is autocorrelated) and W. However, the empirical relevance of this problem is not well understood and this bias may be either small or large. Nevertheless, with instrumental variables, we can at least check the robustness of our findings so far, which have been based on OLS-fixed effects estimation.

the curvature of financial frictions (at the 10 percent significance level), but these effects are not robust to other specifications.

VII. Related Research

Our finding that firm level transaction costs are especially high in low corporate governance environments for firms with large financing needs sheds light on a source of investment inefficiency. In this regard, a recent study by Hsieh and Klenow (2009) is related. They find a much larger dispersion in the (*ex post*) marginal product of capital for industrial plants in China and India than in the U.S and interpret this as evidence of a more efficient allocation of capital in the U.S. With only three countries in their sample, however, any assessment of the causes of this difference in efficiency, and whether or not it is related to institutional differences, is difficult. Also related is Abiad, Oomes, and Ueda (2008) who show that, under certain conditions and controlling for industry and age effects, the cross-sectional dispersion of Q can be a proxy for the *ex ante* efficiency of capital allocation and it is improved by financial liberalization. While their measure captures within-country effects of policy changes, it is less useful for cross-country comparisons, in part because it assumes a steady-state dispersion of Q which is likely country-specific. Another related study is Acharya, Imbs, and Sturgess (2010), who show that financial deregulation brought U.S. states closer to the efficient mean-variance frontier of industrial outputs. However, a similar mean-variance measure cannot easily be used for cross-country comparisons, given the possibility of specialization due to comparative advantage reflected in international trade.

In terms of techniques, our study relates to the tradition of investment regressions investigating the prevalence and impact of credit constraints at the firm level. Starting with

Fazzari, Hubbard, and Petersen (1988), this literature, which is mostly based on reduced-form regressions, typically investigates the sensitivity of investment to firm cash flows as a proxy for credit constraints, controlling for growth opportunities by including Tobin's Q. However, as Gomes (2001) shows, in the presence of financial transaction costs, such reduced-form regressions face serious identification problems. Most importantly, since Q reflects not only growth opportunities but also frictions (e.g., credit constraints), typical regressions of investment on cash flows and Q cannot identify credit constraints. Furthermore, with auto-correlated productivity shocks ("growth opportunities"), current profits contain information on future profitability, in addition to the availability of internal financing, biasing results.

To overcome this identification problem, some recent studies have modeled frictions (e.g., asymmetric information or limited contract enforcement) from first principles. Empirical applications in this spirit, however, have proven difficult, in part due to computational challenges. So far, studies in this line of research have largely relied on calibration exercises (e.g., Lorenzoni and Walentin, 2007) or simulation-based estimations using restricted samples and limited control variables (Karaivanov, et. al. 2010). Accordingly, it is difficult in such models to statistically compare the relative importance of various financial frictions. An alternative approach, on which we build, is that of Hennessy, Levy, and Whited (2007) who include generic transaction costs in their model and then empirically identify the presence of such costs using data for large US individual firms. However, our estimation methodology and theoretical assumptions, for example, in relation to firms' maximization objective are different from those of Hennessy, Levy, and Whited (2007) (see again footnote 24).

Another related paper is by McLean, Zhang, and Zhao (2011). They argue that, if cash flow sensitivity proxies for growth opportunities, then growth should be higher in countries with higher cash flow sensitivity; but if cash flow sensitivity reflects credit constraints, then growth should be higher in countries with low cash flow sensitivity. They find evidence for the latter conjecture. However, this does not necessarily imply that the effect of institutions on investment passes through the credit-constraint channel because, according to Gomes (2001) and our analysis, Q always reflects both effects.[26]

VIII. CONCLUDING REMARKS

Among other institutional factors, we identify corporate governance, and informational problem as a deeper level, as the key determinant of financial frictions for investment. This unique "horse race" empirical study presents a micro evidence to support or reject assumptions in widely-used macro models. By doing this, we also contribute to the literature on institution and growth by providing the first empirical study based on a

[26] If the credit-constraints effect always dominates the growth-opportunities effect, then positive cash flow sensitivity can be interpreted as evidence of credit constraints. But this does not necessarily hold if the growth opportunities effect dominates only *on average*. Suppose that the growth-opportunities effect is stronger in booms but that the credit-constraints effect is stronger in recessions. In this case, there will be a positive association between high cash flow sensitivity and low growth *on average*. But it does not necessary follow that institutions affect the credit constraint. Suppose that institutions affect investment only through the growth opportunities channel. In this case, better institutions will create a higher cash flow sensitivity of investment, but at the same time there will be a positive association between high cash flow sensitivity and low growth.

structural model. To carry out the estimation, we also develop a new method, which we show better than previous methods in the literature.

