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ABSTRACT

Agency Conflicts, Investment and Asset Pricing*

Corporations in many countries are run by controlling shareholders whose cash flow rights in the firm are substantially smaller than their control rights. This separation of ownership and control allows the controlling shareholders to pursue private benefits at the cost of minority investors by diverting resources away from the firm and distorting corporate investment and payout policies. We develop a dynamic general equilibrium model to study the asset pricing and welfare implications of imperfect investor protection. The model predicts that countries with weaker investor protection have more incentives to overinvest, lower Tobin's q, higher return volatility, larger risk premium, and higher interest rate, consistent with existing empirical evidence. We show that weak investor protection causes significant wealth redistribution from outside shareholders to controlling shareholders. Finally, we provide evidence consistent with our model's two new predictions: countries with higher investment-capital ratios have both larger variance of GDP growth and larger variance of stock returns.

JEL Classification: G12, G31, G32 and G34
Keywords: agency conflicts, investor protection, investment specific technological change, overinvestment, asset pricing

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1 Introduction

The separation of corporate control from ownership is one of the main features of modern capital markets (Berle and Means (1932) and Jensen and Meckling (1976)). Many corporations have large shareholders whose control rights far exceed their cash-flow rights (Bebchuk et al. (2000), La Porta et al. (1998), and La Porta et al. (1999)), giving them an incentive to extract private benefits at the expense of minority shareholders. This agency conflict is only partially remedied by regulation aimed at protecting minority investors. Indeed, empirical evidence shows that stock market prices worldwide reflect the magnitude of the private benefits derived by controlling shareholders: Firm value increases in both the extent of minority investors' protection and the controlling shareholder's ownership in the firm.[1] While it is intuitive that weak investor protection lowers equity prices, the effects of investor protection on risk sharing, equity returns and the interest rate through investment and dividend policies are less obvious.

We develop a stochastic general equilibrium model with agency conflicts in investment. Our model departs from standard production-based equilibrium asset pricing models in two important ways. First, we assume that output fluctuations arise from shocks to the marginal efficiency of investment (Keynes (1936)), also known as investment-specific technological shocks. This assumption is motivated by the growing literature that emphasizes the important role of investment-specific technological shocks as a source of aggregate volatility (Greenwood et al. (1988), Greenwood et al. (1997) and Fisher (2006), among others). Second, in our model firm investment decisions are made by a self-interested controlling shareholder who extracts private benefits from minority outside investors. We embed the conflict of interest and the implied heterogeneity between controlling shareholders and minority investors in an equilibrium setting.

To isolate and focus on the effects of assuming investment-specific technological shocks, consider a benchmark economy with no conflicts of interests. Under perfect investor protection, the controlling shareholder rationally pursues no private benefits (because of infinite marginal cost of stealing), and thus behaves in the interest of minority investors. Our benchmark is thus a version of representative-agent asset pricing models such as Cox, Ingersoll, and Ross (1985) (henceforth CIR).[2] As in CIR, and other investment models, investment increases the capital stock on average. However, in our model the investment-specific technological shocks make the representative agent less willing to invest in capital: The amount of capital in the next period stochastically depends on how investment *merges* with the existing capital. A risk averse investor dislikes the volatility in output induced by investment and hence lowers investment, *ceteris paribus*. This makes the newly invested capital less desirable than the installed capital. As a result, Tobin's q is larger than unity, in contrast to CIR which predicts Tobin's q to be one. This technological specification is a key difference between our benchmark model and the

[1] See La Porta et al. (1999), La Porta et al. (2002), Claessens et al. (2002), Doidge et al. (2004), and Gompers et al. (2003). See La Porta et al. (2000b) for a survey of the investor protection literature.

[2] Also see Sundaresan (1984) and Cochrane (1991).

seminal CIR model.

When investor protection is imperfect, a conflict of interest arises between the controlling shareholder and minority investors. The controlling shareholder values private benefits more under weaker investor protection and is able to derive greater private benefits in larger firms (Baumol (1959), Williamson (1964) and Jensen (1986)). Thus, the controlling shareholder has stronger incentives to invest under weaker investor protection, *ceteris paribus*. However, with shocks to the marginal efficiency of investment, more investment means higher volatility of capital accumulation, which is undesirable. In equilibrium, we show that the effect induced by the extraction of private benefits dominates. This leads to the prediction that weaker investor protection implies more investment and more volatility, *ceteris paribus*.

The controlling shareholder's incentives to pursue private benefits and distort investment under weaker investor protection in turn imply a lower dividend payout, *ceteris paribus*. Tobin's q (from the minority shareholders' perspective) is lower, reflecting both the extraction of private benefits and investment distortions by the controlling shareholder. These predictions are in line with La Porta et al. (2000a) who find that corporate payout is lower in countries with weaker investor protection and La Porta et al. (2002), Gompers et al. (2003) and Doidge et al. (2004) who find that firm value increases with investor protection.

Our model also predicts that the equity risk premium is higher in countries with weaker investor protection. The equilibrium equity premium is proportional to the variance of output. The higher investment under weaker investor protection increases both the volatility of capital accumulation and that of output and hence increases the equilibrium risk premium. This prediction is consistent with the cross-country evidence in Hail and Leuz (2004) and Daouk, Lee, and Ng (2004) who establish a positive link between excess returns and various investor protection variables. Harvey (1995), Bekaert and Harvey (1997), and Bekaert and Urias (1999) show that emerging markets display higher return volatility and larger equity risk premia. Erb et al. (1996) find that expected returns and return volatility are higher when country credit risk is higher. Since emerging market economies have on average weaker corporate governance, these papers supply additional evidence in line with our theory.

Finally, the model predicts that countries with weaker investor protection have a higher interest rate. The intuition is as follows. Weaker investor protection generates more incentives for investment and hence higher future output. The desire to smooth consumption leads agents to borrow, thereby raising the interest rate. However, higher investment also makes capital accumulation more volatile and implies a stronger desire for precautionary savings, thereby lowering the interest rate. As the former effect dominates, the interest rate is higher under weaker investor protection. We find supportive evidence for our interest rate prediction using data in Campbell (2003).

We present a calibration of the model which allows us to assess the quantitative significance of improving investor protection. We calibrate the model to the United States and South Korea to match estimates of private benefits in the two countries. The model predicts that moving to perfect investor protection leads to a stock market revaluation of 2.5% in the United States and of 19% in Korea. The welfare implications of such improvement in investor protection are very large. U.S. and Korean minority investors are willing to give up 2.4% and 18% of their wealth to move to perfect investor protection, respectively. On the other hand, the U.S. and Korean controlling shareholders are willing to give up 2.1% and 8.3% of their wealth to maintain the *status quo*, respectively. These welfare numbers are quite robust. We show that, to a reasonable approximation, the welfare benefit to minority investors depends exclusively on the size of private benefits: When the later are large as empirically documented, the former must also be.

These calculations suggest significant wealth redistribution from controlling shareholders to minority investors by enhancing investor protection, particularly for Korea. Of course, the political reform necessary to improve investor protection is by no means an easy task, precisely because of the significant wealth redistribution. After all, the controlling shareholders and incumbent entrepreneurs are often among the strongest interest groups in the policy making process, particularly in countries with weaker investor protection.

Lastly, we test two new empirical predictions that result from our specification of investment-specific technological shocks and the equilibrium solution: A positive association between the investment-capital ratio and the variance of GDP growth and between the investment-capital ratio and the variance of stock returns. We construct measures of the long-run investment-capital ratio and test our hypotheses on a cross-section of 40 countries. We provide evidence consistent with both hypotheses, controlling for exogenous sources of volatility.

Several related papers study how asset prices or investment respond to different aspects of agency. Shleifer and Wolfenzon (2002) is a general equilibrium model with risk-neutral agents. Castro et al. (2004) focus on the implications of weak investor protection for the equilibrium interest rate. In contrast to our results, both papers predict that countries with better investor protection have higher interest rates. Himmelberg et al. (2002) analyze the investment decisions of a risk-averse controlling shareholder under imperfect investor protection in a partial equilibrium setting (by taking the stochastic discount factor as exogenously given), and derive predictions for the firm's cost of capital. Lan and Wang (2006) extend La Porta et al. (2002) to another neoclassical investment model with adjustment cost and show that managers overinvest to increase future private benefits, further reducing firm value. Therefore, better investor protection reduces the level of overinvestment and increases firm value. In contrast, with weak *creditor* protection, firms are subject to endogenous financing constraints and underinvest (Albuquerque and Hopenhayn (2004) and DeMarzo and Fishman (2006)). If creditor protection improves, agency is alleviated, investment increases and so does firm value. In our model overinvestment also arises because of the pursuit of private benefits by the controlling shareholder. This is likely to be the dominant issue for larger firms whereas underinvestment is more important for smaller firms.

The paper that is most closely related to ours is Dow, Gorton, and Krishnamurthy (2005) (henceforth, DGK). They study the effects of agency conflicts on equilibrium asset prices and investment by integrating managerial empire building as in Jensen (1986) into an otherwise neoclassical CIR-style asset pricing model. DGK analyze the manager-shareholder conflict in firms with dispersed ownership, while we study the agency conflict between controlling shareholders and minority investors.[3] As a result, because managers' wealth has zero measure in aggregate, DGK do not need to model their optimization problem. In contrast, controlling shareholders in many countries claim a significant share of aggregate wealth. We therefore model the controlling shareholders' optimization jointly with the minority investors' optimization and derive equilibrium implications for risk sharing, welfare redistribution, and various equilibrium prices and quantities. In addition, the two models differ in the production technology. DGK assume that capital accumulation is as in CIR and hence predict Tobin's q to be unity, independent of agency. In contrast, we assume investment-specific technological shocks, and predict that Tobin's q is larger than unity (under perfect investor protection) and that Tobin's q increases with investor protection. Our model also provides an explanation for the cross-country evidence that countries with weaker investor protection have higher risk premia and larger volatility.

The remainder of the paper is organized as follows. Section 2 presents the model and states the main theorem. Section 3 discusses the model solution under the benchmark with perfect investor protection. Section 4 characterizes the equilibrium outcome and provides intuition for the model's solution. Section 5 gives the model's main predictions for the effects of investor protection on investment and asset prices. Section 6 provides a calibration and supplies quantitative predictions on the value of improving investor protection. Section 7 presents empirical evidence on two of the model's new predictions and Section 8 concludes. The Appendix contains technical details and proofs for the theorem and propositions.

2 The Model

The economy is populated by a continuum of two types of agents, controlling shareholders and minority investors, identified with subscripts "1" and "2," respectively. Minority investors are all identical. All firms and their respective controlling shareholders are assumed to be identical as well and subject to the same shocks. Without loss of generality, we analyze the decision problems of the representative controlling shareholder and of the representative outside minority investor. All agents have infinite horizons and time is continuous.

[3] Danthine and Donaldson (2004) study the manager-shareholder agency conflict and its implications for the aggregate economy within a contracting environment.

2.1 Setup

Production and Investment Opportunities. Firms are all-equity financed. Output is produced via a constant returns to scale technology $hK(t)$, where h is the productivity level and $K(t)$ is the firm's capital stock. We assume that the capital stock evolves according to

$$dK(t) = (I(t) - \delta K(t))\,dt + \epsilon I(t)\,dZ(t), \tag{1}$$

where $I(t)$ is investment, $\delta > 0$ is the depreciation rate, $\epsilon > 0$ is a volatility parameter, $Z(t)$ is a Brownian motion, and $K(0) > 0$.

The capital accumulation specification (1) follows Greenwood, Hercowitz, and Huffman (1988), which in turn is inspired by Keynes' (1936) argument that production is subject to shocks to the marginal efficiency of investment. Equation(1) is different from the traditional specification of shocks via total factor productivity (TFP). The motivation is three-fold. First, quantitatively speaking, these shocks play an important role in the economy. Greenwood et al. (1997, 2000), identifying shocks to the marginal efficiency of investment with shocks to the relative price of investment goods, document that these shocks account for 60% of postwar-U.S. growth (Greenwood et al. (2000)) and 30% of output fluctuations in the postwar-U.S. period (Greenwood et al. (1997)). Using an econometric approach that relaxes the identification in Greenwood et al. (1997), Fisher (2006) shows that 50% of U.S. fluctuations are accounted for by shocks to the marginal efficiency of investment.[4] Second, the standard technology shock specification implies that recessions are caused by TFP decline, namely technical regress. This has met substantial skepticism among macro-economists (Romer (2006)). Third, the assumption of investment-specific technological change is analytically convenient to work with.[5] The capital accumulation process (1) in our paper and the ones in CIR and Sundaresan (1984) are both subject to shocks, unlike the conventional specification. However, unlike CIR (1985) and Sundaresan (1984), where uncertainty of capital accumulation is proportional to the level of capital stock K, uncertainty of capital accumulation is proportional to the level of investment I. We will show that this difference has an important implication on Tobin's q in Section 3.

