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Abstract

Using a panel of about 75,000 firm-years from 48 countries for the period 1990–2007, we study how variations in the institutional environment affect the efficiency of investment. Using a canonical investment model, we identify two channels by which a country's institutional environment can affect investment: (i) the severity of financial frictions at the individual firm (micro) level; and (ii) the required (macro) rate of return. Empirically, we find that good corporate governance and good general institutions reduce financial frictions, especially for small firms, and that good corporate governance lowers the required rate of return. Other specific institutional factors—creditor rights, financial depth, and product market competition—do not robustly affect either financial frictions or the required rate of return. Our results suggest that informational frictions related to corporate governance and contractual enforcement represented by general institutions, rather than a simple collateral constraint for example, are most important sources of financial frictions which, in turn, determine investment efficiency.

JEL Classification Numbers: G30, O16, O43
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I. INTRODUCTION

Research in the last decade has identified a number of country-specific institutional characteristics which are related to economic performance and to overall development. Some of this research has tried to identify specific channels by which these institutional environment features affect economic performance: Important roles have been attributed to financial-sector and corporate-governance institutions in fostering a better allocation of capital, which is deemed as central to economic performance.

A separate literature has used deviations of Tobin's Q from its steady state value as indicators of inefficient use of capital. A high Q firm should add more capital since the value of new capital goods exceeds its cost. A low Q firms should shed capital. These investment patterns lead the firm's Q to adjust back towards its steady-state level (Tobin, 1969).

The present paper combines these two lines of research. First, we show theoretically that the overall effect of good institutions on the speed of convergence of Tobin's Q to its steady state is unclear. Based on a canonical investment model, we identify two forces which affect the speed at which Tobin's Q converges to its steady state value: On the one hand, fewer financial frictions brought about by good institutions reduce the sensitivity of investment to current cash flows. This, in turn, translates into slower adjustments in Tobin's Q. On the other hand, good institutions lead to a lower required rate of return. This allows for larger movements in Tobin's Q towards its steady state level.

Next, using the model, we empirically decompose the effects of institutional quality at the country level along these two channels: a micro channel (financial frictions) and a macro channel (the required rate of return). For a sample of about 75,000 firm-years from 48 countries for the period 1990 to 2007, we find that good corporate governance reduces financial frictions, especially for small firms, and also lowers the required rate of return. Good general institutions (e.g., rule of law and property rights) also reduces small firm premium in financial frictions. These effects are economically substantial. However, other specific institutional environments such as creditor rights, financial depth, and product market competition are not robustly affecting the financial frictions nor the required rate of return. The results suggest that informational frictions related to corporate governance and contractual enforcement represented by general institutions are most important in determining financial frictions, and in turn investment efficiency.

Macroeconomic models with financial frictions (e.g., Bernanke and Gertler, 1989, Greenwood and Jovanovic, 1990, and Kiyotaki and Moore, 1997) also consider the investment process closely with a richer general equilibrium analysis, but typically take the institutional environment as given. In particular, much of the macroeconomic literature assumes that the main financial frictions lie in the bank loans either as a costly state verification or a collateral constraint. Our paper provides evidence against this bank-centered friction assumption, especially for the collateral constraint, by showing that creditor rights is not a key factor determining the financial frictions, at least for the listed firms in major industrial and emerging market economies.

The rest of the paper is organized as follows. Section II reviews the literature; Section III introduces a canonical investment model; Section IV explains the estimation strategy and empirical approach; Section V describes the data set used for this study; Section VI presents the estimation results; Section VII examines measurement error issues, and Section VIII concludes.

II. Literature Review

Theoretical models show investment to be related to Tobin's Q (Tobin, 1969; Mussa, 1977; Abel, 1983; Abel and Eberly, 1994). The relationship is possibly nonlinear due to real adjustment costs (Abel and Eberly, 1994); the presence of financial frictions (Gomes, 2001; Hennessy, Levy, and Whited, 2007) and other market imperfections (Abel and Eberly, 2008) can further alter the relationship, rendering the impact of cash flows on investment, for example, difficult to predict. These studies imply the existence of an equilibrium law of motion for Tobin's Q and suggest several factors that can account for movements in it. Empirically, the existing literature on Tobin's Q has focused primarily on the U.S. and some other developed economies with little attention given to the importance of country-specific institutional factors in determining the efficiency of investment and the associated adjustment in Tobin's Q. Therefore, the actual role of financial frictions in affecting investment efficiency, and the reasons why these frictions arise, remain empirically unclear.

The current paper builds on the existing theoretical literature and tries to fill the empirical gap. In doing so, the paper relates to a broader empirical literature that also attempts to measure the efficiency of allocating capital across sectors using a variety of measures. That literature, however, is typically not related to Tobin's Q and often lacks theoretical underpinnings. Efficiency in allocating capital is sometimes measured by simply GDP or TFP growth (e.g., Beck, Loayza, and Levine, 2000; De Nicolo, Laeven, and Ueda, 2008). Within this line of research, many studies also rely on general measures of financial development (such as market capitalization to GDP ratios) and to analyze how a country's growth rate is related to these measures without empirically identifying specific causal channels (e.g., Demirguc-Kunt and Levine, 2001, Morck et al, 2000, La Porta et al., 2008).

Since these studies do not estimate a specific structural model, they offer limited insights on the institutional determinants of financial frictions associated with investment or the required rate of return for investors.

Conceptually closely related to the present paper is Rajan and Zingales (1998) and subsequent papers which show that industries that depend on external finance tend to grow faster in countries with more developed financial systems. For example, Wurgler (2000) uses a measure of industry-specific investment opportunities derived from growth in value added. He shows that, in a sample of 65 countries, more financially developed countries allocate more capital to growing industries and less to declining sectors.

Investment inefficiency is now considered as a major factor for economic growth. Hsieh and Klenow (2009) find a much larger dispersion in the marginal product of capital for industrial plants in China and India than in the U.S, a result which they interpret as evidence of a less efficient allocation of capital. With only three countries in their sample, however, any assessment of the causes of any inefficiency is difficult.[1] Abiad, Oomes, and Ueda (2008) shows that, under certain conditions and after controlling for industry and age effects, the cross-sectional dispersion of Tobin's Q can be a proxy for the *ex ante* efficiency of capital allocation. For a sample of five developing countries, they find that after financial liberalization the within-industry allocation of capital improves (that is, the dispersion of Q

[1] In contrast with dispersion in the *ex ante* (expected) marginal product of capital, *ex post* dispersion is not necessarily linked to inefficiency. For example, better developed financial systems may allow firms to take high-risk and high-return projects which lead to a larger dispersion in the *ex post* marginal product of capital. Other measures have also been used to gauge the efficiency of capital allocation: Acharya, Imbs and Sturguess (2007), for example, use a mean-variance measure of industrial output for each U.S. state and show that financial deregulation brings a state closer to the efficient frontier. Others (e.g., Galindo, Schiantarelli, and Weiss, 2007) use more conventional *ex post* rate of return-based measures to show the impact of financial and other reforms on the efficiency of the allocation of capital.

declines). However, the dispersion of Q is less useful for cross-country (rather than within-country) comparisons, as Q's steady state values are firm and country specific.