Theoretically, we use a standard investment theory but assume that institutional factors affects investment by varying financial transaction costs at the firm level and the required rate of return at the macro level. Our main empirical result is that good corporate governance, as reflected in strong shareholder protection and, somewhat less robustly, good general institutional quality, is associated with a lower *large financing premium*. This implies less financial discrimination against growing firms, leading to more efficient capital allocation among firms. In addition, in many specifications, good corporate governance is also associated with a low required rate of return. Taken together, good corporate governance not only improves capital allocation but also lowers the overall level of financial frictions for almost all firms.

On the other hand, creditor rights turn out to play a little role. This is construed as important evidence against the validity of many macroeconomic models which focus on collateral requirements or (synonymously) on limited liability constraints. This supports an agency-problem theory that good corporate governance is necessary for these firms to ensure an efficient use of funds, regardless of whether the source of funding is debt or equity. A caveat is that the lack of evidence against creditor rights might be due to the sample firms we study (i.e., listed firms), which can relatively easily raise funds through both debt and equity finance. For these firms, the cost of external finance is perhaps determined by the cost of equity finance, at least for firms with large financing needs. Then, naturally, corporate governance is more important than creditor rights. With this uncertainty, we do not rule out the possibility that collateral constraints may well be important in other settings.[27]

However, our findings of the importance of good corporate governance and the relative lack of importance of creditor protection are consistent with differences in institutions and firm performance between the U.S. and other advanced countries like France, Germany, or Japan. U.S. firms are generally considered better governed than those in other advanced countries. Creditor protection on the other hand is often considered weaker in the U.S., in part because U.S. firms can easily file for Chapter 11. If due to these weaker creditor rights, collateral constraints constitute a more important financial friction in the U.S., then U.S. firms should find it more difficult to finance their investment than firms in, say, France, Germany, or Japan. This is not a general perception, nor is it what we find here. Instead, because of better governance, informational problems are likely to be less severe in the U.S. and, as a consequence, U.S. firms face fewer frictions and adjust investment faster than firms in other countries do. Our empirical results are consistent with this view.[28]

Our approach has some clear methodological advantages. Rather than just documenting statistical associations, we identify specific structural parameters based on a standard theory of investment. This approach allows us to use a feasible estimation strategy to utilize a large data set to disentangle the channels by which institutional factors affect investment through financial frictions. At the same time, our approach comes with caveats.

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[27] Borrowing constraints are known to be important for small firms, especially startups (Cagetti and De Nardi, 2006, Paulson and Townsend, 2008, and Klapper and Love, 2010).

[28] We also check if our results are largely driven by U.S. firms by rerunning the basic regressions after dropping U.S. firms from the sample. The benchmark results remain mostly unchanged (not tabulated).

The move from an articulated theory to an empirical study requires some choices; in particular, we still use somewhat reduced-form financial frictions. This is because, currently, a “horse race” empirical study is almost impossible to carry out if based on a theoretical model with the first principles (e.g., a moral hazard problem). This obviously suggests an agenda for future research.