Imperfect Investor Protection and Private Benefits. The controlling shareholder owns a fixed fraction $\alpha < 1$ of the firm.[6] Following Shleifer and Vishny (1997), La Porta et al. (2002) and the literature on investor protection, we also assume that the controlling shareholder is

[4] The formulation in Greenwood et al. (1988) is a stochastic version of Solow (1960). An alternative interpretation of (1) is as a stochastic installation function. Intuitively, how productive new investments are depends on how well they match with vintages of installed capital. Hence, (1) constitutes an extension of the deterministic installation function analyzed in Uzawa (1969) and Hayashi (1982).

[5] Albuquerque and Wang (2004) write an international variant of this model with TFP shocks, and demonstrate the robustness of our results to different technological specifications.

[6] We treat α as constant. We assume that the controlling shareholder cannot easily trade his shares due to an adverse price impact. This assumption of constant ownership for the controlling shareholders is consistent with La Porta et al. (1999) who empirically show that controlling shareholders' ownership share is quite stable over time.

fully entrenched and has complete control over the firm's investment and payout policies. We refer readers to Bebchuk et al. (2000) for details on how control rights can differ from cash flow rights (via dual-class shares, pyramid-ownership structures or cross ownership) and to La Porta et al. (1999) for evidence that control rights are often concentrated.

Building on Johnson et al. (2000) and La Porta et al. (2002), we model private benefits via a stealing technology.[7] The controlling shareholder may "steal" a fraction $s(t)$ from gross output $hK(t)$ by incurring a cost in the amount of

$$\Phi(s, hK) = \frac{\eta}{2}s^2 hK. \tag{2}$$

The parameter η is a measure of investor protection.[8] A higher η implies a larger marginal cost ηshK of diverting cash for private benefits and hence stronger investor protection. Later we impose a parametric region for η to ensure an interior solution for the stealing level $s(t)$. We choose the quadratic cost formula (2) for simplicity, but the model's intuition carries over to other convex-cost function specifications.

Investment $I(t)$ equals output $hK(t)$ net of dividends $D(t)$ and private benefits extracted by the controlling shareholder $s(t)hK(t)$. Thus, we have

$$I(t) = hK(t) - D(t) - s(t)hK(t). \tag{3}$$

To recapitulate, we have now introduced two key assumptions into the model: (i) the capital accumulation technology (1) subject to investment-specific technological shocks; and (ii) the controlling shareholder's private benefits technology (2). We later show that the interaction of these two assumptions generates the key results and insights of our paper.

Controlling Shareholder. The controlling shareholder is risk-averse and has lifetime utility over consumption sequences

$$E\left[\int_0^\infty e^{-\rho t}u(C_1(t))dt\right], \tag{4}$$

where C_1 denotes the flow of consumption, and the period utility function is

$$u(C) = \frac{1}{1-\gamma}\left(C^{1-\gamma} - 1\right), \gamma > 0. \tag{5}$$

The rate of time preference is $\rho > 0$ and γ is the coefficient of relative risk aversion.[9]

Let $M(t)$ denote the time-t cash flow to the controlling shareholder. It includes both the dividend component $\alpha D(t)$ and the private benefits component and is given as follows:

$$M(t) = \alpha D(t) + s(t)hK(t) - \Phi(s(t), hK(t)). \tag{6}$$

[7] See Barclay and Holderness (1989) for early work on the empirical evidence in support of private benefits of control. See also Johnson et al. (2000), Bae et al. (2002), Bertrand et al. (2002), and Dyck and Zingales (2004).

[8] We think of η as capturing the role of laws and law enforcement protection of minority investors. However, it can be broadly associated with monitoring by outside stakeholders (see, for example, Burkart et al. (1997)).

[9] As usual, $\gamma = 1$ corresponds to logarithmic utility function $u(C) = \log C$.

Let W_1 denote the controlling shareholder's wealth. We assume that the controlling shareholder can invest in the risk-free asset, but cannot trade in the risky asset. This implies that his tradable "liquid" wealth is all in the risk-free asset: $W_1(t) = B_1(t)$. Let $r(t)$ be the risk-free interest rate at t. The controlling shareholder's wealth evolves according to

$$dW_1(t) = \left(r(t)W_1(t) + M(t) - C_1(t)\right) dt, \tag{7}$$

where we assume that $W_1(0) = 0$.

In summary, the controlling shareholder chooses $\{C_1(t), s(t), I(t), K(t), D(t), W_1(t) : t \geq 0\}$ to maximize his lifetime utility defined in (4) and (5), subject to the firm's capital stock dynamics given in (1), wealth accumulation dynamics (7), the "stealing" cost function (2), and a transversality condition specified in the Appendix. In solving his optimization problem, the controlling shareholder takes the equilibrium interest rate process $\{r(t) : t \geq 0\}$ as given.

Real and Financial Assets. Without loss of generality, we may denote μ_K and σ_K as the drift and volatility process for the *equilibrium* capital accumulation process:

$$dK(t) = \mu_K(t)K(t)\, dt + \sigma_K(t)K(t)\, dZ(t). \tag{8}$$

Similarly, we may write the equilibrium processes for dividends D and firm value P as follows:

$$\begin{aligned} dD(t) &= \mu_D(t)D(t)\, dt + \sigma_D(t)D(t)\, dZ(t), & (9)\\ dP(t) &= \mu_P(t)P(t)\, dt + \sigma_P(t)P(t)\, dZ(t), & (10) \end{aligned}$$

where μ_D and μ_P are the corresponding equilibrium drift processes, and σ_D and σ_K are the equilibrium volatility processes. There is also a risk-free asset available in zero net supply. Both minority investors and the controlling shareholder may trade the risk-free asset. We solve for the equilibrium interest rate r, μ_K, μ_D, μ_P, and the volatility processes σ_K, σ_D, and σ_P in Section 4.

Minority Investors. Minority investors have the same preferences given in (4) and (5), evaluated at the consumption process $C_2(t)$. Each minority investor solves a standard consumption-asset allocation problem similar to Merton (1971). Unlike Merton (1971), in our model, both the stock price and the interest rate are endogenously determined in equilibrium.

Let $\omega(t)$ be the fraction of wealth invested in equity at t. Let $\lambda(t)$ denote the time-t risk premium, which is given by $\lambda(t) \equiv \mu_P(t) + D(t)/P(t) - r(t)$. Following Merton (1971), each minority investor accumulates his wealth as follows:

$$dW_2(t) = \left(r(t)W_2(t) - C_2(t) + \omega(t)W_2(t)\lambda(t)\right) dt + \sigma_P(t)\omega(t)W_2(t)dZ(t), \tag{11}$$

with $W_2(0) = 0$. The minority investors' risk-free asset holding is then $B_2(t) = (1 - \omega(t))W_2(t)$.

Each minority investor chooses $\{C_2(t), W_2(t), \omega(t) : t \geq 0\}$ to maximize his lifetime utility function subject to the wealth accumulation dynamics (11) and a transversality condition specified in the Appendix. In solving this problem, each minority investor takes the equilibrium dividend process, firm value process and the interest rate as given.

2.2 Equilibrium: Definition and Existence

We define the equilibrium in our economy and state the theorem characterizing the equilibrium.

Definition 1 *An equilibrium has the following properties:*

(i) $\{C_1(t), s(t), I(t), K(t), D(t), W_1(t) : t \geq 0\}$ *solve the controlling shareholder's problem for the given interest rate* r*;*

(ii) $\{C_2(t), W_2(t), \omega(t) : t \geq 0\}$ *solve each minority investor's problem for given interest rate* r *and stock price and dividend payout stochastic processes* $\{P(t), D(t) : t \geq 0\}$*;*

(iii) the risk-free asset market clears, in that

$$B_1(t) + B_2(t) = 0, \quad \textit{for all } t;$$

(iv) the stock market clears for minority investors, in that

$$1 - \alpha = \omega(t) W_2(t) / P(t), \quad \textit{for all } t; \ \textit{and,}$$

(v) the consumption goods market clears, in that

$$C_1(t) + C_2(t) + I(t) = hK(t) - \Phi(s(t), hK(t)), \quad \textit{for all } t.$$

Condition (v) states that the available resources in the economy, $hK - \Phi(s, hK)$, are either consumed or invested in the firm. The amount diverted shK is a transfer from the firm to the controlling shareholder, but the cost of diversion, $\Phi(s, hK)$, is a "dead-weight" loss.

In general, for heterogeneous agent models such as ours, one needs to keep track of the dynamics of the wealth distribution, namely the evolution of $(W_1(t), W_2(t))$, in addition to standard state variables such as the capital stock K. It turns out that the endogenously determined wealth distribution does not complicate the equilibrium analysis in our model. The following theorem provides a complete characterization of the equilibrium. We will provide intuition for the equilibrium in Section 3. The proof is left to the Appendix.

Theorem 1 *Under Assumptions 1-5 listed in the Appendix, there exists an equilibrium with the following properties. The outside minority investors have zero risk-free asset holdings (*$B_2(t) = 0$*) and invest all their wealth in equity, with* $\omega(t) = 1$*. Minority investors' consumption equals their entitled dividends:*

$$C_2(t) = (1 - \alpha) D(t).$$

The controlling shareholder also holds zero risk-free assets: ($B_1(t) = 0$). He diverts a constant fraction of gross revenue:

$$s(t) = \phi \equiv \frac{1-\alpha}{\eta}. \tag{12}$$

The controlling shareholder's consumption $C_1(t)$ and the firm's investment $I(t)$ and dividends $D(t)$ are proportional to the firm's capital stock $K(t)$, in that $C_1(t)/K(t) = M(t)/K(t) = m$, $I(t)/K(t) = i$, $D(t)/K(t) = d$. Letting $\psi = (1-\alpha)^2/2\alpha\eta$ be a summary measure of the effect of agency on investment we have:

$$m = \alpha\left[(1+\psi)h - i\right] > 0, \tag{13}$$

$$i = \frac{1+(1+\psi)h\epsilon^2}{(\gamma+1)\epsilon^2}\left[1-\sqrt{1-\frac{2(\gamma+1)\epsilon^2\left((1+\psi)h-\rho-\delta(1-\gamma)\right)}{\gamma\left[1+(1+\psi)h\epsilon^2\right]^2}}\right] > 0, \tag{14}$$

$$d = (1-\phi)h - i > 0. \tag{15}$$

The equilibrium dividend process (9), the capital accumulation process (8), and the stock price process (10) all follow geometric Brownian motions with drift and volatility coefficients:

$$\mu_D = \mu_K = \mu_P = i - \delta, \tag{16}$$

$$\sigma_D = \sigma_K = \sigma_P = i\epsilon. \tag{17}$$

The equilibrium value of the firm is $P(t) = qK(t)$, where q is the Tobin's q and is given by

$$q = \left(1+\frac{1-\alpha^2}{2\eta\alpha d}h\right)^{-1}\frac{1}{1-\gamma\epsilon^2 i}. \tag{18}$$

The equilibrium interest rate is

$$r = \rho + \gamma(i-\delta) - \frac{\epsilon^2 i^2}{2}\gamma(\gamma+1). \tag{19}$$

The analysis proceeds by considering the benchmark model of perfect investor protection.

3 Benchmark: Perfect Investor Protection

In the benchmark model of perfect investor protection, the cost of diverting any positive amount of benefits is infinite. Therefore, the controlling shareholder optimally pursues no private benefits ($s^* = 0$). (We denote the equilibrium variables in benchmark model with superscript '*'.) Since there is no conflict of interest, the first-best outcome is obtained in equilibrium, and investment and Tobin's q depend only on the preference and technology parameters (such as the volatility parameter ϵ that captures investment-specific technological shocks).