III. Theoretical Predictions

A. Model Setup

Our first objective is to develop a microeconomic-based law-of-motion for Tobin's Q which incorporates the effect of institutions on capital adjustment. We do so by using the well-known investment models of Hayashi (1982), Abel and Blanchard (1986), and Abel and Eberly (1994), and introduce financial frictions in them, a generalized version 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 (revealed) productivity at the beginning of the current period, ε, investment I is determined, adjustment costs are paid, and a new capital stock K is formed immediately. Using the new capital stock, K, goods are produced with productivity ε. This timing framework is consistent with the continuous time model of Abel and Eberly (1994), as well as with discrete time models with short lags between investment expenditure and the productive use of new machines.[2]

[2] In this formulation, there is no "time-to-build," which means that firm managers make their investment decisions after the revelation of productivity. This affects both the theoretical dynamics and the interpretations of the estimated coefficients. In particular, both current and next period's Qs matter for investment. This contrasts with Barnett and Sakellaris (1999), a special case of the "time-to-build" models. In their model, there is no equilibrium law of motion of Q. Nevertheless, our empirical results are robust to different timing assumptions (see Section VII).

Within-period "working capital" finance (using credit lines or trade credit) is assumed to involve little financial friction costs.[3] Over-the-period external finance B is, however, costly. The amount desired is determined at the end of the period when gross profits (or the return to capital), π, are realized. We use a convex cost function for external finance following Gomes (2001), although our cost function is more general than his linear function.

Profits (return to capital) are denoted by $\pi(K_t, \varepsilon_t)$. Following Hayashi (1982), we model the labor decisions of the firm in a trivial manner, by assuming the labor market to be competitive with a constant-returns-to-scale production function, f, and a competitive wage o such that:

$$\pi(K_t, \varepsilon_t) = \varepsilon_t f(K_t, L_t) - o_t L_t,$$

with the usual marginal condition: $o_t = f_{Lt}$. Similarly, we assume that the product market is competitive. Shocks, ε, to productivity (or rents) are assumed 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 achieve higher profits in the next period as well.[4]

The firm's capital stock increases with investment, I, but it is subject to depreciation at a rate of δ:

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

Investment is associated with adjustment costs, $\phi(I_t, K_t; X_t, W, \varepsilon_t) - \delta K_{t-1} - I_t$. These adjustment costs are lost right after investment because of, for example, costly learning

[3] An observationally equivalent assumption is that the within-period credit is also costly but its transaction cost is proportional to the end-of-period net borrowing. Either one of the assumptions is needed for within-period credit because, in the data, we only observe the end-of-period balance sheet information.

[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," and also affect Tobin's Q.

associated with the introduction of new machines. Note that the gross adjustment costs ϕ, include both depreciation and new investment. In this specification, *X* denotes fundamental characteristics (such as the industry and age of a firm), which can be time-varying but are assumed to be non-stochastic and predictable (e.g., age). *W* denotes "institutional quality," which agents assume to be time-invariant and exogenous, consistent with the fact that institutional quality is known to be stable or slow-moving over time. As in much of literature, we assume the adjustment costs of investment, ϕ, to be linearly homogeneous of degree one in investment *I* and capital *K*.

Given the law of motion for capital (1), the adjustment costs of investment can be expressed as a function of capital in the current and previous periods:

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

The firm also faces financial transaction costs, $\lambda(B_t,K_t;X_t,W,\varepsilon_t)$, where *B* denotes the amount of external finance desired. Financial transaction cost matters only when net external finance is positive, that is, when investment is greater than cash flows. This cost is assumed to be linearly homogeneous in external finance, *B*, and in capital, *K*, as for the adjustment costs of investment. Hence, financial transaction costs can be also expressed as a function of capital of the current and previous periods:

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

Implicitly, we assume that, if a firm reaches a limit in its ability to issue debt, it can still issue equity at a high cost, which is nevertheless still lower than the prohibitively high cost of borrowing. That is, we assume the overall cost function of external finance to be convex and never to reach a limit. This assumption is not far from reality for our sample of listed firms, which are listed and therefore, at least theoretically, always able to issue equity to finance investment. This approach implies that external financing can grow without limits as long as it is used for investment.[5] Similarly, we do not need to consider non-fixed investments, such as cash and equivalents, separately.[6]

A related issue is the firm's maximization objective. We assume the firm to maximize the value of capital for all claimholders, that is, both shareholders and creditors. This is in line with most of the investment literature, which does not distinguish between various types of financing sources. Consistently, profits, π, includes returns to both creditors and shareholders in the form of interest payments, dividends, and retained earnings.

Both the adjustment cost of investment and the financial transactions costs are incurred at the firm level, or are *internal* to the firm. In addition, there is also an *external* or general-equilibrium effect (Mussa, 1977), appearing in our model as the certainty equivalent of the required rate of return, r. This rate is affected by macroeconomic factors, such as the risk free rate, the inflation rate, and general macroeconomic volatility in line with Abel and Eberly (2008). The rate also varies across countries depending on their institutional quality, W, which is non-stochastic. This is because institutional quality may affect the degree of overall investment risk (e.g., arising from weak bankruptcy procedures or the possibility of

[5] Note that we treat the adjustment cost of investment, $\phi(I_t, K_t; X_t, W, \varepsilon_t)$, arising from purely technological issues, not from financing activities. This assumption is consistent with investment models without financial frictions, as well as with Gomes' (2001) model which does include financial frictions. This treatment of investment costs differs from the assumption made by Hennessy, Levy, and Whited (2007) who regard $\phi(I_t, K_t; X_t, W, \varepsilon_t)$ as the adjustment cost of equity finance. Because, unlike them, we do not make any distinction between equity and debt finance $\lambda(B_t, K_t; X_t, W, \varepsilon_t)$ is defined as the costs associated with any form of external finance. By contrast, Hennessy, Levy, and Whited (2007) regard this as the cost of debt finance only.

[6] We treat all assets, including cash and equivalents, as capital, which can generate profits. This is because, in our framework, any frictions associated with non-capital assets, such as cash holdings, are also reflected in the cost of external finance. For example, if cash management is not efficient, outside investors may fear the misuse of internal cash and the cost of external finance would be higher.

nationalization). One of the hypotheses we test below is that a good institutional environment is associated with a lower required rate of return.

The required rate of return also varies with firm characteristics, *X*. For example, it can differ across industries or across vintages of capital (related to firm age). Firms within the same industry are assumed to have the same covariance term with respect to the country-level market portfolio, except that firm age may matter. We therefore include industry dummies and age variables in the vector of firm characteristics, *X*.

We assume that each firm's productivity shock, ε, is observed by firm management, but that the aggregate and industry-specific common components of the shock are unknown to management when making investment decisions. Therefore, the discount factor becomes deterministic after expectations are taken over aggregate and industry-specific common shocks. Current profits, frictions, and the value of the next-period capital stock are non-stochastic with respect to the current firm-level shock. Firm characteristics, *X*, are also assumed to be non-stochastic.

In equilibrium, the required rate of return, given the current value of the firm, will equal the next period's expected profits minus the investment adjustment costs and financial frictions, plus capital gains (see Appendix I for more details on the derivation):

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

Here, the minus-sign, –, in superscript denotes one-period past values and the plus-sign, +, one-period ahead values. Note that both the real adjustment cost of investment (2) and the financial frictions (3) can be expressed as a function of current and previous periods' capital stocks. Also, the value function (4) has only one state variable, capital *K*, in addition to the predetermined firm characteristics *X* and the time invariant country characteristics *W*.