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Figure 1. Financial Transaction Costs as a Function of Capital K given External Finance *B* (Size Effect/Small Firm Premium)

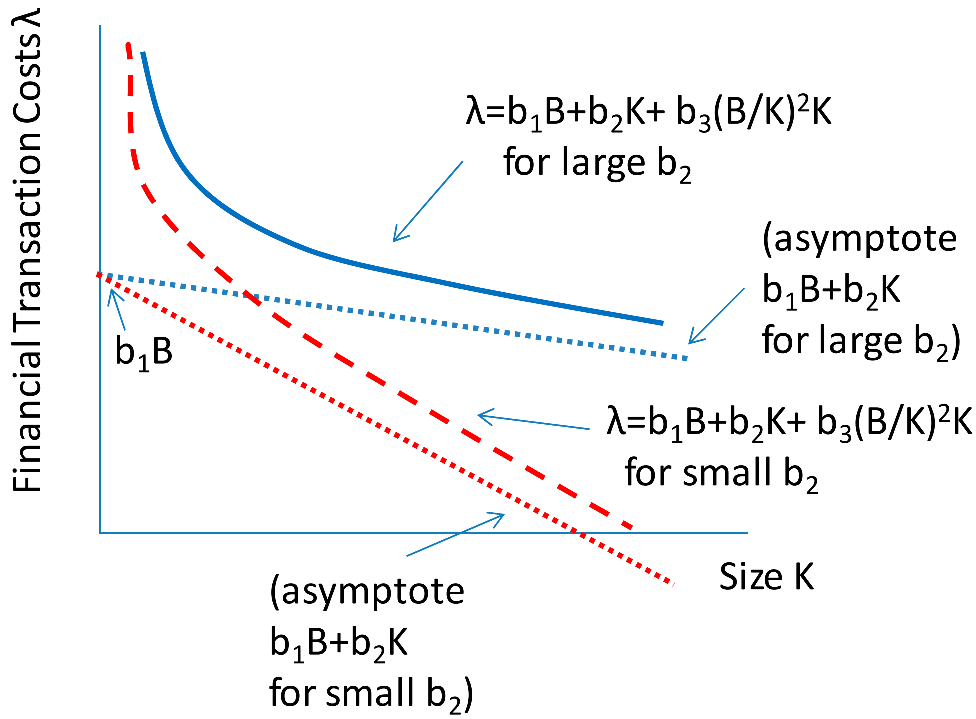

Figure 2. Average Financial Transaction Cost Curve Based on Regression Results (with One Standard Deviation Band)