When one unit of capital is purchased and invested in the firm, the total capital stock of the firm increases by one unit on average. However, the exact amount by which capital increases is subject to uncertainty whose volatility is proportional to the amount of investment I, as seen in the diffusion term in (1).The corresponding first-best Tobin's q is given by

$$q^* = \frac{1}{1 - \epsilon^2 \gamma i^*} > 1, \tag{20}$$

where i^* is given by (14) with $\psi = 0$. First, note that Tobin's q is equal to unity in a deterministic environment ($\epsilon = 0$). Intuitively, capital accumulation is deterministic without adjustment cost, and the production function has constant returns to scale. In general, Tobin's q in equilibrium is larger than unity when capital accumulation is subject to shocks ($\epsilon > 0$) and investors are risk averse. This *investment* risk is systematic and is priced in equilibrium by risk-averse investors. As a result, it drives a wedge between the prices of newly purchased capital and installed capital.

It is worth comparing our model to the CIR model. The capital accumulation process in CIR is subject to shocks whose volatility is proportional to capital stock K: $dK = (I - \delta K)\, dt + \nu K dB_t$. While capital accumulation is stochastic, investment increases the capital stock in a deterministic fashion. Therefore, there is no *immediate* investment risk, and no wedge exists between the values of newly invested and installed capital. As a result, Tobin's q is equal to unity in CIR. To sum up, whether the volatility of capital accumulation is a function of capital stock K (as in CIR) or depends on new investment I (as in our model) has important implications for Tobin's q.

Finally, our model's predictions on q may also be related to those in Abel and Eberly (1994) and Hayashi (1982) where adjustment costs make Tobin's q larger than unity. Unlike theirs, in our model, the investment-specific technological shocks in the capital accumulation process and the investor's risk aversion jointly generate $q > 1$ in equilibrium. Our work thus provides a view on the determinants of q, complementary to the adjustment cost-based investment literature.

Having set up the benchmark, we next turn to the setting with imperfect investor protection.

4 Understanding the Equilibrium Solution

We start by providing some intuition for the model's no-trade equilibrium. The standard way to analyze the equilibrium is to (i) solve the optimization problems for both the controlling shareholder and minority investors for postulated price processes, and (ii) to aggregate the agents' demand and finding the new prices that clear all markets. This process continues until the fixed point (equilibrium) is found. This approach is computationally quite demanding for heterogeneous agent models such as ours. Instead, we conjecture that in equilibrium there is no trading in financial markets. We then show that such conjecture leads to optimal quantities and prices that satisfy all the market clearing conditions.

4.1 The Controlling Shareholder's Optimization

Under the conjecture that the controlling shareholder holds zero risk-free bonds at all times and cannot trade his "inside shares," we have $C_1(t) = M(t)$. The controlling shareholder's problem then essentially becomes a resource allocation problem. He chooses the firm's capital accumulation, dividend payout and private benefits to maximize his own utility.

Let $J_1(K)$ denote the controlling shareholder's value function. The controlling shareholder's optimal payout D and diversion s decisions solve the Hamilton-Jacobi-Bellman equation:

$$\rho J_1(K) = \max_{D,s} \left\{ u(M) + (I - \delta K) J_1'(K) + \frac{\epsilon^2}{2} I^2 J_1''(K) \right\}. \tag{21}$$

The left side of (21) is the flow measure of his value function. The right side of (21) gives the sum of the instantaneous utility payoff $u(M)$ and the instantaneous expected change of his value function (given by both the drift and diffusion terms). The controlling shareholder's optimality implies that he chooses dividend policy D and stealing fraction s to equate the two sides of (21). The first-order conditions with respect to dividend payout D and diversion s are:

$$M^{-\gamma}\alpha - \epsilon^2 I J_1''(K) = J_1'(K), \tag{22}$$

and

$$M^{-\gamma}(hK - \eta s h K) - \epsilon^2 I J_1''(K)\, hK = J_1'(K)\, hK. \tag{23}$$

Equation (22) describes how the controlling shareholder chooses the firm's dividend and investment policy. The model has the usual trade-off that an additional unit of dividend increases consumption today (valued at $M^{-\gamma}\alpha$), but lowers consumption in the future by lowering investment (valued at $J_1'(K)$). In addition, increasing dividends generates an extra benefit by reducing the volatility of future marginal utility (valued at $-\epsilon^2 I J_1''(K)$). This risk aversion/volatility effect comes from: (i) the concavity of the value function due to risk aversion ($J_1''(K) < 0$); and (ii) the fact that investment increases the volatility of capital accumulation because of shocks to the marginal efficiency of investment (equation (1)).

Equation (23) describes the trade-offs associated with the choice of private benefits. The benefits associated with an incremental unit of stealing arise from increased current consumption and lower volatility of future marginal utility. The marginal cost of stealing arises from lower investment and future consumption. Substituting (22) into (23) gives the optimal stealing $s(t) = \phi \equiv (1-\alpha)/\eta$. Intuitively, the stealing fraction ϕ is higher when investor protection is worse (lower η) and the conflicts of interest are larger (smaller α).

We now turn to the minority investors' problem.

4.2 Minority Investors' Optimization

To continue on the implications of our no-trade conjecture, we will suppose and then verify later that in equilibrium the risk premium and interest rate are constant. Then, minority investors solve a standard Merton-style consumption and portfolio choice problem. The investor optimally allocates a constant fraction ω of his total wealth to equity, where

$$\omega(t) = \frac{\lambda}{\gamma \sigma_P^2}. \tag{24}$$

Intuitively, ω increases in the expected excess return λ, but decreases in risk aversion γ and volatility σ_P.

In the conjectured no-trade equilibrium, the minority investor also needs to hold all his wealth in equity ($\omega = 1$). Using (24) and imposing equilibrium gives

$$\lambda = \gamma\sigma_P^2 = \gamma\epsilon^2 i^2. \tag{25}$$

The first equality is the standard equilibrium asset pricing result where the equity premium is equal to the product of the investor's coefficient of relative risk aversion and the instantaneous variance. The last equality states that the equity premium λ increases in the investment-capital ratio i (see (17)).

4.3 Intuition behind the No-trade Equilibrium

Under the no-trade conjecture, minority investors' total wealth consists of their equity holdings. Likewise, controlling shareholders' total wealth consists of the remaining firm equity. While each share of equity offers minority investors dividends at the rate of dK, where the dividend-capital ratio d is given in (15), each share of equity offers the controlling shareholder not only (i) a dividend payment dK, but also (ii) a perpetual flow of private benefits of control. To be specific, the net payoff rate (dividends plus net private benefits) per equity share to the controlling shareholder is

$$\frac{m}{\alpha}K = \left(d + (\psi + \phi)\,h\right)K = \left(d + \frac{1-\alpha^2}{2\alpha\eta}h\right)K. \tag{26}$$

Equation (26) shows that for each unit of dividends that the outside investor receives, the controlling shareholder receives a total payment in the amount of $1 + \left(1-\alpha^2\right)h/\left(2\alpha\eta d\right)$ units. This constant proportionality between payments to outside investors and the controlling shareholder gives rise to identical growth rates of dividends and of the net payoff to the controlling shareholder between any two dates and any two states. Because in the no-trade conjecture we have $C_1(t) = M(t)$, it follows that the marginal rate of substitution (MRS) between time s and $t < s$ for the controlling shareholder is given by

$$e^{-\rho(s-t)}\frac{U'(C_1(s))}{U'(C_1(t))} = e^{-\rho(s-t)}\left(\frac{M(s)}{M(t)}\right)^{-\gamma} = e^{-\rho(s-t)}\left(\frac{D(s)}{D(t)}\right)^{-\gamma}. \tag{27}$$

Similarly, under no trade, the MRS between time s and $t < s$ for the minority shareholder is equal to

$$e^{-\rho(s-t)}\frac{U'(C_2(s))}{U'(C_2(t))} = e^{-\rho(s-t)}\left(\frac{D(s)}{D(t)}\right)^{-\gamma}. \tag{28}$$

Combining (27) and (28) allows us to conclude that the marginal rates of substitution for the controlling shareholder and outside investors are equal under the no-trade conjecture. Therefore, both controlling shareholders and minority investors have the same risk attitude toward securities such as the risk-free asset and hence their zero bond holdings are indeed an equilibrium outcome.

In equilibrium, the economy grows stochastically on a balanced path. In order to deliver such an intuitive and analytically tractable equilibrium, the following assumptions or properties of the model are useful: (*i*) a constant return to scale production and capital accumulation technology specified in (1); (*ii*) optimal "net" private benefits that are linear in the firm's capital stock (arising from the assumptions that the controlling shareholder's benefit of stealing is linear in s and his cost of stealing is quadratic in s); and (*iii*) the controlling shareholder and the minority investors have identical and homothetic preferences. Since the economy is on a balanced growth path, in the remainder of the paper we focus on variables scaled by capital stock, such as the investment-capital ratio $i = I/K$ and the dividend-capital ratio $d = D/K$.

5 Equilibrium Investment and Asset Pricing Implications

First, we analyze equilibrium investment and capital accumulation. Then, we discuss the model's equilibrium implications on firm value, interest rate, return premium, volatility and dividend yield.

5.1 Real Investment

Proposition 1 *The equilibrium investment-capital ratio i decreases in investor protection η and the controlling shareholder's cash-flow rights α, in that $di/d\eta < 0$ and $di/d\alpha < 0$, respectively.*

Under weaker investor protection, the controlling shareholder diverts a higher fraction ϕ of output in each period. Since a larger fraction of a bigger pie is worth more, the rational controlling shareholder values a larger firm more under weaker investor protection. This leads to more investment as investor protection weakens.

However, faster capital accumulation induces higher volatility in capital accumulation and output. This leads to a higher equilibrium risk premium and hence discourages investment to some extent. In a model like ours, we can show that the private benefits incentive is a first-order effect, and the investment-induced volatility/risk aversion effect is of second order.[10] In summary, our model predicts that weak investor protection induces overinvestment relative to a benchmark of perfect investor protection. Similar intuition applies for the comparative statics result with respect to ownership α.

There is a rich supply of empirical evidence on overinvestment and empire building in the U.S. Harford (1999) documents that U.S. cash-rich firms are more likely to attempt acquisitions, but that these acquisitions are value decreasing as measured by either stock return performance

[10] Mathematically, we are able to show that the trade-off between the private benefits and lowering the volatility becomes a linear-quadratic one after solving an inter-temporal optimization problem.

or operating performance.[11] Pinkowitz, Stulz, and Williamson (2003) document that one dollar of cash holdings held by firms in countries with poor corporate governance is worth much less to outside shareholders than that held by firms in countries with better corporate governance. Gompers et al. (2003) and Philippon (2004) document that U.S. firms with low corporate governance have higher investment.

The overinvestment-governance link fits the evidence in developed economies, but also across emerging market economies. A strong indicator that firms in Korea and Thailand overinvested is the documented volume of non-performing loans prior to the East Asian crisis in 1997 (25% of GDP for Korea and 30% of GDP for Thailand) (Burnside et al. (2001)).[12] China is another example of a country with very large amounts of nonperforming loans in the banking sector. Allen et al. (2004) show that China has had consistently high growth rates since the beginning of economic reforms in the late 1970s, even though its legal system is not well developed and law enforcement is poor. Our paper argues that the incentives for insiders to overinvest can at least partly account for China's high economic growth despite weak investor protection.[13]

Finally, note that the controlling shareholder's incentive to overinvest in our model derives solely from pecuniary private benefits. In reality, controlling shareholders also receive nonpecuniary private benefits in the form of empire building or name recognition from managing larger firms. The pursuit of such nonpecuniary private benefits exacerbates the controlling shareholder's incentive to overinvest (see also Baumol (1959), Williamson (1964) and Jensen (1986)). Also, controlling shareholders are often founding family members that have a desire to pass the "empire" bearing their names down to their offsprings (Burkart, Panunzi, and Shleifer (2003)). Incorporating these nonpecuniary private benefits would increase the degree of overinvestment and amplify the mechanism described in our paper.

We next compute firm value from the perspectives of outside investors and of controlling shareholders.