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

The optimality condition can be easily derived using $Q = V_1$, the derivative of firm value with respect to capital (see Appendix I):

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

This equation describes the equilibrium law-of-motion of Tobin's 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-the-period value of capital. The right-hand-side is the sum of the expected capital gains and profits, net of the marginal costs associated with investment and external finance. By rearranging (5), we can obtain a formula to be used empirical tests:

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

Recall that financial friction costs are paid only when external finance is actually used. Therefore, the λ terms vanish from equation (6) when external finance is non-positive (consistent with the Kuhn-Tucker conditions when we solve the equation with this condition explicitly). Similarly, investment adjustment costs are zero when investment is non-positive, in which case that the ϕ term drops from (6).[7]

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

C. Relation to the Speed of Adjustment of Tobin's Q

In a world without frictions, Tobin's Q should quickly converge to one. Intuitively, we may therefore expect that the better the institutional environment, the faster convergence is. Our model shows, however, that the relationship between the adjustment speed of Tobin's Q and the institutional environment is theoretically ambiguous. To see this, we rewrite equation (6) as:

$$\frac{Q^{-}-E[Q]}{Q^{-}}=\frac{(1+\lambda_1)\pi_1-(1+\delta)(\phi_2+\lambda_2)}{Q^{-}}-(r+\delta)\,. \tag{7}$$

Equation (7) shows that the adjustment speed of Q to its steady state value is a function of the required rate of return, *r*, and the (marginal) financial frictions of investment, λ_1, but with opposite signs. We conjecture that better institutions reduce both the required rate of return and the degree of financial frictions.[8]

Starting from a Q greater than 1, better institutions, leading to a lower required rate of return, imply a larger decline in Tobin's Q. At the same time, better institutions reduce the marginal financial frictions of investment, λ_1. This implies that, for a given level of marginal profits, π_1, firms in a country with better institutions see Q adjust more slowly. This is an equilibrium phenomenon: the divergence of Q from steady state is small to begin with for firms in countries with low financial frictions, and therefore their adjustment speed is also lower. This shows that, from a theoretical perspective, although better institutions do bring about a more efficient investment allocation, better institutions need not necessarily mean that Q adjusts faster or larger.

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[8] For example, investors are likely to require a lower risk premium for a firm in a country with good institutions, which *ceteris paribus* ensures efficient management and little misuse of funds.

We also allow for a size discount (or small firm premium) denoted by λ_2. This coefficient is expected to be positive (but less than one), that is, larger firms pay lower fees per unit of capital. This small firm premium is likely to be lower in a country with a good institutional environment.

D. Average versus Marginal Q

As in other models, our predictions apply to the marginal Q, the derivative of firm value with respect to capital. This can differ from the average Q, the ratio of firm value to assets. However, as in most of the literature, we follow Hayashi (1982) and assume conditions such that the marginal equals the average value of Q. We do, however, differ from Hayashi's model in that we include the external finance cost function, λ. Since λ is assumed to be symmetric (linearly homogeneous of degree one) to the real adjustment cost of investment, Hayashi's proof (allowing marginal values to equal average ones) still holds.[9]

IV. Estimation Methodology

A. Minimizing One-Period-Ahead Forecast Errors

Both adjustment costs and financial frictions are assumed to be linear functions of firm characteristics, X ($n \times k_1$ matrix, with n being the sample size i.e., the number of firm-

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

year observations) and country institutions, W ($n \times k_2$ matrix). We can therefore write the regression equation based on (6) as:

$$E[Q \mid \varepsilon] = X\gamma_1 + W\gamma_2 + Q^{-}\alpha_1 + (X * Q^{-})\alpha_2 + (W * Q^{-})\alpha_3 + Z\beta_1 + (X * Z)\beta_2 + (W * Z)\beta_3. \quad (8)$$

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

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

$$\xi = Q - E\left[Q \mid \varepsilon\right]. \quad (9)$$

Note that 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.[10]

By minimizing the one-period-ahead forecast errors based on the equilibrium law of motion of Tobin's Q, our approach avoids some of the technical problems of typical investment regressions (see further details in Appendix II). We may still have measurement and specification error issues, as encountered in the general literature on *Q*; these are discussed in the last section.

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[10] We still need to correct for the fact that firms within a country are likely to be subject to correlated shocks (heteroskedasticity) in each year. We therefore use robust standard errors with clustering at the country-year level.

B. Parameterization

As in most studies, we use linear, homogeneous and convex investment adjustment costs:[11]

$$\phi(I,K,\varepsilon)=c_1 I+c_2 K+\frac{c_3}{2}\left(\frac{I}{K}\right)^2 K\,. \tag{10}$$

Although new to this literature, we think it is natural to assume a similar functional form for financial frictions, which can be seen as a generalized version of Gomes (2001):

$$\lambda(B,K,\varepsilon)=b_1 B+b_2 K+\frac{b_3}{2}\left(\frac{B}{K}\right)^2 K\,. \tag{11}$$

As in Equation (6), the partial derivatives of these adjustment costs and financial frictions functions drive the equilibrium law of motion of Tobin's Q. In particular, it is the coefficients c_2, c_3, b_1, b_2, and b_3 that matter.[12] We next assume that these coefficients are each a linear function of the real environment characteristics, *X*, and of the institutional factors, *W*. We make a similar assumption with respect to the required rate of return, *r*, which will be reflected in the coefficient *a* on the lagged *Q* — *a(X, W)*. As discussed already, we use *Total Asset, A,* as a broad measure of capital, including cash and equivalents.

Taken together, based on equation (6), our regression equation becomes:

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[11] Although there is no "pure" fixed cost in (10), the *K* term can be regarded as a fixed cost which is proportional to the size of the firm, regardless of the size of investment.

[12] 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.

$$
\begin{aligned}
Q_{i,j,k,t} = \; & \kappa\pi_{1,i,j,k,t} \\
& +\gamma\left(X_{j,k,t}, W_k\right) \\
& +a\left(X_{j,k,t}, W_k\right)Q_{i,j,k,t-1} \\
& -b_1\left(X_{j,k,t}, W_k\right)\pi_{1,i,j,k,t}\chi_{i,j,k,t} \\
& +b_2\left(X_{j,k,t}, W_k\right)\chi_{i,j,k,t} \\
& -b_3\left(X_{j,k,t}, W_k\right)\left\{\left(\frac{B_{i,j,k,t}}{A_{i,j,k,t}}\right)\pi_{1,i,j,k,t} + \frac{1}{2}\left(\frac{B_{i,j,k,t}}{A_{i,j,k,t}}\right)^2\right\}\chi_{i,j,k,t} \\
& +c_2\left(X_{j,k,t}\right)\Psi_{i,j,k,t} \\
& -c_3\left(X_{j,k,t}\right)\left(\frac{I_{i,j,k}}{A_{i,j,k,t}}\right)^2\Psi_{i,j,k,t} \\
& +\xi_{i,j,k,t}, \qquad (12)
\end{aligned}
$$

where the last term represents the one-period ahead forecast errors, as defined in (9). The indicator functions are defined as:

$$
\begin{aligned}
\Psi_{i,j,k,t} &= 1, \text{ if } {=}\mathrm{I}_{i,j,k,t} > 0, \\
&= 0, \text{ otherwise; and}
\end{aligned}
$$

$$
\begin{aligned}
\chi_{i,j,k,t} &= 1, \text{ if } B_{i,j,k,t} > 0, \\
&= 0, \text{ otherwise.}
\end{aligned}
$$

The marginal return 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 second term $\gamma\left(X_{j,k,t}, W_k\right)$ controls for level effects, including country and industry fixed effects. We describe the variables in more detail in the data section below.

C. Identification

The effects of institutions on financial frictions and on the required rate of return are identified by the interaction terms. Institutional variables are time invariant and therefore all the level effects of institutions are absorbed in the country fixed effects. The coefficients for investment and external finance are identified because their values differ.[13] In addition, because investment is not supposed to be influenced by current profits, but financing is, only external finance is interacted with profits (in the form of b_1 and b_3). This is similar to what is implicitly assumed for cash flow sensitivity in a typical investment regression, except that the mechanism in this paper allows for a more precise way to measure financial frictions.

We also assume that the institutional factors do not affect the technological adjustment of the investment. Nevertheless, we revisit this issue later.