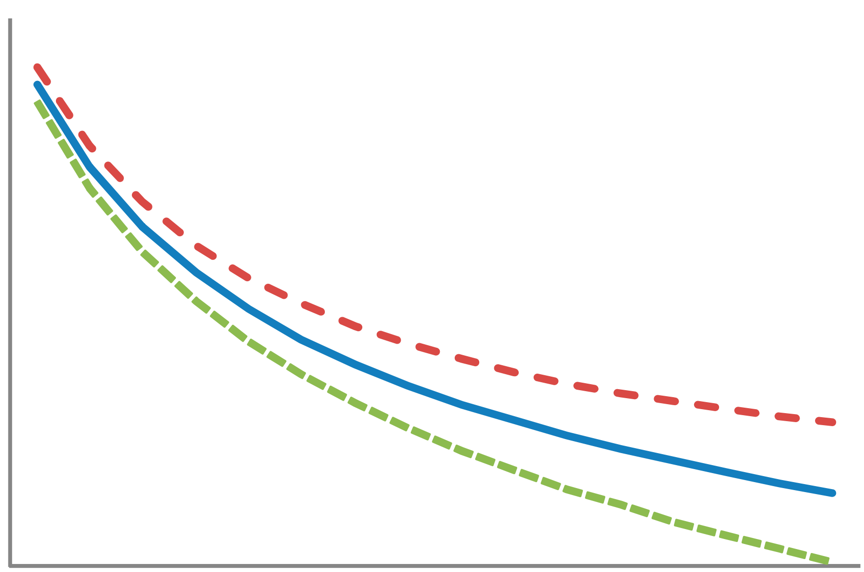

Figure 3. Overall Effect Based on Regression Results

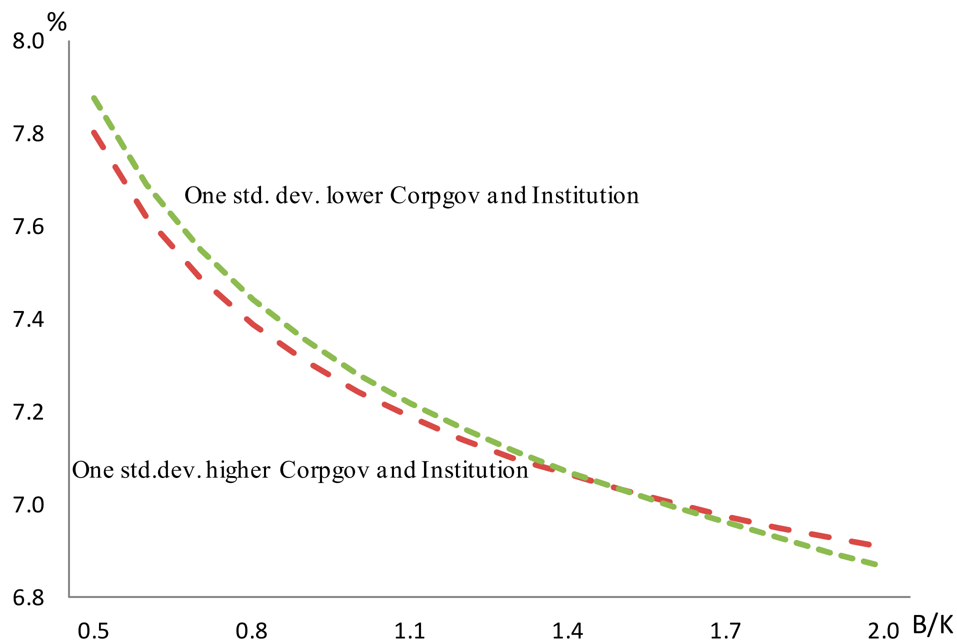

Table 1a. Variables: Definition, Sources and Descriptive Statistics

Variable	Definition/Source	Mean	Std.Dev	25%	Median	75%	Obs	Obs>0
Worldscope Data								
Q	Tobin's Q	3.3	157.2	1.0	1.3	1.9	290365	
Age	Company Age	33.4	35.3	9.0	23.0	49.0	270716	
Marginal Profit	Before-Tax Income	-0.2	80.8	-0.1	0.1	0.4	267702	
	After-Tax Income	-0.1	57.9	-0.1	0.1	0.4	266740	
Investment	capital expenditure over total assets	0.1	0.5	0.0	0.0	0.1	288089	262190
	capital expenditure plus change in cash over total assets	0.0	4.7	0.0	0.1	0.1	251275	198731
External Finance	capital expenditure plus change in cash correcting for invetories and trade credits over total assets	0.3	21.7	0.0	0.0	0.1	229828	99970
	change in total debt plus new cash from equity sales over total assets	0.1	15.7	0.0	0.0	0.1	266528	155578
Country Level Variables								
Interest	Interest Rate/IFS	6.9	9.6	2.4	4.0	7.4	816	
Inflation	Inflation Rate/IFS	17.2	116.3	1.8	3.2	8.3	766	
Corporate Gov	Antidirector Rights Index/ La Porta et al. (1998)	3.1	1.3	2.0	3.0	4.0	42	
	Antidirector Rights Index/Spamann (2009)	3.9	1.0	3.5	4.0	4.5	42	
	Self Dealing Index/ Djankov et al. (2008)	0.5	0.2	0.3	0.5	0.7	48	
	Corporate Governance Quality Index/ De Nicola, Leaven and Ueda (2008)	0.6	0.1	0.6	0.6	0.6	45	
Creditors' Right	Strength of Legal Right Index/Doing Business (2007)	6.1	2.3	4.0	7.0	8.0	48	
	Creditor Rights / Djankov et all (2008)	1.9	1.1	1.0	2.0	3.0	45	
	Efficiency of Bankruptcy Law/ Global Competitiveness Report (2004)	5.2	1.0	4.3	5.2	6.0	48	
Institional Quality	Property Rights/ Heritage Foundation and Wall Street Journal Index of Economic Freedom (1997)	4.3	0.8	4.0	4.5	5.0	40	
	Rule of Law in 2000/ Kraay and Kaufman(2003)	1.0	1.0	0.2	1.2	2.0	42	
	Trust in People/ World Values Survey 1990-1993	0.4	0.2	0.3	0.4	0.5	26	
Product Market Competition	Barriers to Trade in 2007/World Economic Forum Global Competitiveness Report (2007)	5.0	0.8	4.2	5.1	5.5	48	
	Business Entry Rate in 2005 (New Registrations as % of Total)/WDI	9.9	3.6	6.7	9.9	12.7	38	
	Cost of Starting a Business in 2007(% of income per capita)/Doing Business	12.9	17.0	2.4	7.7	19.8	48	
Financial Dev	Market Capitalization to GDP in 2006 / WDI	102.5	83.0	43.6	83.7	126.7	47	
	Sum of stock market capitalization and private bond market capitalization and bank credit over GDP in 2007/ IFS	2.2	1.3	1.0	2.0	3.1	41	
	Foreign Ownership Restrictions/ World Economic Forum Global Competitiveness Report(2007)	5.4	0.7	5.0	5.5	6.0	48	
Macro Volatility	Standard Deviation of GDP growth/ WDI	2.8	1.6	1.4	2.1	3.7	47	
	Coefficient of Variation of Exchange Rate/WEO	0.4	0.6	0.1	0.2	0.4	48	
	Standard Deviation of inflation/ WDI	31.0	117.7	1.3	3.0	9.2	47	