5.2 Tobin's q and Controlling's Shareholder's shadow (Tobin's) q

Proposition 2 *Tobin's q increases with investor protection η and with the controlling shareholder's cash flow rights, in that $dq/d\eta > 0$, and $dq/d\alpha > 0$, respectively.*

[11] See also Lang, Stulz, and Walkling (1991), Blanchard, López-de-Silanes, and Shleifer (1994), and Lamont (1997).

[12] While these local firms benefitted from government subsidies via, for example, a low borrowing rate, a low borrowing rate by itself does not generate a large size of nonperforming loans. Thus, while a subsidized borrowing channel encourages socially inefficient overinvestment, it does not imply overinvestment from the firm's perspective, given the subsidized cost of funds. Our argument that firms overinvest because of weak investor protection remains robust even in the presence of other frictions such as government subsidies.

[13] While we do not formally model state-owned enterprises in this paper, in practice these firms are not much different than the firms with controlling shareholders as described in our model. The cash flow rights of the managers come from their regular pay, which in general depends on firm performance, and the control rights come from the government appointing the manager.

Intuitively, both outright stealing and investment distortions lower firm value, measured by Tobin's q. Stronger investor protection mitigates both stealing and investment distortion. As a result, Tobin's q is higher.

Empirical evidence largely supports the predictions in Proposition 2. La Porta et al. (2002), Gompers et al. (2003) and Doidge et al. (2004) find a positive relationship between firm value and investor protection. The incentive-alignment effect due to higher cash-flow rights is consistent with empirical evidence in Claessens et al. (2002) on firm value and cash flow ownership.

Turn now to the controlling shareholder's (shadow) firm valuation $\hat{P}$. Using the equilibrium MRS, we evaluate the controlling shareholder's cash flow stream M/α (per share) as follows:

$$\hat{P}(t) = \frac{1}{\alpha} E_t \left[\int_t^\infty e^{-\rho(s-t)} M(s) \frac{M(s)^{-\gamma}}{M(t)^{-\gamma}} ds \right] = \frac{1}{1-\epsilon^2 i\gamma} K(t).$$

We thus may interpret $\hat{q}$ given below as the controlling shareholder's shadow Tobin's q:

$$\hat{q} = \frac{1}{1-\epsilon^2 i\gamma}. \tag{29}$$

First, it is immediate to see that $\hat{q}$ is higher than q^*, Tobin's q under perfect investor protection, given in (20). By revealed preference, the controlling shareholder can always set the investment-capital ratio to i^* and steal nothing $s = 0$, which would imply $\hat{q} = q = q^*$. If instead he chooses $s > 0$ and distorts investment $i > i^*$, it must be that $\hat{q} > q^*$. Second, using Proposition 2, we have $q^* > q$ for firms under imperfect investor protection. Combining these two results, we have shadow q is larger than first-best Tobin's q, which is larger than Tobin's q, in that $\hat{q} > q^* > q$. This states the value transfer from outside investors to controlling shareholders when investor protection is imperfect. However, minority investors are rational in the model and hence pay the fair market prices for their shares.

5.3 Risk-Free Rate

The equilibrium interest rate r given in (19) is determined by three components: (i) the discount rate ρ; (ii) an economic-growth effect, $\gamma(i-\delta)$; and (iii) a negative precautionary-saving term, $-\epsilon^2 i^2 \gamma(\gamma+1)/2$. In a risk-neutral world, the interest rate must equal the subjective discount rate ρ in order to clear the market. This explains the first term. The intuition for the second term, the growth effect, is that a higher net investment-capital ratio $(i-\delta)$ implies that more goods are available for future consumption and thus raises the demand for current goods. To clear the market, the interest rate increases. This effect is stronger when the agent is less willing to substitute consumption intertemporally, which corresponds to a lower elasticity of intertemporal substitution $1/\gamma$, or a higher γ. The intuition for the precautionary effect is that a high net investment-capital ratio increases the riskiness of firms' cash flows and makes agents more willing to save. This preference for precautionary savings reduces current demand for consumption and decreases the interest rate. The next proposition describes how the interest rate changes with investor protection.

Proposition 3 *The interest rate decreases in investor protection η and ownership α, if and only if* $1 > \epsilon^2 (\gamma + 1) i$.

Weakening investor protection produces two opposing effects on the equilibrium interest rate. Both effects result from investment being higher under weaker investor protection. First, the economic-growth effect leads to higher interest rates. Second, the precautionary-saving effect leads to a lower interest rate. The growth effect dominates the precautionary effect if and only if $1 > \epsilon^2 (\gamma + 1) i$. As demonstrated in the Appendix this condition is satisfied for sufficiently low ϵ, h, or ψ, and holds in all our calibrations below.

As a simple assessment of the empirical validity of Proposition 3, we use the cross-country data in Campbell (2003) and separate the countries into civil law countries, those with weaker investor protection, and common law countries, those with better investor protection (La Porta et al. (1998)). Consistent with the model, the average real interest rate on his sample of common law countries is 1.89% per year, statistically smaller than the average real interest rate on his sample of civil law countries of 2.35% per year.

We next turn to the predictions on volatility, risk premium and the expected return.

5.4 Volatility, Risk Premium, and Expected Return

Proposition 4 *Return volatility σ_P, risk premium λ, and the expected return all decrease in investor protection η and ownership α.*

Recall that Proposition 1 shows that weaker investor protection creates incentives to invest. Because investment generates volatility in the capital accumulation process (through investment-specific technological shocks), the rate of capital accumulation becomes more volatile under weaker investor protection. With the economy on a balanced growth path, the return on firm equity is also more volatile under weaker investor protection (recall that $P(t) = qK(t)$).

The equilibrium risk premium is given by:

$$\lambda = \gamma \sigma_P^2 = \gamma \epsilon^2 i^2.$$

Hence, a larger volatility (due to greater investment) implies a higher equity risk premium in equilibrium. The expected return on equity is given by the sum of the interest rate r and the risk premium λ. Since both r and the risk premium λ decrease in investor protection η, the expected return on equity also decreases with the degree of investor protection.[14]

[14] While Proposition 3 for the interest rate requires a bit stronger condition, the result on the expected equity return does not. Below is a sketch to show this. It is immediate to show

$$r + \lambda = \rho + \gamma (i - \delta) - \frac{1}{2} \gamma (\gamma - 1) \epsilon^2 i^2.$$

There is evidence supporting Proposition 4. Hail and Leuz (2004) find that countries with strong securities regulation and enforcement mechanisms exhibit lower levels of cost of capital than countries with weak legal institutions. Daouk, Lee, and Ng (2004) create an index of capital market governance that captures differences in insider trading laws, short-selling restrictions, and earnings opacity. They model excess equity returns using an international capital asset market model that allows for varying degrees of financial integration. Consistent with Proposition 4, they show that improvements in their index of capital market governance are associated with lower equity risk premia. The cross-country data in Campbell (2003) indicates that civil law countries have higher average excess equity returns than common law countries. The average annual excess equity return on his sample of common law countries is 4.12%, smaller than the 6.97% average annual excess equity return on his sample of civil law countries.

Harvey (1995), Bekaert and Harvey (1997), and Bekaert and Urias (1999) show that emerging markets display higher volatility of returns and larger equity risk premia. Bekaert and Harvey (1997) correlate their estimated conditional stock return volatilities with financial, microstructure, and macroeconomic variables and find some evidence that countries with lower country credit ratings, as measured by *Institutional Investor*, have higher volatility. Erb et al. (1996) show that expected returns, as well as volatility, are higher when country credit risk is higher. Since emerging market economies and countries with worse credit ratings have on average weaker corporate governance, this empirical evidence lends some support to our theory.

We next turn to the dividend yield.

5.5 Dividend Yield

Let y be the equilibrium dividend yield: $y = D/P = d/q$. In the appendix we show that:

Proposition 5 *The dividend yield is given by*

$$y = \rho + (\gamma - 1)\left(i - \delta - \frac{\gamma}{2}\epsilon^2 i^2\right). \tag{30}$$

The dividend yield decreases (increases)with the degree of investor protection η when $\gamma > 1$ ($\gamma < 1$).

A weaker investor protection gives rise to a higher investment-capital ratio, but also a more volatile dividend/output process. As we discussed earlier, the effect of investor protection on growth (via incentives to "steal and overinvest") is stronger than the effect on volatility (via precautionary saving), in that

$$\frac{d}{d\eta}\left(i - \delta - \frac{\gamma}{2}\epsilon^2 i^2\right) = \left(1 - \gamma\epsilon^2 i\right)\frac{di}{d\eta} < 0. \tag{31}$$

Note that $d(r+\lambda)/d\eta = \gamma\left(1 - (\gamma - 1)\epsilon^2 i\right) di/d\eta$, and $\left(1 - (\gamma - 1)\epsilon^2 i\right) > 0$ for all admissible parameters. Therefore, the net sign effect of η on the expected return is the same as the effect of η on investment. From Proposition 1, we know that stronger investor protection curtails investment and hence lowers expected returns.

where the inequality follows from Proposition 1 and the parametric condition $1 - \gamma\epsilon^2 i > 0$, a necessary condition for the solution to be well behaved as shown in the appendix. Therefore, whether the dividend yield y increases or decreases in η only depends on the sign of $\gamma - 1$. First, for logarithmic utility investors ($\gamma = 1$), the dividend yield is constant and is equal to the investors' subjective discount rate ρ. This is the standard result: The logarithmic investor does not have an inter-temporal hedging demand (Merton (1971)).

When $\gamma > 1$, the elasticity of intertemporal substitution ($1/\gamma$) is less than unity implying that the income/wealth effect in consumption is stronger than the substitution effect. As a result, the net impact of strengthening investor protection (increasing η) enhances firm value by a greater percentage than it does for dividends. Therefore, the dividend yield y decreases with η, when $\gamma > 1$. For $\gamma < 1$, the substitution effect is stronger and the opposite result holds.

Next, we quantify the effects of weak investor protection.

6 Quantifying the Effects of Investor Protection

We first provide a calibration of the parameters. Then, we calculate the implications on stock market revaluation and wealth redistribution if investor protection were to be made perfect.

6.1 Calibration

Our model is quite parsimonious, for a heterogeneous-agents equilibrium model, having only seven parameters. As a result, the calibration procedure is easier, more transparent and also more robust. Indeed, we will show that our main *quantitative* results on stock market revaluation and welfare benefits from enhancing investor protection are effectively unchanged under various moment calibrations, provided that we match the empirically documented level of private benefits of control.

As is standard, the choice of parameter values is done in two ways. Some parameters are obtained by direct measurements conducted in other studies. These include the risk aversion coefficient γ, the depreciation rate δ, the rate of time preference ρ, and the equity share of the controlling shareholder α. The remaining three parameters (η, ϵ, h) are selected so that the model matches three moments in the data.

We calibrate the model to the U.S. and South Korea. Starting with the first set of parameters, we choose the coefficient of relative risk aversion γ to be 2, and the subjective discount rate ρ to be 0.01 (Hansen and Singleton (1982)). The annual depreciation rate is set to 0.07. These parameters are common to both the U.S. and Korea. We choose the share of firm ownership held by the controlling shareholders to be $\alpha = 0.08$ for the U.S. and $\alpha = 0.39$ for Korea (Dahlquist et al. (2003)), representing the percentage of overall market capitalization that is closely held.

For the second set of parameters, we calibrate the productivity parameter h, the volatility parameter ϵ, and the investor protection parameter η so that the model matches: (i) the real interest rate; (ii) the standard deviation of output growth; and (iii) the ratio of private benefits to firm value, $(\hat{q}-q)/q$. The average U.S. real interest rate is set to 0.9% (Campbell (2003)). The Korean annual real interest rate is set to 3.7%, obtained as the average annual real prime lending rate in the period 1980-2000 using data from the World Bank World Development Indicators (WDI) database. Using the WDI dataset, we set the annual standard deviation of output growth in the U.S. to 2% and that in South Korea to 3.77%. Finally, the ratio of the dollar value of private benefits to firm value (in the model and in Dyck and Zingales (2004) equal to $\alpha(\hat{q}-q)/q$) is set to 0.2% in the U.S. and 8.6% in Korea.[15] With our calibrated values for α, these numbers imply that $(\hat{q}-q)/q$ is equal to 2.5% in the U.S. and 22% in Korea. The resulting calibrated parameters are $(\epsilon,\eta,h)=(.28,2020,.08)$ for the U.S. and $(\epsilon,\eta,h)=(.44,25.9,.109)$ for Korea. For both countries these parameters imply that the model matches all three moments exactly. Moreover, the calibrated model implies a stealing fraction $(\phi=(1-\alpha)/\eta)$ of 0.045% for the U.S. and 2.34% for Korea, which is 52 times higher than that of the U.S. The flow cost of stealing as a fraction of gross output $(\Phi(s,hK)/hK=(1-\alpha)^2/2\eta)$ are 0.02% for the U.S. and 0.7% for Korea, respectively.