V. Data Description

All variable definitions, data sources and some sample statistics are presented in Table 1. We use firm level data from the Worldscope database, provided by Thomson Financial. The data set used for this study is obtained in January 2009, covering the period 1990 to 2007 from 48 countries, and containing about 380,000 firm-year observations for which Tobin's Q can be constructed.[14] We eliminate observations for a number of reasons:

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

[14] Original firm-year observations, including those for which Tobin's Q cannot be constructed, are about one million, although those without Tobin's Q may well include inactive firms. The 48 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,

(continued)

First, observations are dropped when values are economically not meaningful, such as when the value of capital expenditure is negative. Second, observations are dropped on a statistical basis, by eliminating observations in excess of three standard deviations from the mean for that variable based on the U.S. sample. Third, in the resulting data set, countries which have less than 15 non-financial companies per country with non-missing values for Tobin's Q in the year 2000 are dropped (Egypt, Morocco, Slovakia, Slovenia and Zimbabwe). Fourth, in both the U.S. and the global samples, 2-digit SIC industries which have less than five firms with non-missing values for age and Tobin's Q in the year 2000, as well as all unclassified companies (SIC 99), are dropped. About 300,000 observations with Q remain in the sample. For the regression results, however, availability of lagged Q and other variables reduces the sample significantly, leaving about 75,000 firm-year observations in the benchmark regression.[15]

The marginal profit, π_1, 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* (the variable names here and below correspond to those of Worldscope unless otherwise noted). For robustness, we also use *Operating Income + Depreciation and Amortization*. The main difference is that the latter is a before-tax measure, which is perhaps

Portugal, Russia, Singapore, South Africa, Spain, Sri Lanka, Sweden, Switzerland, Taiwan, Thailand, Turkey, United Kingdom, United States, and Venezuela.

[15] The firm age variable, described below, is especially costly in reducing the sample size from about 150,000 to 75,000. Even though the age variable itself can be constructed for about 270,000 observations, roughly the same sample size as Tobin's Q, out of the original one million observations, the joint availability is much smaller. We check below the robustness of our results by excluding firm age and using a bigger sample. Non-availability of all the other variables halves the sample size from 300,000 to 150,000. Note that if missing data should be interpreted as zero, we use zero (for example, *Net Proceeds from Sale/Issue of Common and Preferred Stocks*).

less susceptible to tax driven adjustments. While accounting adjustments may sometimes hide the true performance of a firm, these adjustments are often legitimate (e.g., reflecting tax credits for R&D expenditures or for future losses). Also, taxation matters for firm valuation.

For investment, *I*, we use *Capital Expenditure* as the benchmark. This is the usual definition of investment which is subject to adjustment costs, although our broader definition of capital stock includes cash and equivalents (e.g., holdings of bonds and equity investments in other companies). But, as a robustness check, we also use the broader notion, *Capital Expenditure + Change in Cash and Short-Term Investment*, for investment.

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 use *Total Asset* as our broad measure of capital and define Tobin's Q as (*Market Capitalization + Total Asset – Total Equity)/Total Asset*. Tobin's Q is measured at fiscal-year end, usually right after the ex-dividend date. This measure of Q is commonly used in the cross-country corporate finance literature because the short time dimension of the panel data prevents more elaborate calculations of capital stocks—our data set includes only 16 years, which are too short to calculate capital stocks on the basis of the permanent inventory method (Blanchard, Rhee, and Summers, 1994). Debt is valued at par since corporate bond prices are not available for most countries in our sample. We discuss these potential measurement error issues in Section VII.

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

The required rate of return is an unobservable risk premium plus an unobservable risk free rate. Our measure of the risk free rate is the country-specific real short-term risk free rate (i.e., short-term government Treasury bill rate minus CPI inflation). To capture the true risk free rate, we control for the country specific macroeconomic environment, that is, CPI inflation rate and macroeconomic volatility, which in the benchmark is measured by the standard deviation of real GDP growth for the period 1995-2006. Moreover, these macroeconomic environments may as well affect financial frictions (e.g., a higher interest rate translates to a higher cost of external finance). Thus, they appear in every relevant coefficient. The last two variables are drawn from the World Development Indicators, while short-term government Treasury bill rates are from various sources, but mainly from the IMF's International Financial Statistics.

To capture country-level institutional factors, *W*, we use several variables, covering both the *de jure* and the *de facto* characteristics. Specifically, we investigate five dimensions: the quality of corporate governance (*CorpGov*), creditor rights (*Creditor*), general institutional quality (*Institution),* product market competition (*Compet*), and financial market development (*FinMkt*). We have several indicators for each institutional measure (Table 1). In the benchmark regression, we use as a measure of corporate governance quality (*CorpGov*) the shareholder (anti-director) rights (La Porta et al., 1998), a commonly used measure of investor (shareholder) protection in the literature. For the degree of creditor protection (*Creditor*), we use the strength of legal protection for lenders and borrowers (World Bank, Doing Business Survey, 2008). For general institutional quality (*Institution*), we use the measure of property rights from La Porta et al. (1998). As a proxy for product market competition (*Compet*), we use a measure of trade barriers (World Economic Forum, 2007). For financial market development (*FinMkt*), we use the stock market-capitalization-to-GDP ratio for 2005 (World Development Indicators).

Altogether, we write the interaction terms with lagged Q in (12) as,

$$\begin{aligned} a(X_{j,k,t,}W_k) = &\sum\nolimits_j a_{1j} IndustryDummy_j + a_2 Age_{i,j,k,t} \\ &+a_3 RiskFreeRate_k + a_4 Inflation + a_5 Macro \\ &+a_6 CorpGov + a_7 Creditor + a_8 Institution \\ &+a_9 Compet + a_{10} FinMkt. \end{aligned} \tag{13}$$

The coefficients on the other interaction terms, $\boldsymbol{b_1}$, $\boldsymbol{b_2}$, $\boldsymbol{b_3}$, $\boldsymbol{c_2}$, and $\boldsymbol{c_3}$, take the same form as above. The level effect $\boldsymbol{\gamma}$ includes country fixed effects, that is,

$$\begin{aligned} \gamma(X_{j,k,t,}W_k) = &\sum\nolimits_k \gamma_{0k} CountryDummy_k + \sum\nolimits_j \gamma_{1j} IndustryDummy_j + \gamma_2 Age_{i,j,k,t} \\ &+\gamma_3 RiskFreeRate_k + \gamma_4 Inflation + \gamma_5 Macro \\ &+\gamma_6 CorpGov + \gamma_7 Creditor + \gamma_8 Institution \\ &+\gamma_9 Compet + \gamma_{10} FinMkt. \end{aligned} \tag{14}$$

VI. ESTIMATION RESULTS

A. Benchmark Regression

Tables 2 shows the result of the benchmark regression. Specifically, it shows the coefficient estimates of the interaction terms of interest, where each cell representing the interaction term between the corresponding row (e.g., *Corporate Governance*) and column (e.g., lagged Q, *Required Return*).[16]

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) significantly is associated with a low required rate of return, with a coefficient of -0.0433. The magnitude of the effect should be interpreted as follows: A one-standard-deviation improvement (increase of 1.3) in the anti-director rights would lower Q by 0.16 immediately for the average firm (with Q=3). Thus, Tobin's Q quickly approached to one. Intense product market competition is associated with a high required rate of return (although this coefficient is significant only at the 10 percent level). Ironically, if firms are more protected, they may appear safer bets from the viewpoint of investors. Firm age is also associated with the opposite sign but the effect is tiny—Q increases by 0.01 for an average firm getting one year older. Other factors do not change the required rate of return.