Table 1b. Correlation among Country Level Variables

			[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]	[16]	[17]	[18]
Corporate Gov	Antidirector Rights Index/ La Porta et al. (1998)	[1]	1.00																	
	Self Dealing Index/ Djankov et al. (2008)	[2]	0.56	1.00																
	Corporate Governance Quality Index/ De Nicola, Leaven and Ueda (2008)	[3]	0.12	0.11	1.00															
Creditors' Right	Strength of Legal Right Index /Doing Business (2007)	[4]	0.39	0.50	0.45	1.00														
	Creditor Rights / Djankov et all (2008)	[5]	0.12	0.44	0.11	0.43	1.00													
	Efficiency of Bankruptcy Law/ Global Competitiveness Report (2004)	[6]	0.13	0.33	0.77	0.65	0.27	1.00												
Institional Quality	Property Rights/ Heritage Foundation and Wall Street Journal Index of Economic Freedom (1997)	[7]	0.11	0.28	0.58	0.48	0.41	0.67	1.00											
	Rule of Law in 2000/ Kraay and Kaufman(2003)	[8]	0.16	0.25	0.81	0.58	0.31	0.87	0.83	1.00										
	Trust in People/ World Values Survey 1990-1993	[9]	0.10	0.11	0.54	0.51	0.09	0.67	0.51	0.70	1.00									
Product Market Competition	Barriers to Trade in 2007/World Economic Forum Global Competitiveness Report (2007)	[10]	0.12	0.29	0.50	0.44	0.34	0.63	0.42	0.62	0.26	1.00								
	Business Entry Rate in 2005 (New Registrations as % of Total)/WDI	[11]	0.10	0.53	0.02	0.22	0.50	0.23	0.41	0.28	0.05	0.24	1.00							
	Cost of Starting a Business in 2007(% of income per capita)/Doing Business	[12]	-0.08	-0.12	-0.48	-0.28	-0.16	-0.49	-0.62	-0.63	-0.31	-0.23	-0.30	1.00						
Financial Dev	Market Capitalization to GDP in 2006 / WDI	[13]	0.39	0.43	0.44	0.53	0.30	0.47	0.30	0.44	0.27	0.31	0.11	-0.30	1.00					
	Sum of stock market capitalization and private bond market capitalization and bank credit over GDP in 2007/ IFS	[14]	0.25	0.39	0.71	0.57	0.43	0.70	0.50	0.68	0.57	0.41	0.18	-0.44	0.85	1.00				
	Foreign Ownership Restrictions/ World Economic Forum Global Competitiveness Report(2007)	[15]	0.24	0.28	0.37	0.56	0.24	0.64	0.40	0.60	0.48	0.71	0.06	-0.16	0.35	0.40	1.00			
Macro Volatility	Standard Deviation of GDP growth/ WDI	[16]	-0.09	-0.02	-0.41	-0.29	0.01	-0.56	-0.34	-0.54	-0.33	-0.35	0.07	0.28	-0.17	-0.39	-0.35	1.00		
	Coefficient of Variation of Exchange Rate/WEO	[17]	-0.19	-0.25	-0.15	-0.45	-0.14	-0.46	-0.51	-0.51	-0.60	-0.41	0.01	0.16	-0.25	-0.38	-0.51	0.46	1.00	
	Standard Deviation of Inflation/ WDI	[18]	-0.03	-0.16	0.02	-0.30	-0.15	-0.23	-0.33	-0.24	-0.44	-0.30	0.02	-0.02	-0.08	-0.20	-0.39	0.22	0.87	1.00

