AGENCY CONFLICTS, INVESTMENT, AND ASSET
PRICING

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ABSTRACT

The separation of ownership and control allows controlling shareholders to pursue private benefits.
We develop an analytically tractable dynamic stochastic general equilibrium model to study asset pricing
and welfare implications of imperfect investor protection. Consistent with empirical evidence, 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. Calibrating the model
to the Korean economy reveals that perfecting investor protection increases the stock market's value
by 22 percent, a gain for which outside shareholders are willing to pay 11 percent of their capital stock.

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It is widely accepted that governance problems are of first-order importance in many countries (La Porta, Lopez-de-Silanes, and Shleifer (1998, 2000a)). Corporations in many countries are run by controlling shareholders whose cash flow rights in the firm are substantially smaller than their control rights (La Porta et al. (1999)). For example, controlling shareholders may acquire complete control with cash flow rights significantly lower than 50% via dual-class shares, pyramid-ownership structures, or cross-ownership (Bebchuk, Kraakman, and Triantis (2000)). The separation of ownership and control allows controlling shareholders to pursue private benefits at the cost of outside shareholders. The size of private benefits depends in large part on the extent of investor protection and corporate governance safeguarding outside investors.[1] La Porta et al. (2002), Claessens et al. (2002), Doidge, Karolyi, and Stulz (2004), and Gompers, Ishii, and Metrick (2003), among others, document how imperfect investor protection lowers firm value.

Investor protection influences not only firm value as emphasized in the literature, but also equilibrium interest rates, asset returns, and welfare costs. Intuitively, agents' consumption and savings decisions and firms' cost of capital are fundamentally linked in general equilibrium, which depends in turn on firms' production and investment decisions and the extent of agency conflicts. However, to date little theoretical research has been devoted to formulating equilibrium asset pricing implications of agency conflicts. Shleifer and Wolfenzon (2002) present a static model with risk-neutral agents and determine the interest rate in general equilibrium. In this paper, we present one of the first dynamic stochastic general equilibrium models to study the implications of imperfect investor protection for risk sharing and asset pricing. We therefore provide one of the first quantitative frameworks to assess the magnitudes of both the loss of investor welfare and the reduction in market value due to imperfect investor protection.

We introduce two new features into a standard production-based equilibrium asset pricing model. First, we assume that output fluctuations arise from shocks to the marginal efficiency of investment (Keynes (1936)), i.e. investment-specific technology shocks. This assumption is motivated by the growing literature that emphasizes the important role of investment-specific technology shocks as a source of aggregate volatility (Greenwood, Hercowitz, and Huffman (1988), Greenwood, Hercowitz, and Krusell (1997), and Fisher (2006), among others). Second, in our model, firms' investment decisions are made by self-interested controlling shareholders who extract private benefits from outside shareholders (Berle and Means (1932) and Jensen and Meckling (1976)). We embed the conflict of interest and the implied heterogeneity between controlling shareholders and outside shareholders in an equilibrium setting.

To isolate the effects of our assumption of investment-specific technology shocks on real investment and asset prices, we first consider a benchmark economy with no conflicts of interest. Under perfect investor protection, the controlling shareholder rationally pursues no private benefits (because of infinite marginal cost of stealing) and thus he behaves in the interest of outside shareholders. Our benchmark model is the extension of representative-agent asset pricing models such as Cox, Ingersoll, and Ross (1985) (henceforth, CIR). As in CIR and other investment models, investment increases the capital stock on average. However, in our model the investment-specific technology shocks make the representative agent less willing to invest in capital: The amount of capital in the next period depends stochastically on how new 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, in the CIR model Tobin's q is equal to unity. This technological specification is a

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key difference between our benchmark model and the seminal CIR model. To the best of our knowledge, ours is the first model predicting Tobin's q to be larger than unity in an equilibrium framework à la CIR without technological frictions such as adjustment costs or investment irreversibility.

When investor protection is imperfect, a conflict of interest arises between the controlling shareholder and outside shareholders. 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 imply a lower dividend payout, ceteris paribus. Tobin's q (from the outside 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. (2000b), who find that corporate payouts are lower in countries with weaker investor protection, and La Porta et al. (2002), Gompers, Ishii, and Metrick (2003) and Doidge, Karolyi, and Stulz (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) shows that emerging markets display higher return volatility and larger equity risk premia. 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 a greater incentive to invest and hence higher future output. Predicting higher output, agents' consumption smoothing motive leads them to borrow, which raises the interest rate. However, higher investment also makes capital accumulation more volatile and implies a stronger desire for precautionary savings, which lowers the interest rate. Because the former effect dominates, the interest rate is higher under weaker investor protection. The higher interest rate and the higher cost of capital (sum of the interest rate and the risk premium) have equilibrium feedback effects discouraging investment, ceteris paribus. We show that the agency channel effect (of overinvesting to pursue future private benefits) is stronger than the cost of capital effect in equilibrium. Therefore, the equilibrium investment-capital ratio and the interest rate both decrease with investor protection. We find evidence in support of our interest rate prediction using data in Campbell (2003).