The second to fourth columns present estimates of the effects of institutions and other variables on firm-level financial frictions. The second column presents the effect of institutions on the cost of external finance, or equivalently, the intercept of the marginal cost of external finance. The third column presents the effect of size, capturing the large firm

[16] Because the number of coefficients for the benchmark regressions with all the institutional variables included exceeds 500, we do not show the other coefficients (e.g. country and industry fixed effects) or interaction terms involving industry dummies (which can be provided upon request).

discount or small-firm premium. The fourth column presents the estimated effects of institutional quality on the curvature of external financing costs, or, equivalently, on the slope of the marginal cost curve. This is assumed to be increasing in the ratio of external finance to capital. Note that the second and fourth columns are expected to have opposite signs, as shown in equation (12).

Good corporate governance increases the intercept of marginal cost associated with financial frictions (column 2), but the effect is very small and significant only at the 10 percent level. Importantly, better corporate governance reduces the extra costs that small firms have to pay (column 3), with a one standard deviation improvement in investor protection (1.3) lowering this premium by about 3 percent per assets.[17] This means that a firm with assets one million dollars smaller than the world average can save 30,000 dollars in external financing costs in a country with one-standard-deviation better than average corporate governance (compared to a similar firm in a country with world-average corporate governance).

Good general institutional quality also lowers the small-firm premium. A one standard deviation improvement in this variable (0.8) lowers the small firm premium by about 4 percent per assets. Good creditor rights appear to increase the small firm premium, but the statistical significance of this result is low and not robust in other specifications discussed below. Other factors do not have statistically significant effects on firm-level financial frictions.

[17] The coefficient is positive on size. That is, a larger firm needs pay *more* in countries with good corporate governance compared to a similar firm in other countries. This means that a smaller firm pays *less* in these countries.

The effects can also be interpreted in terms of the speed of convergence of Q, as in equation (6) or (7). Specifically, the regression results imply that Q is expected to move relatively rapidly towards one (or its firm-specific steady state value) in countries with good corporate governance because the required return in these countries is low in comparison with countries where shareholder protection is poor. In addition, the adjustment in the Q of small firms becomes similar to large firms in countries where shareholder protection and the general institutional environment are good.

B. Robustness Checks

To verify that results are not driven by the specific measures we use, we examine a number of alternative proxies. We start with different measures of some of the 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 financial investments, in addition to fixed capital investment. In Table 3c, we use a narrower concept of external finance, excluding trade credit from the benchmark specification. The regressions with different measures of accounting items essentially replicate the benchmark results (Tables 3a–c). A slight change appears when we use a narrower concept of external capital (Table 3c): All effects become less significant except for the reduction in the small firm premium associated with better corporate governance. Note that effects of the real factors are not tabulated hereafter as their effects are hardly different from the benchmark regression in any regressions.

Next, we check if the true effect of one component, say corporate governance, is underestimated because other factors are correlated with it. Therefore, we estimate the effects of each institutional factor without including the other factors; each row of Table 4 shows the corresponding one-by-one regression—again, the coefficients on real factors are omitted as these are essentially unchanged. The regression results are virtually the same as in the benchmark regression. However, product market competition and financial market development show some significant effects, which are not observed in the benchmark regressions that include all the institutional factors at once. Because the omitted variable bias is controlled for in the benchmark regressions, the benchmark regression results do not overestimate the effects. In other words, the true effects lie somewhere between the two regressions. In what follows, we always include all five elements of institutional factors, as in the benchmark regressions.

Then, we examine alternative proxies for the institutional factors in the benchmark specification in Table 2 and reproduce the results using alternative institutional variables in Table 5 (each row presents the effect of one alternative institutional variable).

Other measures of corporate governance broadly support the conclusion that good corporate governance reduces financial frictions, although the effect varies. We first use Spamann's version of the anti-director rights (Spamann, 2010), which reconstruct the same index as in the benchmark regressions by a different researcher. This reverses the effects, which is not surprising given that Spamann argues that his index is quite different from La Porta, et al. (1998). The difficulty of coding the laws and regulations has led researchers to construct *de facto* measures, rather than *de jure* measures. We use the more up-to-date anti-self-dealing index, developed by Djankov et al. (2008), which is based on surveys of lawyers, and reflects actual practice rather than the law in the books. The benchmark regression 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 disclosure practices and the transparency of firms (we use the 1995-2003 average).[18] The benchmark regression results are, again, broadly replicated, except that the effect of corporate governance on the required rate of return is no longer statistically significant.[19]

For creditor rights (*Creditor*), we use a narrower definition that does not take into account the borrower-side sub-indices (Djankov, et al., 2007), and find that good creditor rights (not necessarily accompanied by good borrower protection) are associated with a high small firm premium, in contrast with most of the other regression specifications where creditor rights have low or little significance. If informational problems associated with small firms are central, then better creditor rights without better borrower protection, should reduce the small firm premium. By contrast, if banks enjoy monopoly power, then better creditor, but not borrower, protection should increase the bargaining power of banks so that the small firm premium should rise too. We also use a measure of bankruptcy efficiency (Djankov, et al., 2009), which is a survey-based measure of actual bankruptcy procedures. With this alternative, the benchmark results are replicated, that is, there is no effect of creditor rights on the convergence of Q. This is important evidence against many macroeconomic models that use the collateral requirement or synonymously the limited liability constraint as the financial frictions.

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[18] This index measures corporate governance in three dimensions: disclosure (number of accounting items disclosed, an updated version of CIFAR, 1993), transparency (disparity of earnings before and after accounting adjustments following Leuz, Nanda, and Wysocki, 2003), and stock price comovement (following Morck et al., 2000). Note that Doidge et al. (2007) report that, in cross-country studies, country-level corporate governance matters much more than the firm-level corporate governance. We therefore use only country-level corporate governance measures.

[19] 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.

As an alternative measure of general institutional quality (*Institution*), we use the rule of law (drawn from Kaufman, Kraay, and Mastruzzi, 2003) and trust in people (from the World Values Survey, www.worldvaluessurvey.org). Using either variable as measures of general institutional quality reduces the small firm premium as in the benchmark regression. However, these also exhibit an opposite effect, contributing to a higher curvature of the financing costs as in the benchmark. However, this effect is not robust to the different account definitions (Tables 3a-c), one-by-one regression (Table 4), and many specifications in Table 5 though not tabulated.

As an alternative measure of product market competition (*Compet*), we use the degree of new business entry (*World Development Indicators,* 2008) as well as the cost of business start-ups (World Bank Doing Business Survey, 2008) with the caveat that these *de facto* measures are also related to other institutional factors governing financial sector development. The effects are similar to those of corporate governance: high entry is associated with a low small-firm premium; and low start-up costs are associated with a low curvature of the financial cost function. These effects may reflect more intense product market competition, but may also capture broader financial characteristics that facilitate new firm entry and lower start-up costs. This potential multicollinearity may change the effect of general institutional quality, which, in this specification, appears to increase the curvature of financing costs, as well as the effect of corporate governance, which now appears to reduce the curvature of financial costs (reports of these effects of other variables are not tabulated).

As an alternative measure of financial development (*FinMkt*), we use private credit to GDP and the absence of foreign ownership restrictions (both are from *World Economic*

Forum, 2007). Different measures of financial market development hardly alter the benchmark regression results.

We also conduct robustness checks for our measures of macroeconomic volatility (*Macro*): We use the coefficient of variation of the exchange rate and the standard deviation of inflation rate, both from *World Development Indicator*s. The benchmark results are unchanged (not tabulated).