Table 2. Benchmark Regressions

The coefficients in Tables 2 through 8 should be interpreted as follows. Column 1 presents the effects of various institutional and real factors on the required rate of return (the macroeconomic channel). Column 2 presents the effects on the marginal financial transaction costs. Column 3 presents the effects on the sensitivity of the financial transaction costs to firm size (the "small firm premium"). Column 4 presents the effects on the curvature of the financial transaction cost function. Columns 5 presents the effects on the sensitivity of the technological (non-financial) investment adjustment cost function to firm size, and column 6 presents the effects on the curvature of the investment adjustment cost function. T-statistics (based on robust standard errors clustered at the country-year level) are presented in parentheses.

	a	**-b1**	**b2**	**-b3**	**c2**	**-c3**
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature	Inv. Adj. Cost Coeff. Capital	(-) Inv. Adj. Cost Curvature
	[1]	[2]	[3]	[4]	[5]	[6]
Institutional Factors						
Corporate Governance	-0.0433	-0.0028	0.0200	0.0230		
	[-2.403]**	[-1.778]*	[2.639]***	[1.167]		
Creditor Rights	-0.0099	-0.0042	-0.0102	0.0399		
	[-0.454]	[-1.119]	[-1.673]*	[1.148]		
Institution	-0.0007	0.0091	0.0639	-0.2282		
	[-0.016]	[0.734]	[3.683]***	[-1.750]*		
Product Market	0.0772	0.0003	-0.0071	-0.0950		
Competition	[1.864]*	[0.045]	[-0.423]	[-0.858]		
Financial Markets	0.0001	0.0000	0.0001	-0.0004		
	[0.357]	[-0.167]	[0.414]	[-0.508]		
Real Factors						
Firm Age	0.0026	0.0001	-0.0003	0.0000	0.0034	0.0140
	[5.296]***	[1.501]	[-1.243]	[-0.035]	[0.987]	[1.146]
Risk Free Rate	0.0036	0.0002	0.0038	-0.0234	0.0170	-0.0656
	[0.346]	[0.102]	[1.521]	[-0.823]	[1.370]	[-0.729]
Inflation	-0.0075	0.0026	-0.0003	-0.0210	-0.0224	0.1453
	[-0.706]	[0.697]	[-0.101]	[-0.598]	[-1.613]	[1.308]
Macro Volatility	-0.0381	-0.0030	-0.0028	0.0025	0.1359	0.0068
	[-1.352]	[-1.120]	[-0.358]	[0.093]	[1.440]	[0.023]
Observations						74272
R-squared						0.496
Number of Clusters						608

Table 3a. Regressions Using Before-Tax Income

	a	-b1	b2	-b3
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature
	[1]	[2]	[3]	[4]
Institutional Factors				
Corporate Governance	-0.0443	-0.0039	0.0204	0.0284
	[-2.461]**	[-2.576]**	[2.613]***	[1.612]
Creditor Rights	-0.0098	0.0015	-0.0091	0.0158
	[-0.447]	[0.435]	[-1.406]	[0.355]
Institution	-0.0052	-0.0074	0.0628	-0.1433
	[-0.119]	[-0.460]	[3.588]***	[-0.706]
Product Market	0.0761	0.0018	-0.0080	-0.0986
Competition	[1.825]*	[0.203]	[-0.481]	[-0.642]
Financial Markets	0.0001	0.0000	0.0001	-0.0008
	[0.356]	[-0.981]	[0.597]	[-1.007]
Observations				74249
R-squared				0.509
Number of Clusters				608