6.2 A Stock Market Analysis of Imperfect Investor Protection

Consider the hypothetical experiment of improving investor protection to $\eta=\infty$. With our calibrated baseline parameters, moving to perfect investor protection produces a long-run U.S. stock market revaluation (i.e., $(q^*-q)/q$) of 2.49% and a long-run Korean stock market revaluation of 21.9%. This suggests that agency conflicts have a significant effect on firm value and that this effect matches closely the controlling shareholder's private benefits of control. The following approximation sharpens the intuition behind the determinant of the stock market revaluation:

$$\frac{q^*-q}{q}\approx\frac{\hat{q}-q}{q}-\gamma\epsilon^2\left(i-i^*\right).$$

The size of the revaluation is thus approximately equal to the ratio between the private benefits and firm value, $(\hat{q}-q)/q$, plus a term that reflects the difference of the volatility/risk aversion effects under imperfect versus perfect investor protection. This latter term is economically negligible compared with the first term $(\hat{q}-q)/q$, for any reasonable calibration of volatility and risk aversion. We conclude that the stock market revaluation calculation above is robust to model parameters so long as the model is required to match the size of private benefits in the economy (e.g., $(\hat{q}-q)/q=22\%$ in Korea). This result confirms our earlier intuition that the private-benefits effect dominates the risk aversion/volatility effect.

We next measure the welfare cost of weak investor protection.

[15] These numbers coincide with the conservative, lower bounds on private benefits reported in Table III in Dyck and Zingales (2004). The highest estimates reported in the same Table in Dyck and Zingales (2004) are of 4.4% for the U.S. and 15.7% for Korea. Barclay and Holderness (1989) estimate that private benefits for the U.S. are 4% of firm value.

6.3 A Welfare Analysis of Imperfect Investor Protection

One approach to quantify the net effect of weak investor protection on the aggregate economy is to use a welfare criterion that weights the utility levels of the controlling shareholder and minority shareholders. Because of the inherent subjectivity of this approach, we instead compute measures of equivalent variations for minority investors and the controlling shareholder. Both measures quantify the wealth redistribution from minority investors to the controlling shareholders, and do not require us to make any subjective assumptions on welfare weights.

For minority investors, we compute the fraction of wealth that the minority investor is willing to give up for a permanent improvement of investor protection from the current level η to the benchmark (first-best) level of $\eta = \infty$. Let $(1 - \zeta_2)$ denote this fraction of wealth. Then, the minority investor is indifferent if and only if the following equality holds:

$$J_2^*(\zeta_2 W_0) = J_2(W_0),$$

where J_2 and J_2^* are the minority investor's value functions under current level investor protection η and perfect investor protection $\eta = \infty$, respectively, and W_0 is the initial wealth level. Using the explicit value function formula in the appendix, we obtain

$$\zeta_2 = \frac{d}{d^*}\left(\frac{y}{y^*}\right)^{1/(1-\gamma)}, \tag{32}$$

where d and y are the dividend-capital ratio and the dividend yield, respectively.

While outside investors lose from weak investor protection, the controlling shareholder benefits. For the controlling shareholder, we compute the fraction of wealth that he requires to voluntarily give up the status quo (weak investor protection) in exchange for perfect investor protection $\eta = \infty$. Let $(\zeta_1 - 1)$ denote this fraction of wealth. Therefore, we have

$$J_1^*(\zeta_1 W_0) = J_1(W_0), \tag{33}$$

where W_0 is the initial wealth level. Solving (33) gives:[16]

$$\zeta_1 = \left(\frac{y}{y^*}\right)^{-\gamma/(1-\gamma)}. \tag{34}$$

Proposition 6 *The minority investors' utility cost is higher under weaker investor protection, in that* $d\zeta_2/d\eta > 0$. *The controlling shareholder's utility gain is higher with weaker investor protection,* $d\zeta_1/d\eta < 0$. *For any* $\eta < \infty$, $0 < \zeta_2 < 1 < \zeta_1$.

[16] By applying L'Hopital's rule to (33) around $\gamma = 1$, we obtain the formula for ζ_1 for logarithmic utility:

$$\zeta_1 = \exp\left[\frac{(\mu_D - \frac{1}{2}\sigma_D^2) - (\mu_D^* - \frac{1}{2}\sigma_D^{*2})}{\rho}\right].$$

Similarly, when $\gamma = 1$, ζ_2 becomes $\zeta_2 = \zeta_1 d/d^*$.

Minority investors are willing to give up a substantial part of their own wealth for stronger investor protection. Even for the U.S., minority investors are willing to give up 2.4% of their wealth, if the U.S. investor protection can be made perfect. In Korea, minority investors are willing to give up 18% of their wealth to adopt perfect investor protection! The utility losses for minority investors are due to both stealing and investment distortions.

These calculations indicate that the benefits of improving investor protection, particularly for countries such as Korea, are economically significant. This point can be made more forcefully because the welfare benefit calculation is quite robust: Any calibration that is required to match the empirically observed private benefits in Korea of $(\hat{q} - q)/q = 22\%$, as measured by Dyck and Zingales (2004), must necessarily imply sizable stealing and investment distortions and hence significant welfare benefits from improving investor protection. To reinforce this point, note that for $\gamma = 2$, $1 - \zeta_2$ is approximately given by:[17]

$$1 - \zeta_2 \approx \frac{\hat{q} - q}{q} - \left(\frac{\hat{q} - q}{q}\right)^2.$$

Therefore, the fraction of wealth $(1 - \zeta_2)$ that minority investors are willing to pay for perfect investor protection, are effectively determined by the size of the private benefits of control. For Korea, using the approximation, we have $1 - \zeta_2 \approx 22\% - 22\%^2 = 17.2\%$, which is very close to 18% using the exact formulae. This calculation is thus indicative of the robustness of our conclusion that the welfare benefits to minority investors of moving to perfect investor protection are closely tied to the size of private benefits in the economy.

While we show that the utility gain from increasing investor protection is large for outside investors, we do not view policy interventions to improve investor protection as an easy task. This is not surprising even if one ignores costly implementation, because improving investor protection involves a difficult political reform process that may reduce the benefits to incumbents. This wealth redistribution is significant with controlling shareholders in the U.S. (Korea) losing about 2.1% (8.3%) of their wealth when moving to the benchmark case of perfect investor protection. Moreover, the controlling shareholders are less subject to the collective action problem than outside investors are, because there are fewer controlling shareholders than outside investors and the amount of rents at stake for each controlling shareholder is substantial. Thus, incumbent entrepreneurs and controlling shareholders are often among the most powerful interest groups in the policy making process, particularly in countries with weaker investor protection. It is in the vested interests of controlling shareholders to maintain the status quo,

[17] Using Taylor expansion, for a given risk aversion coefficient γ, we may show that the wealth redistribution $1 - \zeta_2$ is approximately given by

$$1 - \zeta_2 \approx \frac{\gamma - 2}{\gamma - 1} \frac{d^* - d}{d^*} + \left[\frac{\hat{q} - q}{q} - \left(\frac{\hat{q} - q}{q}\right)^2 - \gamma\epsilon^2 (i - i^*)\right] \frac{1}{\gamma - 1}.$$

For any reasonable volatility ϵ and risk aversion γ parameters, the last term in the square brackets is a second order effect.

since they enjoy the large private benefits at the cost of outside minority investors and future entrepreneurs.

7 Empirical Evidence

In this section, we generate new empirically testable predictions. More precisely, we explore the implications from our technological specification (equation (1)) and the equilibrium balanced growth solution (Theorem 1). This leads to the following proposition.

Proposition 7 *The standard deviations of GDP growth and stock returns are given by ϵi.*

Specifically, we test whether (i) the standard deviation of GDP growth is positively correlated with the investment-capital ratio, and whether (ii) the standard deviation of stock returns is positively correlated with the investment-capital ratio. In designing the tests, we control for exogenous sources of uncertainty, which may arise from cross-country variations in ϵ.[18]

7.1 Data

We use the World Bank's WDI annual real per capita GDP to measure the volatility of GDP growth. We measure the volatility of stock returns by using the total monthly return series from MSCI (starting in January of 1970 for some countries). We further restrict the sample to countries for which an MSCI index exists and the ratio of market capitalization to GDP is at least 10% by the year 2000. Because the variables JUDICIAL and DCIVIL are not available for Hungary, Morocco, Poland, and China, these countries are excluded in the analysis leaving 40 observations.[19]

To test our predictions, we estimate a country's long-run average investment-capital ratio using aggregate data. Because the model's capital-GDP ratio is constant, i.e., $dY(t)/Y(t) = dK(t)/K(t)$, we can use the capital accumulation equation (1) to obtain the long-run GDP

[18] Note that the investment-capital ratio is invariant to a first order with respect to ϵ. Mathematically, the derivative of the investment-capital ratio with respect to ϵ is approximately zero when evaluated at realistically low values of ϵ (i.e., $di/d\epsilon = 0$ at $\epsilon = 0$). This means that our model predicts that if all of the cross-country variation in the highlighted volatility measures comes from variation in ϵ, then we should not be able to detect any association between the volatility measures and the investment-capital ratio even if we do not control for ϵ in the regressions. Provided we find such an association we can then reasonably conclude that it is not solely due to cross-country variation in ϵ. Intuitively, in the model, cross-country variation in ϵ only adds noise to the correlation between output growth volatility and the investment-capital ratio, because it makes the volatility numbers change without any corresponding movement in investment.

[19] Univariate regressions suggest that including these countries would not change the results. The countries (and country abbreviations) are Argentina (ARG), Australia (AUL), Austria (AUT), Belgium (BEL), Brazil (BRA), Canada (CAN), Chile (CHL), Colombia (COL), Denmark (DEN), Egypt (EGY), Finland (FIN), France (FRA), Germany (GER), Greece (GRE), Hong Kong (HK), India (IND), Ireland (IRE), Israel (ISR), Italy (ITA), Japan (JAP), Malaysia (MAL), Mexico (MEX), the Netherlands (NET), New Zealand (NZ), Norway (NOR), Pakistan (PAK), Peru (PER), Philippines (PHI), Portugal (POR), Singapore (SIN), South Africa (SA), South Korea (KOR), Spain (SPA), Sweden (SWE), Switzerland (SWI), Thailand (THA), Turkey (TUR), UK, USA, and Venezuela (VEN).

growth rate $(i-\delta)$. Hence, the investment-capital ratio is the sum of the long-run mean of real GDP growth and the depreciation rate δ, which is set at 0.07. Annual real GDP data is obtained from the World Bank World Development Indicators database for the period of 1960 to 2000. Note that the premise of this procedure is that of a constant capital-GDP ratio within a country, but not across countries. Following King and Levine (1994), we estimate the long-run mean GDP growth rate using a weighted average of the country's average GDP growth rate and the world's average GDP growth rate with the weight on world growth equal to 0.75. The weighting of growth rates is meant to account for mean-reversion in growth rates. In spite of the balanced growth path assumption underlying this estimate, King and Levine (1994) show that it produces estimates of investment-capital ratios that match quite well with those computed using the perpetual inventory method.

We conduct our tests controlling for several investor protection variables, which we divide into two subsets. The first set measures investor protection with the antidirector rights variable introduced in La Porta et al. (1998) (ANTIDIR) and a country's legal origin (DCIVIL= 1 for a civil law country and 0 for a common law country). The second set of variables describes the efficiency of the judicial system (JUDICIAL), the rule of law (LAW), and government corruption (CORRUPTION).[20] These variables capture the notion that law enforcement is also important in constraining opportunistic behavior. While CORRUPTION does not directly reflect the quality of law enforcement, it is nonetheless related as it pertains to the government's attitude towards the business community. For ANTIDIR and the enforcement variables, a higher score corresponds to better investor protection.