Finally, we check the robustness of the results by using less restrictive samples. Because *Age* is often missing, we exclude the *Age* variables from our regression and rerun it with a sample size which almost doubles, from 74,272 to 147,711(Table 6). Yet, the results are broadly similar to the benchmark results except that corporate governance does not matter for the required rate of return (Table 6). Finally, the regression results in the benchmark are based on non-financial firms, but the results remain similar when using either all firms or manufacturing firms only (not tabulated).

Overall, the benchmark results are broadly replicated in most regressions. Good corporate governance and general institutional quality consistently lower the financial cost premium of small firms. In addition, good corporate governance lowers the required rate of return in many specifications. All other factors do not show robust evidence on either required returns or on external finance costs.

The importance of shareholder, rather than creditor, protection suggests that differences in financial frictions are primarily driven by the availability of equity finance. Recall that our samples are listed firms. At the margin, they can resort to issue equity if the borrowing cost skyrocketed. This threshold is determined by how easy they can issue equity. Thus, even though typically most external finance is debt finance, the financial friction function seems to be largely influenced by equity finance. An alternative interpretation is that good corporate governance is necessary to ensure an efficient use of funds regardless of whether the source of funding is debt or equity finance. For example, information problems are likely to be more severe in smaller firms, and therefore better corporate governance reduces the small firm premium on financial frictions. A good general institutional quality reinforces this mechanism by ensuring more secure contract enforcement. At the aggregate level, the required rate of return is likely to be lower with better corporate governance. Thus, all firms, including large ones, benefit from better corporate governance.

C. Real Adjustment of Investment and Institutions

Good general and specific institutions may affect the speed of investment not only by lowering financial frictions but also by reducing real investment adjustment costs, for example, managerial entrenchment (e.g., Myers and Majluf, 1984, Gaudet, Lasserre, and Van Long, 1998) or worker sabotage (Parente and Prescott, 2000). We therefore include all the institutional variables in the coefficients that characterize the real adjustment costs of investment.

Regression results (Table 7) confirm that good corporate governance lowers the rate at which adjustment costs increase with size (***c2***). This size effect, presumably due to technological and managerial diseconomies of scale, is theoretically costly for larger firms and therefore lowering it is beneficial.[20] However, this benefits is somewhat offset by increased slope of the marginal real adjustment costs of investment: small new investments

[20] This is in contrast with the case of external financing costs in which the size effect goes in the opposite direction, that is, smaller firms pay a premium.

(relative to asset) appear to cost less but big new investments cost more. However, overall effect on investment (relative to asset) remains unknown because, unlike financial frictions, the intercept term is not identified econometrically.

As for financial frictions and the required rate of return, all the effects of corporate governance, general institutional quality, and other factors remain virtually unchanged from the benchmark regression.

VII. Measurement Errors

A. Source of Measurement Errors

Stock Price Movements

Stock markets may not always reflect fundamental values. For U.S. data, Abel and Blanchard (1986) circumvent this issue by constructing a time series for Tobin's Q on the basis of a long time series of past marginal products of capital. Phillippon (2009) utilizes a long time series of corporate bond prices, also for U.S. firms. Like them, the investment literature has been using U.S.-based data heavily. Because of the cross-country nature of the present study, and because the cross-country panel data are short in the time dimension, we cannot utilize these strategies. Note that price movements are quite volatile, and the measurement errors, if any, should have little auto-correlation.

Accounting Issues

In general, each accounting item is subject to some measurement errors. Thus, we have run robustness checks using different measures for the major variables other than Tobin's Q (Table 3a – c). As for the mismeasurement of debt (in the numerator) and the replacement cost of capital (in the denominator) of Tobin's Q, Blanchard, Rhee, and

Summers (1994) construct the capital stock from past investment and use bond yields to estimate the market value of debt using a long time series available for U.S. firms. Again, given the short time-dimension in our panel data, we cannot implement their approach and have to take the data as they are. Although intentional and unintentional misreporting may also prevail, country fixed effects take away institutionally persistent measurement errors.

Average Q vs Marginal Q

Ever since Hayashi (1982), theoretical differences between the marginal and average values of Q have been recognized in the literature. As noted above, we follow conventional assumptions so that the two values should coincide. However, as Hayashi (1982) shows, monopoly power in the product market may create a disparity between the marginal and average Q, and moreover, as Abel and Eberly (2008) show, movements in Q become larger with monopoly power and with decreasing returns to scale. Empirically, we have shown that the coefficients on product market competition are not robustly related to changes in Tobin's Q, based on the observed average Q. This suggests that, on average at the country level, monopoly power is small, compared with other factors affecting the evolution of the marginal Q. Note that industry-specific movements, to the extent that they are due to the industry's monopolistic nature, are controlled for by including industry interaction terms.

Different Timing Assumptions

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

Nevertheless, we consider different timing assumptions regarding the revelation of the current productivity shock. So far, we have assumed that the current 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, it is treated as non-stochastic from the viewpoint of the beginning of the current period.

It may be the case 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 we observe $E[Q^-|\varepsilon^-]$, not Q^- itself. If so, there will be no observation errors in the next period Q, as we 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: That is, decisions are made on the basis of the realized value of Q^- but we only observe the forecast value $E[Q^-|\varepsilon^-]$. Since these errors are one-period-ahead forecast errors, they should not exhibit any auto-correlation.

B. Testing for Measurement Errors

All four forms of measurement errors possibly affect the observed values of Tobin's Q. However, if indeed sizable measurement errors exist, then the OLS errors will exhibit serial correlation. To see this, note that the OLS errors can be expressed as

$$u_{OLS} = (\xi + \nu) - \left\{ \nu^- \alpha_{1OLS} + (X * \nu^-)\alpha_{2OLS} + (W * \nu^-)\alpha_{3OLS} \right\}, \qquad (15)$$

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

$$E\left[u_{OLS}'u_{OLS}^{+}\right]=-\left\{E\left[v'v\right]\alpha_{1OLS}+E\left[v'(X*v)\right]\alpha_{2OLS}+E\left[v'(W*v)\right]\alpha_{3OLS}\right\}. \quad (16)$$

This is expected to be non-zero in the presence of any measurement errors. If the measurement errors, *v*, are also serially correlated, more terms enter into (16) 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. Indeed, we find that the null hypothesis of zero serial correlation in (16) cannot be rejected.[21] Hence, the size of measurement errors, if any, is very small in comparison with the one-period-ahead forecast errors.

C. Instrumental Variable Estimation

Despite the conclusion that measurement errors are likely to be small in magnitude, we check the robustness of our findings against measurement errors by using instrumental variable estimation. Given the very small size of the measurement errors, it is likely that all measurement errors combined, if any, exhibit little auto-correlation.[22] This is consistent with

[21] Note that, with the fixed effect estimation we have used so far, theoretically the regression errors *u* have an additional autocorrelation (see Wooldridge, 2002, p.275). If we use only the samples of the last year in our dataset, we need to test for the autocorreation in (16) against the theoretical one, $-1/(T-1)$, where the time dimension $T=18$ in our case. We conduct this test correcting for the potential heteroskedasticity: the AR(1) coefficient of the fixed effect residuals is 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 in the dataset, we have to test the autocorrelation in (16) 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.

[22] If our test had indicated the presence of large measurement errors and the possibility of autocorrelation in measurement errors themselves, the best estimation technique would have been the measurement-error-robust GMM estimation developed by Erickson and Whited (2000). Because this is not the case, we use a simpler IV estimation strategy described below.

the plausible case where large swings in stock prices dominate all other sources of measurement errors.