Table 3b. Regressions Using a Broad Concept of Investment (incl. Security Investment)

	a	-b1	b2	-b3
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature
	[1]	[2]	[3]	[4]
Institutional Factors				
Corporate Governance	-0.0456	-0.0030	0.0211	0.0259
	[-2.519]**	[-1.869]*	[2.837]***	[1.310]
Creditor Rights	-0.0105	-0.0039	-0.0100	0.0371
	[-0.482]	[-1.127]	[-1.644]	[1.161]
Institution	-0.0069	0.0076	0.0641	-0.2125
	[-0.158]	[0.663]	[3.681]***	[-1.800]*
Product Market	0.0767	-0.0006	-0.0066	-0.0792
Competition	[1.867]*	[-0.094]	[-0.397]	[-0.808]
Financial Markets	0.0001	0.0000	0.0000	-0.0004
	[0.392]	[-0.131]	[0.135]	[-0.613]
Observations				74272
R-squared				0.503
Number of Clusters				608

Table 3c. Regressions Using a Narrow Concept of External Finance (excl. Trade Credit)

	a	-b1	b2	-b3
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature
	[1]	[2]	[3]	[4]
Institutional Factors				
Corporate Governance	-0.0132	0.0002	0.0102	0.0109
	[-0.586]	[0.109]	[1.650]*	[0.568]
Creditor Rights	-0.0324	0.0013	-0.0003	-0.0101
	[-0.847]	[1.485]	[-0.033]	[-0.938]
Institution	0.0001	0.0014	0.0139	0.0000
	[0.002]	[0.574]	[0.743]	[.]
Product Market Competition	0.0253	0.0006	-0.0159	0.0142
	[0.199]	[0.350]	[-0.597]	[0.478]
Financial Markets	0.0008	-0.0000	-0.0001	0.0002
	[2.243]**	[-0.664]	[-0.282]	[0.544]
Observations				81562
R-squared				0.294
Number of Clusters				608

Table 4. One-by-One Regressions

	a	-b1	b2	-b3			
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature	Obs	R-Squared	Number of Clusters
	[1]	[2]	[3]	[4]			
Corporate Governance	-0.0494	-0.0037	0.0222	0.0335	74319	0.494	608
	[-2.665]***	[-1.603]	[2.964]***	[1.443]			
Creditor Rights	-0.0184	-0.0039	0.0077	0.0002	75816	0.490	608
	[-1.144]	[-1.587]	[1.340]	[0.010]			
Institution	-0.0632	-0.0062	0.0535	-0.0794	74272	0.492	608
	[-1.534]	[-0.893]	[3.299]***	[-1.187]			
Product Market Competition	0.0858	0.0041	-0.0264	-0.0775	75816	0.491	608
	[2.154]**	[0.737]	[-1.814]*	[-0.965]			
Financial Market	-0.0003	-0.0001	0.0002	0.0009	75816	0.490	608
	[-0.920]	[-1.782]*	[1.494]	[1.684]*			