We use several control variables to account for other exogenous sources of volatility (to capture cross-country variation in ϵ). As measures of aggregate uncertainty, we use the long-run means of the volatility of inflation (SDINF) and of the volatility of real exchange rate returns (SDRER) (Pindyck and Solimano (1993)).[21] To account for volatility induced by government policies we use the long-run mean share of total government spending in GDP (G/GDP) and an index of outright confiscation or forced nationalization from the Political Risk Services Group (RISKEXP). A high score for RISKEXP means less risk of expropriation. Finally, we control for the initial level of real GDP per capita in logs (GDP1960) and for the degree of openness as given by the 1960 ratio of exports plus imports to GDP (OPEN).

7.2 Results

Figure 1 and Table 1 report the results for the relation between the standard deviation of output growth and the investment-capital ratio. Figure 1 illustrates a positive (unconditional) association as predicted by the model. Table 1 shows that the significance of this association

[20] See La Porta et al. (1998) for a complete description of these variables.

[21] Pindyck and Solimano (1993) suggest that the level of inflation can also be used as a proxy for aggregate uncertainty. In our sample, the correlation between the mean inflation and the mean volatility of inflation is over 0.95, and including both measures induces strong multicollinearity problems.

survives the inclusion of control variables. Regression (1) in Table 1 documents the association illustrated in Figure 1 (the coefficient on I/K is 1.033 with a p-value of 0.002). The estimated coefficient implies that 60% of the growth volatility differential between the U.S. and Korea may be explained by different investment-capital ratios in these countries.[22] In regression (2), we add several controls for exogenous sources of volatility. The coefficient on the investment-capital ratio increases slightly to 1.48 and remains significant (p-value of 0.002). Higher SDINF and SDRER are associated with higher volatility of GDP growth, but only the first variable has a significant coefficient (p-value of 0.01). Richer economies in 1960 also display greater volatility (p-value on GDP1960 is 0.085). The effect of the government is mixed. Higher share of spending on GDP lowers variance, perhaps counteracting the effect of GDP1960 because several rich countries have large governments. But higher risk of expropriation (lower RISKEXP) increases variance.

[Figure 1 and Table 1 here.]

In regression (3), we regress the volatility of GDP growth on the investment-capital ratio and the enforcement-type variables of investor protection. The investment-capital ratio has a lower estimated coefficient, but remains significant (p-value of 0.075). The investor protection variables are also jointly significant with a p-value of 0.012. In regression (4), we add volatility control variables to those regressors in regression (3). Both the investment-capital ratio and the investor protection variables are significant (p-values of 0.002 and 0.056, respectively). The variables SDINF and SDRER are now both significant (p-values of 0.003 and 0.054, respectively) and so are the government variables (p-value on G/GDP is 0.034 and on RISKEXP is 0.003); GDP1960 is no longer significant.

The antidirector rights variable (ANTIDIR) and the dummy for legal origin (DCIVIL) are never jointly significant, though in regression (5) DCIVIL is significant and positive, implying that countries with civil law have higher variance (over and above that induced through the investment-capital ratio). More importantly, adding these variables does not remove the significance of the association of the investment-capital ratio to the standard deviation of GDP growth (p-values on I/K of 0.001 in both regressions).

Figure 2 and Table 2 present the results for the association between the standard deviation of stock returns and the investment-capital ratio. As predicted by the model, Figure 2 illustrates a positive (unconditional) association between these variables. Regression (1) in Table 2 gives the numbers for the statistical association apparent in Figure 2 (the slope coefficient of 2.288 and p-value of 0.038). This estimate implies that 31% of the stock return volatility differential between

[22] The investment-capital ratio in the U.S. and Korea is, 0.107 and 0.117, respectively. The growth volatility numbers for these countries are 0.0204 and 0.0377. Hence, $0.6 = 1.033 \times (0.117 - 0.107) / (0.0377 - 0.0204)$.

the U.S. and Korea is due to the differential investment-capital ratios in these countries.[23] In regression (2), we add controls for exogenous volatility variation. The significance of I/K remains (p-value of 0.008) and in contrast to the volatility of output growth, only G/GDP and RISKEXP are significant (p-values of 0.07 and 0.049, respectively).

[Figure 2 and Table 2 here.]

Similarly to the results in Table 1, Table 2 shows that the enforcement variables have more predictive power than the antidirector rights (ANTIDIR) and legal origin (DCIVIL) variables. In regression (3), we combine the enforcement variables with the investment-capital ratio as predictors of the stock return volatility. While the investment-capital ratio loses its significance (p-value of 0.506), the three investor protection variables are still jointly significant (p-value of 0.001). In particular, JUDICIAL (p-value of 0.046) indicates that countries with better investor protection have lower volatility. This is reversed in regression (4) when we add controls for exogenous causes of volatility. The investment-capital ratio is then significant at the 3% level, but the investor protection variables have a joint significance with p-value of 0.2042. This suggests that the impact of the investor protection variables occurs through the investment-capital ratio only, as predicted by the model. Out of the volatility controls, only SDINF and RISKEXP are significant (p-values of 0.031 and 0.093, respectively).

The antidirector rights variable (ANTIDIR) and the dummy for legal origin (DCIVIL) are not jointly significant after controlling for I/K (p-values of 0.1 and 0.3875 for regressions (5) and (6), respectively). In regression (5), DCIVIL is significant at the 10% level, suggesting as in Table 1 that civil law countries have higher volatility of stock returns. However, controlling for these measures of investor protection does not alter the significance of the association between the investment-capital ratio and the standard deviation of stock returns (p-values of 0.008 and 0.01 for regressions (5) and (6), respectively). In regression (6), only G/GDP and RISKEXP are significant (p-values of 0.054 and 0.046, respectively) as controls for other sources of volatility.

8 Conclusions

A large corporate finance literature on investor protection has convincingly documented that corporations in many countries, especially those with weak investor protection, often have controlling shareholders. Controlling shareholders pursue private benefits at the cost of outside minority shareholders. We construct a dynamic stochastic general equilibrium model in which (i) the controlling shareholder pursues private benefits and also makes corporate decisions in his

[23] The investment-capital ratios in the U.S. and Korea are, respectively, 0.107 and 0.117. The standard deviations of stock returns are, respectively, 0.0447 and 0.1195. Hence, $0.31 = 2.288 \times (0.117 - 0.107)/(0.1195 - 0.0447)$.

own interest; and (*ii*) outside investors make their optimal inter-temporal consumption-saving, and asset allocation decisions.

The forward-looking controlling shareholder's incentive to pursue private benefits leads him to distort capital accumulation and payout policies. In particular, his incentive to overinvest is stronger when investor protection is weaker. Following the recent research in macro on real investment (e.g. Greenwood et al. (1997, 2000) and Fisher (2006)), we introduce investment-specific technological shocks to the capital accumulation process. With shocks to the efficiency of investment, overinvestment also induces risk in capital accumulation. We show that in equilibrium, the private benefits effect dominates the risk aversion/precautionary saving effect, and leads to overinvestment.

Despite the conflicts of interests and the heterogeneity of investment opportunities between the controlling shareholder and outside investors, we are able to characterize the equilibrium in closed form. The model allows us to analytically derive theoretical predictions on asset prices and returns. We show that weaker investor protection leads to a lower Tobin's q, a higher interest rate, a larger volatility, and a higher risk premium, consistent with existing evidence. We show that strengthening investor protection has a significant wealth redistribution effect from the controlling shareholder to outside investors. However, we argue that this political process is naturally difficult to realize. Finally, we provide evidence consistent with our model's two new predictions: countries with a higher investment-capital ratio have both a larger variance of GDP growth and also a larger variance of stock returns.

Appendix

This Appendix contains the proofs for the theorem and propositions in the main text. Throughout we make use of the following assumptions:

Assumption 1 $h > \rho + \delta\left(1-\gamma\right).$

Assumption 2 $1-\alpha < \eta$.

Assumption 3 $2\left(\gamma+1\right)\left[\left(1+\psi\right)h - \rho - \delta\left(1-\gamma\right)\right]\epsilon^2 \leq \gamma\left[1+\left(1+\psi\right)h\epsilon^2\right]^2$.

Assumption 4 $\left(1-\phi\right)h > i$.

Assumption 5 $\rho + \left(\gamma-1\right)\left(i-\delta\right) - \gamma\left(\gamma-1\right)i^2\epsilon^2/2 > 0\,.$

Assumption 1 states that the firm is sufficiently productive and thus investment will be positive for risk-neutral firms under perfect investor protection. Assumption 2 ensures agency costs exist and lie within the economically interesting and relevant region. Assumptions 3 and 4 ensure positive and real investment and positive dividends, respectively. Assumption 5 gives rise to finite and positive Tobin's q and dividend yield. While we describe the intuition behind these assumptions, obviously we cannot take the intuition and implications of these assumptions in isolation. These assumptions jointly ensure that the equilibrium exists with positive and finite net private benefits, investment rate, dividend, and Tobin's q.

Proof of Theorem 1.

We conjecture and verify that the controlling shareholder's value function is given by

$$J_1\left(K\right) = \frac{1}{1-\gamma}\left(A_1 K^{1-\gamma} - \frac{1}{\rho}\right),$$

where A_1 is constant to be determined. The first-order condition (22) gives

$$m^{-\gamma}\alpha = A_1\left(1-\epsilon^2 i\gamma\right)\,, \tag{A.1}$$

where $m = M/K$ and $i = I/K$ are the controlling shareholder's equilibrium consumption-capital ratio, and the firm's investment-capital ratio, respectively. Plugging the stealing function into (6) gives

$$m = \alpha d + \frac{1-\alpha^2}{2\eta}h = \alpha\left((1-\phi)h - i + \frac{1-\alpha^2}{2\alpha\eta}h\right) = \alpha\left((1+\psi)h - i\right)\,, \tag{A.2}$$

where

$$\psi = \frac{(1-\alpha)^2}{2\alpha\eta},$$

is an agency cost parameter, and d is the dividend-capital ratio. Plugging (A.1) and (A.2) into the HJB equation (21) gives

$$\begin{aligned} 0 &= \frac{1}{1-\gamma}m^{1-\gamma} - \rho\frac{A_1}{1-\gamma} + (i-\delta)A_1 - \frac{\epsilon^2}{2}i^2\gamma A_1 \\ &= \frac{A_1}{1-\gamma}\left((1+\psi)h - i\right)\left(1-\epsilon^2\gamma i\right) - \rho\frac{A_1}{1-\gamma} + (i-\delta)A_1 - \frac{\epsilon^2}{2}i^2\gamma A_1. \end{aligned}$$

The above equality implies the following relation:

$$\left((1+\psi)h - i\right)\left(1-\epsilon^2\gamma i\right) = y, \tag{A.3}$$

where y is the dividend yield and is given by

$$y = \rho - (1-\gamma)(i-\delta) + \frac{1}{2}\gamma(1-\gamma)\epsilon^2 i^2 . \tag{A.4}$$

We note that (A.3) and (A.4) automatically imply the following inequality for the investment-capital ratio:

$$i < \left(\epsilon^2\gamma\right)^{-1} . \tag{A.5}$$

This inequality will be used in proving the propositions.