Based on (8), the one-period-ahead forecast errors including measurement errors can be expressed as

$$\begin{aligned}\tilde{\xi} = (Q+\nu) - \{ & X\gamma_{1IV} + W\gamma_{2IV} \\ & +(Q^{-}+\nu^{-})\alpha_{1IV} + (X*(Q^{-}+\nu^{-}))\alpha_{2IV} + (W*(Q^{-}+\nu^{-}))\alpha_{3IV} \\ & +Z\beta_{1IV} + (X*Z)\beta_{2IV} + (W*Z)\beta_{3IV} \}.\end{aligned} \qquad (17)$$

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

$$E\left[S'\tilde{\xi} \right] = 0. \qquad (18)$$

The usual requirement for the 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 expunge the bias. We use twice-lagged Tobin's Q as the instrumental variable for lagged Q. This is a legitimate choice because the twice-lagged Q is well correlated to the lagged Q, but it is orthogonal to the one-period-ahead forecast error in the current period and has a measurement error which is (empirically found to be) orthogonal to the one associated with the 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., the lagged *E[Q]* in the limit), that is, $(X*E[Q^{-}])$ and $(W*E[Q^{-}])$. These fitted values are obtained by the OLS estimation. Otherwise, technically, the procedure is a standard two-stage-least-square estimation using lagged values similar to many studies (e.g., Almeida and Campello, 2010).[23]

Note that there is a general problem associated with the instrumental variable estimation. Instruments include an approximation error, because they are not perfectly correlated with the original variables (*weak instruments*).[24] In addition, in our case, the approximation error 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 effect estimation.

Table 8 shows the results for the benchmark specification using instrumental variables as described above. The results broadly replicate those of the OLS-fixed effects estimation. A notable difference is that the required rate of return is no longer affected by corporate governance but, instead, the curvature of financial frictions is now lowered significantly by better corporate governance. As in previous results, the small firm premium is lower in counties with good corporate governance and good general institutional quality.

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[23] 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 this by clustering at the country-year level. Theoretically, any n-times lagged Q's ($n>2$) can also be used as 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 firm, considering the computational burden, we use only the twice lagged Q with the just-identified system.

[24] There are no well-established tests for the *weak instruments* 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 enough to suggest the instruments are not weak. However, the Anderson-Rubin *F*-statistic is 165, rejecting the null hypothesis of under-identification. This, in turn, suggests that the instruments are not weak. Note that the latter test is considered stronger than the former.

Creditor rights no longer affect any of the dependent variables, but more developed financial markets reduce the required rate of return (significant only at the 10 percent level). Finally, more product market competition pushes up the required rate of return, as in the benchmark regression.

VIII. Concluding Remarks

We investigate how institutional environments affect investment. Theoretically, we modify a canonical investment model to include general financial frictions. Investments are assumed to be affected by institutional factors through financial frictions at the firm level and the required rate of return at the macro level. We then develop an estimation strategy to identify the effects of various institutional factors on financial frictions and on the required rate of return.

Our main empirical result is that good corporate governance, as reflected in strong shareholder protection and, somewhat less robustly, good general institutional quality, are associated with low financial frictions, in particular, the small-firm premium. Moreover, in many specifications, good corporate governance is associated with a low required rate of return. Taken together, these results imply that good corporate governance and general institutions lead to a more efficient capital allocation.

These findings are closely related to the convergence speed of Tobin's Q in different institutional environments. In a country with good corporate governance, our result suggests that Tobin's Q moves more rapidly towards one (or its firm-specific steady state value) because investors require a low rate of return. In addition, in countries with good corporate governance and institutions, small firms can raise capital and invest easily, so that their Tobin's Q evolves much like the Q of large firms.

Other factors, especially creditor rights, hardly affect the efficiency of capital allocation. One interpretation for the importance of shareholder rather than rights is that good corporate governance affects the cost of external equity finance and it is this cost which determines the overall cost of external finance. This is because, at the margin, listed firms switch to equity finance, if borrowing costs are soared, and they reduce their debt burden. Another interpretation is that the cost of external finance, regardless of the financial instruments used, implicitly measures investor fear of mismanagement of the injected capital. This effect is likely to be especially pronounced in smaller firms, which are subject to severe informational frictions. This interpretation is consistent with our findings on the link between good corporate governance and the small-firm premium. Good general institutions reinforce this mechanism by creating more secure contract enforcement.

Overall, our results highlight the importance of informational frictions related to corporate governance and contractual enforcement represented by general institutions are most important in determining financial frictions, and in turn investment efficiency. At the same time, the results points that creditor rights is not a key factor determining the financial frictions, at least for the listed firms in major industrial and emerging market economies, and thereby provide evidence against the bank-based financial friction, especially for the collateral constraint, which is employed in many macroeconomic models.

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Table 1a. 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	
Competitiveness	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]	[19]
Corporate Gov	Antidirector Rights Index/ La Porta et al. (1998)	[1]	1.00																		
	Antidirector Rights Index/Spamann (2009)	[2]	0.45	1.00																	
	Self Dealing Index/ Djankov et al. (2008)	[3]	0.56	0.20	1.00																
	Corporate Governance Quality Index/ De Nicola, Leaven and Ueda (2008)	[4]	0.12	0.19	0.11	1.00															
Creditors' Right	Strength of Legal Right Index /Doing Business (2007)	[5]	0.39	0.25	0.50	0.45	1.00														
	Creditor Rights / Djankov et all (2008)	[6]	0.12	0.14	0.44	0.11	0.43	1.00													
	Efficiency of Bankruptcy Law/ Global Competitiveness Report (2004)	[7]	0.13	0.21	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)	[8]	0.11	0.12	0.28	0.58	0.48	0.41	0.67	1.00											
	Rule of Law in 2000/ Kraay and Kaufman(2003)	[9]	0.16	0.17	0.25	0.81	0.58	0.31	0.87	0.83	1.00										
	Trust in People/ World Values Survey 1990-1993	[10]	0.10	-0.17	0.11	0.54	0.51	0.09	0.67	0.51	0.70	1.00									
Competitiveness	Barriers to Trade in 2007/World Economic Forum Global Competitiveness Report (2007)	[11]	0.12	0.19	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	[12]	0.10	0.05	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	[13]	-0.08	-0.21	-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	[14]	0.39	0.14	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	[15]	0.25	0.09	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)	[16]	0.24	0.02	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	[17]	-0.09	-0.23	-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	[18]	-0.19	0.01	-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	[19]	-0.03	0.18	-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 Regression

	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	-0.0433	-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]*		
Competitiveness	0.0772	0.0003	-0.0071	-0.0950		
	[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. Regression Using Before-Tax Income

	a Required Return [1]	-b1 (-) Fin. Friction Coeff. Ext. Fin. [2]	b2 Fin. Friction Coeff. Capital [3]	-b3 (-) Fin. Friction Curvature [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]
Competitiveness	0.0761	0.0018	-0.0080	-0.0986
	[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. Regression Using a Broad Concept of Investment (incl. Security Investment)

	a Required Return [1]	-b1 (-) Fin. Friction Coeff. Ext. Fin. [2]	b2 Fin. Friction Coeff. Capital [3]	-b3 (-) Fin. Friction Curvature [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]*
Competitiveness	0.0767	-0.0006	-0.0066	-0.0792
	[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. Regression Using a Narrow Concept of External Finance (excl. Trade Credit)

	a Required Return [1]	-b1 (-) Fin. Friction Coeff. Ext. Fin. [2]	b2 Fin. Friction Coeff. Capital [3]	-b3 (-) Fin. Friction Curvature [4]
Institutional Factors				
Corporate Governance	-0.0064	0.0005	0.0575	0.0095
	[-0.299]	[0.330]	[1.664]*	[0.492]
Creditor Rights	-0.0461	0.0008	0.0458	-0.0073
	[-1.140]	[0.854]	[0.767]	[-0.661]
Institution	0.0126	0.0023	0.0999	0.0000
	[0.182]	[0.972]	[0.937]	[.]
Competitiveness	0.0106	0.0010	-0.1212	0.0196
	[0.076]	[0.563]	[-0.513]	[0.710]
Financial Markets	0.0008	0.0000	-0.0008	0.0002
	[2.665]***	[-0.602]	[-1.301]	[0.550]
Observations				42421
R-squared				0.254
Number of Clusters				608