Table 5. Alternative Definitions of Institutional Factors

	a Required Return [1]	-b1 (-) Fin. Friction Coeff. Ext. Fin. [2]	b2 Fin. Friction Coeff. Capital [3]	-b3 (-) Fin. Friction Curvature [4]	Obs	R-Squared	Number of Clusters
Corporate Governance							
Self-Dealing Index	-0.1745	-0.0187	0.1030	-0.0789	74272	0.4950	608
	[-1.267]	[-1.060]	[1.828]*	[-0.367]			
CGQ-Index	-0.7344	-0.3374	1.2952	2.9030	73619	0.4990	608
	[-0.756]	[-2.152]**	[2.930]***	[1.372]			
Creditor Rights							
Narrower Definition	-0.0083	0.0095	-0.0326	-0.0580	73887	0.4950	608
	[-0.272]	[1.454]	[-2.752]***	[-0.647]			
Bankruptcy Efficiency	0.0195	-0.0058	0.0385	-0.1338	74272	0.4960	608
	[0.328]	[-0.599]	[1.565]	[-1.125]			
Institution							
Rule of Law	0.0178	0.0189	0.0566	-0.3387	74319	0.4960	608
	[0.333]	[1.368]	[2.679]***	[-2.479]**			
People's Trust	0.3880	0.0377	0.2505	-0.5678	67431	0.5070	608
	[1.748]*	[1.381]	[2.945]***	[-2.025]**			
Product Market Competition							
New Firm Entry	-0.0013	-0.0024	0.0063	0.0212	68040	0.4970	608
	[-0.190]	[-1.546]	[1.864]*	[0.934]			
Business Start-Up Cost	0.0006	-0.0003	-0.0005	0.0129	74272	0.4950	608
	[0.296]	[-1.522]	[-0.741]	[3.127]***			
Financial Market							
Private Credit/GDP	0.0360	0.0036	-0.0023	-0.0168	74272	0.4960	608
	[0.680]	[0.423]	[-0.137]	[-0.239]			
Absence of Foreign	0.0238	0.0012	0.0097	0.0170	73325	0.4960	608
Ownership Restrictions	[0.899]	[0.312]	[0.901]	[0.436]			

Table 6. Including Institutional Effects in Real Investment Adjustment

	a Required Return [1]	**-b1** (-) Fin. Friction Coeff. Ext. Fin. [2]	**b2** Fin. Friction Coeff. Capital [3]	**-b3** (-) Fin. Friction Curvature [4]	**c2** Inv. Adj. Cost Coeff. Capital [5]	**-c3** (-) Inv. Adj. Cost Curvature [6]
Institutional Factors						
Corporate Governance	-0.0424**	-0.0027*	0.0249***	0.0220	-0.1738***	-0.9204**
	[-2.346]	[-1.759]	[3.193]	[1.117]	[-3.300]	[-2.060]
Creditor Rights	-0.0102	-0.0042	-0.0100	0.0411	0.0324	-0.0422
	[-0.465]	[-1.142]	[-1.571]	[1.187]	[0.503]	[-0.185]
Institution	0.0010	0.0094	0.0638***	-0.2332*	-0.2343*	-0.1380
	[0.023]	[0.761]	[3.584]	[-1.786]	[-1.663]	[-0.238]
Product Market	0.0782*	0.0005	-0.0013	-0.1008	0.1335	-0.9498
Competition	[1.885]	[0.076]	[-0.074]	[-0.903]	[0.852]	[-1.633]
Financial Markets	0.0001	0.0000	0.0000	-0.0003	0.0029	0.0063
	[0.356]	[-0.158]	[0.252]	[-0.498]	[1.291]	[0.586]
Observations						74272
R-squared						0.496
Number of Clusters						608

Table 7. Instrumental Variable Estimation

	a	**-b1**	**b2**	**-b3**
	Required Return	(-) Fin. Friction Coeff. Ext. Fin.	Fin. Friction Coeff. Capital	(-) Fin. Friction Curvature
	[1]	[2]	[3]	[4]
Institutional Factors				
Corporate Governance	-0.0209	-0.0022	0.0164	0.0361
	[-1.373]	[-1.473]	[2.321]**	[2.202]**
Creditor Rights	-0.0120	-0.0009	-0.0040	0.0221
	[-0.558]	[-0.205]	[-0.623]	[0.530]
Institution	-0.0113	0.0022	0.0578	-0.2333
	[-0.254]	[0.129]	[3.440]***	[-1.291]
Product Market	0.0811	0.0015	-0.0215	-0.1098
Competition	[1.968]**	[0.162]	[-1.501]	[-0.782]
Financial Markets	0.0001	0.0000	0.0001	-0.0015
	[0.286]	[0.713]	[0.390]	[-1.789]*
Observations				74272
R-squared				0.496
Number of Clusters				608
Number of Regressors				506
Number of Instruments				507
Number of Excluded Instruments				71
Kleibergen-Paap Wald rk F statistic				5.14
Anderson-Rubin Wald test				F(71,607)=165.17