We further simplify (A.3) and give the following quadratic equation for the investment-capital ratio i:

$$\gamma\left(\frac{\gamma+1}{2}\right)\epsilon^2 i^2 - \gamma\left[1+(1+\psi)h\epsilon^2\right]i + (1+\psi)h - (1-\gamma)\delta - \rho = 0. \tag{A.6}$$

For $\gamma > 0$, solving the quadratic equation (A.6) gives

$$i = \frac{1}{\gamma(\gamma+1)\epsilon^2}\left[\gamma\left[1+(1+\psi)h\epsilon^2\right] \pm \sqrt{\Delta}\right], \tag{A.7}$$

where

$$\Delta = \gamma^2\left[1+(1+\psi)h\epsilon^2\right]^2\left[1 - \frac{2\gamma(\gamma+1)\epsilon^2\left((1+\psi)h - (1-\gamma)\delta - \rho\right)}{\gamma^2\left[1+(1+\psi)h\epsilon^2\right]^2}\right].$$

In order to ensure that the investment-capital ratio given in (A.7) is a real number, we require that $\Delta > 0$, which is explicitly stated in Assumption 3. Next, we choose between the two roots for the investment-capital ratio given in (A.7). We note that when $\epsilon = 0$, the investment-capital ratio is

$$i = \left[(1+\psi)h - (1-\gamma)\delta - \rho\right]/\gamma,$$

as directly implied by (A.6). Therefore, by a continuity argument, for $\epsilon > 0$, the natural solution for the investment-capital ratio is the smaller root in (A.7) and is thus given by

$$i = \frac{1}{\gamma(\gamma+1)\epsilon^2}\left[\gamma\left[1+(1+\psi)h\epsilon^2\right] - \sqrt{\Delta}\right]. \tag{A.8}$$

We also solve for the value function coefficient A_1 and obtain

$$A_1 = \frac{m^{-\gamma}\alpha}{1-\epsilon^2 i\gamma} = \frac{m^{1-\gamma}}{y}, \tag{A.9}$$

where y is the dividend yield and is given by (A.4).

Next, we check the transversality condition for the controlling shareholder:

$$\lim_{T\to\infty} E\left(e^{-\rho T}|J_1(K(T))|\right) = 0. \tag{A.10}$$

It is equivalent to verify $\lim_{T\to\infty} E\left(e^{-\rho T}K(T)^{1-\gamma}\right) = 0$. We note that

$$\begin{aligned} E\left(e^{-\rho T}K(T)^{1-\gamma}\right) &= E\left[e^{-\rho T}K_0^{1-\gamma}\exp\left((1-\gamma)\left(\left(i-\delta-\frac{\epsilon^2 i^2}{2}\right)T + \epsilon i Z(T)\right)\right)\right] \\ &= e^{-\rho T}K_0^{1-\gamma}\exp\left[(1-\gamma)\left(i-\delta-\frac{\epsilon^2 i^2}{2}+\frac{1-\gamma}{2}\epsilon^2 i^2\right)T\right]. \end{aligned}$$

Therefore, the transversality condition will be satisfied if $\rho > 0$ and the dividend yield is positive ($y > 0$), as stated in Assumption 5.

Now, we turn to the optimal consumption and asset allocation decisions for the controlling shareholder. The transversality condition for the minority investor is

$$\lim_{T\to\infty} E\left(e^{-\rho T}|J_2(W(T))|\right) = 0.$$

Recall that in equilibrium, the minority investor's wealth is all invested in firm equity and thus his initial wealth satisfies $W_0 = (1-\alpha)\,qK_0$. Since the minority investor's wealth dynamics and the firm's capital accumulation dynamics are both geometric Brownian motions with the same drift and volatility parameters, it follows immediately that the transversality condition for minority investor is also met if and only if the dividend yield y is positive, as stated in Assumption 5. Moreover, we verify that the minority investor's value function is given by

$$\begin{aligned} J_2(W_0) &= E\left[\int_0^\infty e^{-\rho t}\frac{1}{1-\gamma}\left([(1-\alpha)\,dK(t)]^{1-\gamma}-1\right)dt\right] \\ &= \frac{1}{1-\gamma}\left([(1-\alpha)\,dK_0]^{1-\gamma}\frac{1}{y}-\frac{1}{\rho}\right) = \frac{1}{1-\gamma}\left(A_2 W_0^{1-\gamma}-\frac{1}{\rho}\right), \end{aligned}$$

where $A_2 = 1/y^\gamma$. Following Merton (1971), we may conclude that the minority investor's consumption rule is given by:

$$C_2(t) = \left(\frac{\rho - r(1-\gamma)}{\gamma} - \frac{\lambda^2(1-\gamma)}{2\gamma^2\sigma_P^2}\right)W(t).$$

The portfolio rule is reported in (24).

To complete the proof of the theorem we give the equilibrium interest rate and Tobin's q. In equilibrium, the minority investor's consumption is $C_2(t) = (1-\alpha)\,D(t)$. Applying Ito's lemma to the minority investor's marginal utility, $\xi_2(t) = e^{-\rho t} C_2(t)^{-\gamma}$, we obtain the process for the stochastic discount factor:

$$\frac{d\xi_2(t)}{\xi_2(t)} = -\rho dt - \gamma \frac{dK(t)}{K(t)} + \frac{\epsilon^2 i^2}{2} \gamma (\gamma + 1)\, dt.$$

The drift of ξ_2 equals $-r\xi_2$, where r is the equilibrium interest rate. Importantly, the implied equilibrium interest rate by the controlling shareholder's ξ_1 and the minority investor's ξ_2 are equal. This confirms the leading assumption that the controlling shareholders and the minority investors find it optimal not to trade the risk-free asset at the equilibrium interest rate.

Tobin's q can be obtained by computing the ratio of market value to the replacement cost of the firm's capital. The firm's market value is (from the perspective of outside investors):

$$P(t) = \frac{1}{1-\alpha} E_t \left[\int_t^{\infty} \frac{\xi_2(s)}{\xi_2(t)} (1-\alpha)\, D(s)\, ds \right].$$

Using the definitions of $\xi_2(t) = e^{-\rho t} C_2(t)^{-\gamma} = e^{-\rho t} (y W_2(t))^{-\gamma}$, $D(t)/K(t) = d$, and $W_2(t)/K(t) = (1-\alpha)\, q$, we rewrite $P(t)$ as

$$P(t) = \frac{d}{K(t)^{-\gamma}} E_t \left[\int_t^{\infty} e^{-\rho(s-t)} K(s)^{1-\gamma}\, ds \right] = d \frac{A_1}{m^{1-\gamma}} K(t) = qK(t)\ ,$$

using the conjectured controlling shareholder's value function $J_1(K)$.

Therefore, Tobin's q is given by

$$q = \frac{\alpha d}{m} \left(\frac{1}{1-\epsilon^2 i\gamma} \right) = \frac{d}{d + (\psi + \phi)\, h} \left(\frac{1}{1-\epsilon^2 i\gamma} \right) = \left(1 + \left(\frac{1-\alpha^2}{2\eta\alpha d} \right) h \right)^{-1} \left(\frac{1}{1-\epsilon^2 i\gamma} \right),$$

where the first equality uses (A.9), the second equality uses (13), and the third follows from simplification.

A constant q and dividend-capital ratio d immediately implies that the drift coefficients for dividend, stock price, and capital stock are all the same, i.e., $\mu_D = \mu_P = \mu_K = i - \delta$, and the volatility coefficients for dividend, stock price, and capital stock are also the same, i.e., $\sigma_D = \sigma_P = \sigma_K = \epsilon i$. A constant risk premium λ is an immediate implication of constant μ_P, constant dividend-capital ratio d, and constant equilibrium risk-free interest rate. ■

Proof of Proposition 1. Define

$$f(x) = \frac{\gamma(\gamma+1)}{2} \epsilon^2 x^2 - \left[1 + (1+\psi)\, h\epsilon^2 \right] \gamma x + (1+\psi)\, h - \rho - \delta (1-\gamma).$$

Note that $f(i) = 0$, where i is the equilibrium investment-capital ratio and the smaller of the zeros of f. Also, $f(x) < 0$ for any value of x between the two zeros of f and is greater than or equal to zero elsewhere. Now,

$$f\left(\gamma^{-1}\epsilon^{-2}\right) = \frac{1-\gamma}{2\gamma\epsilon^2} - \rho - \delta(1-\gamma).$$

Therefore, $f\left(\gamma^{-1}\epsilon^{-2}\right) < 0$ if and only if Assumption 5 is met. Hence, under Assumption 5, $i < \gamma^{-1}\epsilon^{-2}$. Also, under Assumption 1, $f(0) = (1+\psi)h - \rho - \delta(1-\gamma) > 0$ which implies that $i > 0$.

Abusing notation slightly, use (8) to define the equilibrium investment-capital ratio implicitly as $f(i,\psi) = 0$. Taking the total differential of f with respect to ψ, we obtain

$$\frac{di}{d\psi} = \frac{1}{\gamma}\frac{h\left(1-\gamma\epsilon^2 i\right)}{1-\gamma\epsilon^2 i + \left((1+\psi)h - i\right)\epsilon^2}.$$

At the smaller zero of f, $i < \gamma^{-1}\epsilon^{-2}$. Together with $(1+\psi)h - i > (1-\phi)h - i = d > 0$, this implies that $di/d\psi > 0$. ■

Proof of Proposition 3. Differentiate (19) with respect to the agency cost parameter ψ to obtain:

$$\frac{dr}{d\psi} = \gamma\left[1-\epsilon^2(\gamma+1)i\right]\frac{di}{d\psi},$$

and note that $di/d\psi > 0$. Hence, the interest rate is lower when investor protection improves if and only if $1 > \epsilon^2(\gamma+1)i$, or using (A.8), if and only if

$$\gamma > 2\left[(1+\psi)h - (\gamma+1)\left((1-\gamma)\delta+\rho\right)\right]\epsilon^2.$$

This inequality is always true if $(1+\psi)h - (\gamma+1)\left((1-\gamma)\delta+\rho\right) < 0$; otherwise, it holds for sufficiently low ϵ, h, or ψ. ■

Proof of Proposition 2. We prove the result with respect to η. The case for the controlling shareholder's ownership α is then immediate. Use the expression for the dividend yield in (30) to express Tobin's q as the ratio between the dividend-capital ratio d and the dividend yield y. Differentiating $\log q$ with respect to investor protection gives:

$$\begin{aligned}
\frac{d\log q}{d\eta} &= \frac{1}{y}\left[-h\frac{d\phi}{d\eta} - \frac{di}{d\eta} - \left(\frac{d}{y}\right)\frac{dy}{d\eta}\right] \\
&= \frac{1}{y}\left[-h\frac{d\phi}{d\eta} - \frac{di}{d\eta} - q\left((\gamma-1)\frac{di}{d\eta} - \gamma(\gamma-1)\epsilon^2 i\frac{di}{d\eta}\right)\right] \\
&= \frac{1}{y}\left[\frac{1-\alpha}{\eta^2}h - \frac{di}{d\eta}\left(1+\frac{1-\alpha^2}{2\eta\alpha\, d}h\right)^{-1}\left(\frac{1-\alpha^2}{2\eta\alpha d}h+\gamma\right)\right] > 0\,,
\end{aligned}$$

where the inequality uses $\gamma > 0$ and $di/d\eta < 0$. ■

Proof of Proposition 4. Weaker investor protection or lower share of equity held by the controlling shareholder both lead to a higher agency cost parameter ψ. Proposition 1 shows that a higher ψ leads to more investment and hence both higher volatility of stock returns $\sigma_P^2 = \epsilon^2 i^2$ and higher expected excess returns $\lambda = \gamma\sigma_P^2$. To see the effect of investor protection on total expected equity returns, we note that

$$\frac{d\left(\gamma\epsilon^2 i^2 + r\right)}{d\psi} = \gamma\left(\epsilon^2 i + 1 - \epsilon^2 i\gamma\right)\frac{di}{d\psi},$$

which is strictly positive under Assumption 5. Expected returns are higher with weaker investor protection or a lower share of equity held by the controlling shareholder. ■

Proof of Proposition 5. We first use the equivalent martingale measure to derive the formula for dividend yield. Adjusting for risk, the dividend process (under the risk-neutral probability measure) follows:[24]

$$dD(t) = gD(t)dt + \sigma_D D(t)d\tilde{Z}(t)\,,$$

where $\tilde{Z}(t)$ is the Brownian motion under the risk-neutral probability measure and g is the risk-adjusted growth rate $g = \mu_D - \lambda = i - \delta - \gamma i^2 \epsilon^2$. Therefore, firm value is given by[25]

$$P(t) = E_t\left[\int_t^{\infty} \frac{\xi_2(s)}{\xi_2(t)} D(s)ds\right] = \tilde{E}_t\left[\int_t^{\infty} e^{-r(s-t)} D(s)ds\right] = \frac{D(t)}{r-g}.$$

Therefore, the dividend yield y is given by $y = r - g$.