Table 4. One-by-One Regressions

	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	-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]			
Competitiveness	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							
Spamnn's Version	0.0190	0.0108	-0.0258	-0.0693	74272	0.4950	608
	[0.853]	[2.451]**	[-2.237]**	[-1.169]			
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]**			
Competitiveness							
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. Less Restricted Samples, Including Firms without Age Variables

	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	-0.0370	-0.0013	0.0283	0.0196
	[-1.460]	[-0.890]	[3.001]***	[1.127]
Creditor Rights	-0.0314	-0.0002	-0.0192	0.0182
	[-1.226]	[-0.106]	[-3.386]***	[0.912]
Institution	-0.0646	0.0051	0.1081	-0.0746
	[-0.959]	[0.787]	[6.159]***	[-0.986]
Competitiveness	0.0762	0.0026	-0.0248	0.0081
	[1.489]	[0.561]	[-1.654]*	[0.163]
Financial Markets	-0.0001	0.0000	0.0002	-0.0006
	[-0.382]	[0.620]	[1.390]	[-1.591]
Observations				147711
R-squared				0.435
Number of Clusters				608

Table 7. Including Institutional Effects in Real Investment Adjustment

	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	-0.0424**	-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]
Competitiveness	0.0782*	0.0005	-0.0013	-0.1008	0.1335	-0.9498
	[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 8. 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]
Competitiveness	0.0811	0.0015	-0.0215	-0.1098
	[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

Appendix I. Assumptions on Shocks and the Value Function

Suppose in each period a firm I subject to a shock $\varepsilon \in \mathrm{E}$ which follows a *cdf F*. This overall shock has three sources: an aggregate shock, $\theta \in \Theta$, which follows a *cdf G*; an industry-specific shock, $\omega \in \Omega$, which follows a *cdf H*; and an idiosyncratic shock, $\upsilon \in \Upsilon$. The three components are assumed to be orthogonal to each other and each component follows a probability distribution with support (0, ∞), for example, a log-normal distribution.

We assume that firm managers can infer the overall shock, *ε*, when making investment decisions, but does not know the size of each component. We assume this in a strict sense, that is, $E\left[\theta+\omega \mid \varepsilon\right]=E\left[\theta+\omega \mid \varepsilon'\right]$ for any pair $(\varepsilon,\varepsilon') \in \mathrm{E}\times\mathrm{E}$.

We also assume that firm characteristics, *X*, are either time invariant (e.g., industry), or non-stochastic and predictable (e.g., age). For the institutional characteristics, *W*, we assume that they are stable and that any changes are perceived by firm managers as (unexpected) regime changes.

Based on those assumptions, the stochastic discount factor can be simply represented by $m(\theta,\omega;X,W)$ — it depends on the aggregate shock *θ* and the industry-specific shock *ω*, given firm characteristics *X* and institutions *W*. Note that this formulation already factors in the predictable change in the firm characteristics, as defined below using the original discount factor $\tilde{m}(\theta,\omega;gX,W)$ with *g*, the deterministic growth of *X*:

$$\tilde{m}(\theta,\omega;X^{+},W)=\tilde{m}(\theta,\omega;gX,W)=h(g)\tilde{m}(\theta,\omega;X,W)=m(\theta,\omega;X,W),$$

where, for simplicity, *h(g)* is assumed to be an increasing power function.

Using this normalized stochastic discount factor, the value function can now be expressed as

$$
\begin{aligned}
V(K^{-};X,W,\varepsilon) &= \max_{K}\int_{\Theta\times\Omega} m(\theta,\omega;X,W)\Big\{\pi(K,\epsilon)-\phi(I,K;X,W,\epsilon) \\
&\quad -\lambda(B,K;X,W,\epsilon)+\int_{\mathrm{E}} V(K;X^{+},W,\epsilon^{+})dF\Big\}dGdH \\
&= \max_{K}\int_{\Theta\times\Omega} m(\theta,\omega;X,W)dGdH\Big\{\pi(K,\epsilon)-\phi(I,K;X,W,\epsilon) \\
&\quad -\lambda(B,K;X,W,\epsilon)+\int_{\mathrm{E}} V(K;X^{+},W,\epsilon^{+})dF\Big\} \qquad \text{(A1)} \\
&= \max_{K}\frac{1}{1+r\big(E[\theta],X,W\big)}\Big\{\pi(K,\epsilon)-\phi(I,K;X,W,\epsilon) \\
&\quad -\lambda(B,K;X,W,\epsilon)+\int_{\mathrm{E}} V(K;X^{+},W,\epsilon^{+})dF\Big\},
\end{aligned}
$$

where the expected discount factor is defined as:

$$\frac{1}{1+r\big(E[\theta],X,W\big)}=\int_{\Theta\times\Omega} m(\theta,\omega;X,W)dGdH.$$

This varies with firm characteristics, *X,* and with institutional quality, *W*. The industry-specific risk premium stemming from stochastic process *ω* is absorbed in the "industry effect" portion of firm characteristics, *X*. Unexpected regime changes in macro shocks and industry level shocks are also potentially allowed in this expression. Note that the last line of (A1) is equivalent to (4).

Marginal conditions can be easily derived. Assuming positive investment and positive external finance, the first-order condition is:

$$\phi_1+\lambda_1=\pi_1+\lambda_1\pi_1-\phi_2-\lambda_2+E\big[V_1\big].$$

And the envelope condition is:

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

By combining the two conditions together, we obtain:

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

By definition: $Q = V_1$. Using the approximation, $1 + r + \delta \approx \frac{1+r}{1-\delta}$, we simplify the condition to:

$$(r+\delta)Q^{-} = E\left[Q - Q^{-}\right] + (1+\lambda_1)\pi_1 - \phi_2 - \lambda_2 . \tag{A2}$$

This is the same as (5).

Appendix II. Relation to Typical Investment Regressions

Many studies investigate financial constraints by regressing investment on cash flows and Tobin's Q. The typical assumption is that the sensitivity of investment to current cash flows reflects credit constraints. Tobin's Q is then used to control for growth opportunities. However, as Gomes (2001) shows, this "classic" investment regression is fraught with problems related to the identification of financial frictions. With auto-correlated productivity shocks ("growth opportunities"), current profits contain information on future profitability which affects investment decisions. This mechanism makes it difficult to argue that the sensitivity of investment to cash flows represents financing constraints. Moreover, with financial frictions as in (6), Tobin's Q reflects not only growth opportunities (as a discounted sum of future profits) but also financial frictions (e.g., credit constraints). In addition, there is also a macroeconomic effect on the value of Tobin's Q through the required rate of return.

Liu, Whited, and Zhang (2009) also used the canonical investment model (without financial frictions) but derived a different orthogonality condition, namely, the equivalence of the stock returns and the levered investment returns (i.e., a variant of the returns on equity). They show that the Q-theory based predictions for stock returns for U.S firms fit much better than previous models (i.e., CAPM, Fama-French, 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 and specification errors. Although measurement and specification errors exist, relying on these errors to estimate coefficients is not suitable for our study which is based on cross-country panel data unlike their U.S.-only sample. Because institutional factors could contribute to errors, using their methods could mean that we interpret the effects of institutional environments as reflecting minimizing measurement errors.