Differentiate the dividend yield y with respect to ψ to obtain:

$$\frac{dy}{d\psi} = \frac{di}{d\psi}\left(\gamma - 1\right)\left(1 - \gamma\epsilon^2 i\right) \lesseqgtr 0 \text{ iff } \gamma \lesseqgtr 1,$$

and note that the agency cost parameter ψ decreases with both investor protection and η and ownership α. The proposition then follows. ■

Proof of Proposition 6. Differentiating $\log\zeta_2$ with respect to η gives:

$$\begin{aligned}
\frac{d\log\zeta_2}{d\eta} &= \frac{d\log d}{d\eta} + \frac{1}{1-\gamma} d\log y \\
&= \frac{d\log d}{d\eta} + \frac{1}{1-\gamma}\frac{1}{y}\left(\left(\gamma - 1\right)\frac{di}{d\eta} - \gamma(\gamma-1)\epsilon^2 i \frac{di}{d\eta}\right) \\
&= \frac{d\log d}{d\eta} - \frac{di}{d\eta}\frac{1}{y}\left(1 - \gamma\epsilon^2 i\right) > 0\,,
\end{aligned}$$

where the inequality uses $1 - \gamma\epsilon^2\, i > 0$ and $di/d\eta < 0$ (from Proposition 1), and $d\log d/d\eta > 0$. For the controlling shareholder, we have

$$\frac{d\log\zeta_1}{d\eta} = \frac{-\gamma}{1-\gamma}\log\left(y\right) = \gamma\frac{di}{d\eta}\frac{1}{y}\left(1 - \gamma\epsilon^2 i\right) < 0,$$

where the inequality follows from $di/d\eta < 0$. ■

[24] Using Girsanov's theorem, the dynamics of the Brownian motion under the risk-neutral probability measure are given by

$$d\tilde{Z}(t) = dZ(t) + (\lambda/\sigma_D)\,dt.$$

[25] The first equality in (8) is the standard asset pricing equation. The second equality uses the pricing formula under the risk-neutral probability measure and $\tilde{E}$ denotes the expectation under the risk-neutral probability measure. The last equality uses the dividend dynamics (8) under the risk-neutral probability measure.

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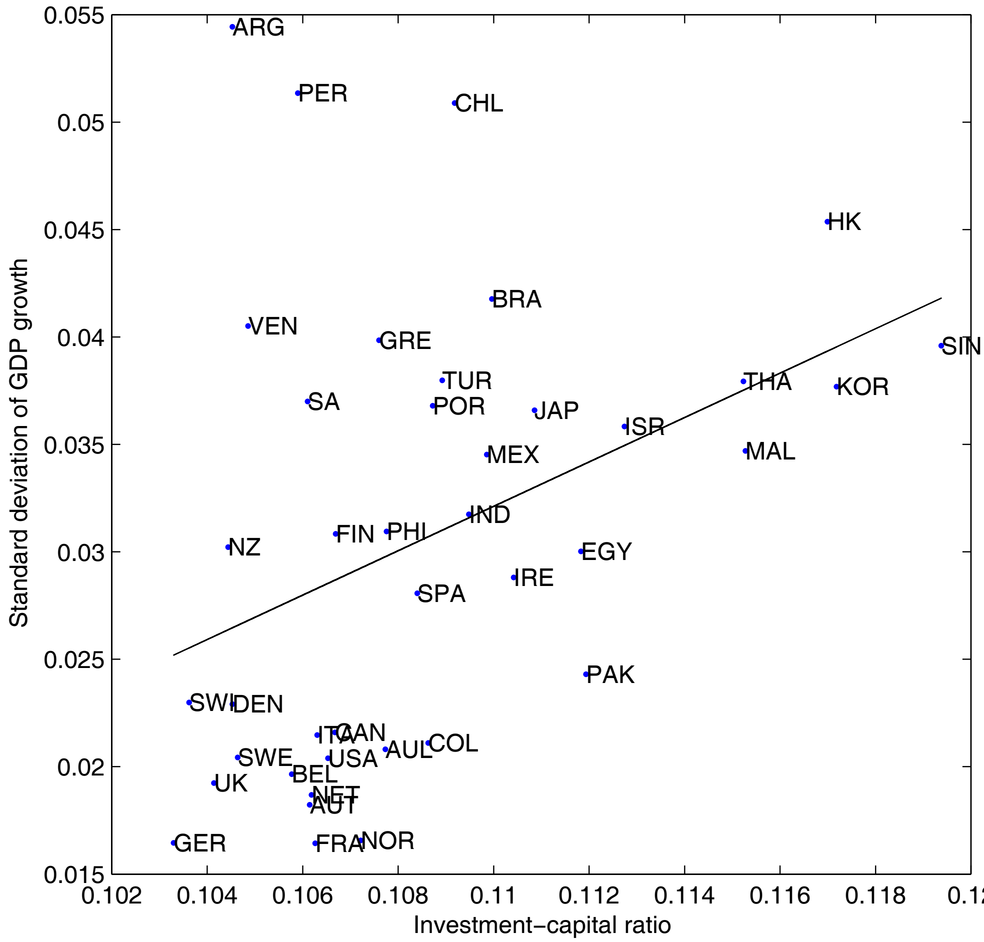

Figure 1: Scatter plot and linear fit of the volatility of GDP growth on the investment-capital ratio across countries. See text for country abbreviations.

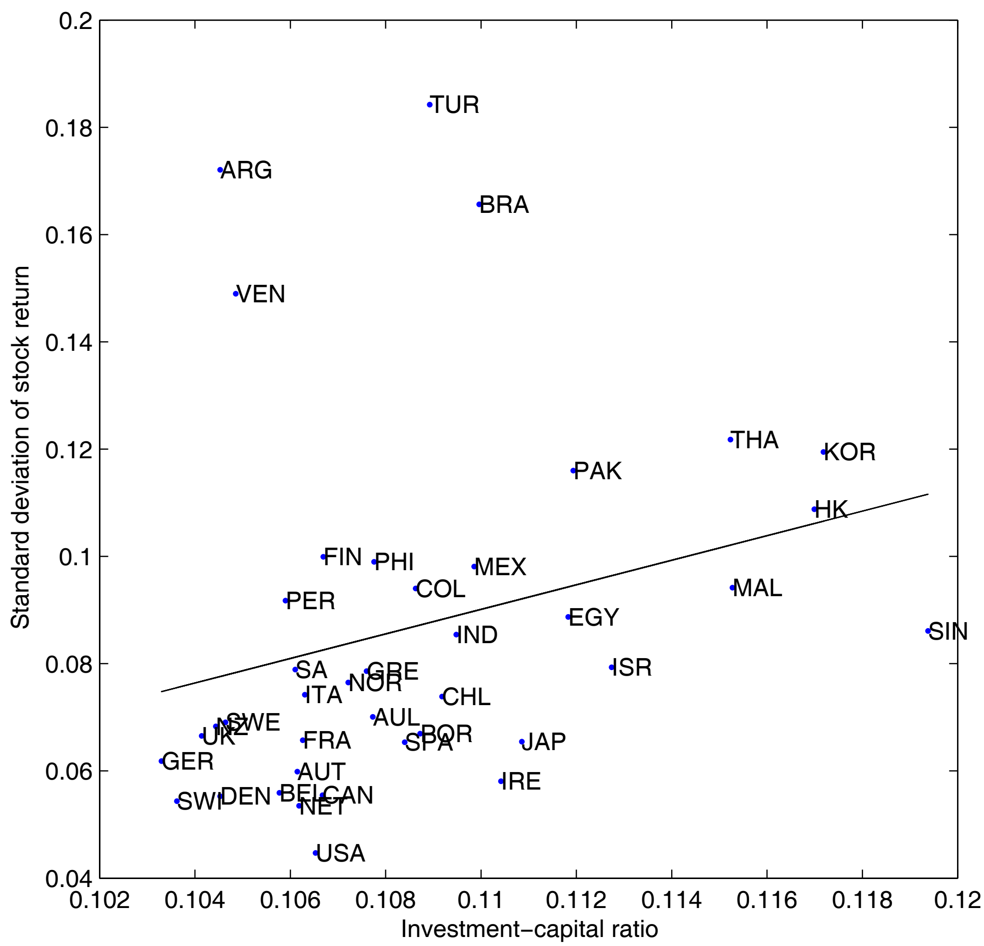

Figure 2: Scatter plot and linear fit of the volatility of stock returns on the investment-capital ratio across countries. See text for country abbreviations.

Table 1

Ordinary Least Squares Regressions: Standard Deviation of Real GDP Growth

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
I/K	1.033	1.480	0.771	1.691	1.102	1.480
	0.002	0.002	0.075	0.002	0.001	0.001
CORRUPTION			0.001	0.004		
			0.744	0.028		
JUDICIAL			-0.001	-0.000		
			0.134	0.968		
LAW			-0.002	0.003		
			0.348	0.263		
ANTIDIR					0.002	0.001
					0.111	0.300
DCIVIL					0.008	-0.001
					0.043	0.719
SDINF		0.001		0.001		0.001
		0.010		0.003		0.059
SDRER		0.0314		0.058		0.056
		0.344		0.054		0.145
G/GDP		-0.055		-0.004		-0.051
		0.014		0.034		0.025
RISKEXP		-0.004		-0.006		-0.004
		0.031		0.003		0.033
OPEN		-0.001		-0.004		-0.001
		0.467		0.120		0.449
GDP1960		0.009		0.003		0.010
		0.085		0.695		0.093
Intercept	-0.082	-0.128	-0.036	-0.137	-0.101	-0.134
	0.021	0.030	0.489	0.042	0.004	0.019
Adjusted R^2	0.133	0.632	0.258	0.673	0.191	0.630
Joint significance of investor protection vars.			0.012	0.056	0.121	0.236

Notes: Variables are the investment-capital ratio (I/K), antidirector rights (ANTIDIR), a dummy for civil law countries (DCIVIL), the efficiency of the judicial system (JUDICIAL), the rule of law (LAW), corruption (CORRUPTION), the standard deviations of inflation (SDINF) and of changes in the real exchange rate (SDRER), the share of government spending in GDP (G/GDP), the ratio of exports plus imports to GDP (OPEN), the 1960-level of real GDP per capita in logs (GDP1960), and risk of expropriation (RISKEXP). Each cell reports the coefficient estimate and the White-corrected p-value on the null that the coefficient is zero.

Table 2

Ordinary Least Squares Regressions: Standard Deviation of Stock Returns

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
I/K	2.288	2.958	0.771	2.828	2.898	2.995
	0.038	0.008	0.506	0.031	0.008	0.010
CORRUPTION			-0.006	-0.001		
			0.366	0.908		
JUDICIAL			-0.008	-0.005		
			0.046	0.243		
LAW			0.0001	0.009		
			0.983	0.140		
ANTIDIR					-0.002	-0.005
					0.632	0.182
DCIVIL					0.015	-0.007
					0.072	0.441
SDINF		0.0002		0.001		0.001
		0.961		0.031		0.798
SDRER		0.175		0.155		0.119
		0.145		0.250		0.467
G/GDP		-0.141		-0.089		-0.184
		0.070		0.273		0.054
RISKEXP		-0.011		-0.013		-0.012
		0.049		0.093		0.046
OPEN		-0.104		-0.0053		-0.011
		0.200		0.543		0.171
GDP1960		0.014		0.012		0.016
		0.307		0.584		0.267
Intercept	-0.162	-0.181	0.090	-0.148	-0.232	-0.156
	0.176	0.183	0.526	0.349	0.037	0.258
Adjusted R^2	0.049	0.444	0.391	0.456	0.066	0.447
Joint significance of investor protection vars.			0.001	0.204	0.100	0.388

Notes: Variables are the investment-capital ratio (I/K), antidirector rights (ANTIDIR), a dummy for civil law countries (DCIVIL), the efficiency of the judicial system (JUDICIAL), the rule of law (LAW), corruption (CORRUPTION), the standard deviations of inflation (SDINF) and of changes in the real exchange rate (SDRER), the share of government spending in GDP (G/GDP), the ratio of exports plus imports to GDP (OPEN), the 1960-level of real GDP per capita in logs (GDP1960), and risk of expropriation (RISKEXP). Each cell reports the coefficient estimate and the White-corrected p-value on the null that the coefficient is zero.