We present a calibration of the model that allows us to assess the quantitative significance of improving investor protection. Specifically, we calibrate the model to the United States and South Korea to match estimates of the two countries' private benefits. The model predicts that moving to a perfect investor protection regime leads to a stock market revaluation of 2.49%

in the United States and 21.96% in Korea. The welfare implications of such improvements in investor protection are very large. Outside investors in the U.S. and Korea are willing to give up, respectively, 0.38% and 11.17% of the capital stock they own to move to perfect investor protection. This represents $43 billion of U.S. market capitalization and $4.7 billion of Korean market capitalization. On the other hand, the U.S. and Korean controlling shareholders are willing to give up 2.1% and 8.4% of their capital stock to maintain the status quo, respectively. We show that these welfare numbers are robust to different calibrations.

These calculations suggest significant wealth redistribution from controlling shareholders to outside shareholders 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 that would follow. 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 technology 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 other sources of volatility.

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.[2] As a result, because managers' wealth has zero measure in aggregate, DGK do not need to model their consumption and portfolio allocation decisions. In contrast, we study the agency conflict between controlling shareholders and outside shareholders. Because controlling shareholders in many countries claim a significant share of aggregate wealth, we therefore model the controlling shareholders' consumption and portfolio allocation decisions jointly with the outside shareholders' consumption and portfolio allocation decisions and derive equilibrium implications for risk sharing, welfare redistribution, and various equilibrium prices and quantities. The two models also differ in the production technology. DGK assume that capital accumulation follows the process given by CIR and hence they predict Tobin's q to be unity, independent of agency conflicts. In contrast, we assume investment-specific technology shocks, and predict that Tobin's q is larger than unity (even under perfect investor protection) and increasing with investor protection. Our model therefore provides an explanation for the evidence that countries with weaker investor protection observe higher risk premia and larger volatility. DGK and our model do share a common and key prediction; namely, that firms overinvest. However, to endogenize the degree of overinvestment DGK endow shareholders with a costly auditing technology, while we use an exogenously specified cost function for private benefits to model the degree of investor protection. Finally, with respect to preferences, DGK assume that investors have logarithmic preferences whereas we allow controlling and outside shareholders to share any degree of constant relative risk aversion.

We design our heterogenous-agent model with the objective of delivering a complete characterization of both resource allocation (over time and across shareholders) and equilibrium asset pricing that can be reconciled with empirical evidence. In order to achieve this objective in a parsimonious setting, we follow La Porta et al. (2002) and Lan and Wang (2006) and model

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investor protection by adopting a simple convex cost function for the controlling shareholder's pursuit of private benefits.[3] The alternative is to model agency conflicts via a contracting approach. Castro, Clementi, and MacDonald (2004) study a two-period overlapping generations model where entrepreneurs can abscond with revenues and project financiers are constrained by this agency friction. They focus on equilibrium implications for the interest rate and economic growth. However, they do not analyze welfare implications and asset pricing predictions for the risk premium, Tobin's q, and volatility.

It is worth noting that there is also a growing literature on optimal *dynamic* contracting in corporate finance. However, these models are often cast as a single firm contracting problem and produce no asset pricing implications. Albuquerque and Hopenhayn (2004) and DeMarzo and Fishman (2006) study the effects of financing constraints and agency conflicts on real investments. These models generate underinvestment, rather than overinvestment, because the degree of underinvestment becomes an incentive alignment tool between the investors and the manager. In our model, overinvestment arises because of the pursuit of private benefits by the controlling shareholder. This is likely to be the dominant issue for larger firms around the world whereas the underinvestment implied by these contracting models is potentially more important for smaller firms. DeMarzo and Sannikov (2006) formulate a continuous-time dynamic contracting problem and provide an optimal capital structure implementation that alleviates the friction arising from outside investors not being able to observe the cash flows generated by the firm.

The remainder of the paper is organized as follows. Section I presents the model and states the main theorem. Section II discusses the model's solution under the benchmark with perfect investor protection. Section III characterizes the equilibrium outcome and provides

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intuition for the model's solution. Section IV gives the model's main predictions for the effects of investor protection on investment and asset prices. Section V provides a calibration and supplies quantitative predictions on the value of improving investor protection. Section VI presents empirical evidence on two of the model's new predictions and Section VII concludes. The Appendix contains technical details and proofs of the theorem and propositions.

I. The Model

The economy is populated by a continuum of two types of agents, controlling shareholders and outside shareholders, identified with subscripts "1" and "2," respectively. Outside shareholders are all identical. All firms and their respective controlling shareholders are assumed to be identical as well and subject to the same shocks. This assumption substantially simplifies our analysis because we do not need to keep track of the controlling shareholders' holdings in other firms. Thus, without loss of generality, we analyze the decision problems of a representative controlling shareholder and a representative outside shareholder. All agents have infinite horizons and time is continuous.

A. *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) is a continuous-time version of Greenwood, Hercowitz, and Huffman (1988), which is based on 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 to total factor productivity (TFP). Our motivation for this choice of specification is three-fold. First, quantitatively speaking, these shocks play an important role in the economy. Identifying shocks to the marginal efficiency of investment with shocks to the relative price of investment goods, Greenwodd, Hercowitz, and Krusell (1997, 2000) document that these shocks account for 60% of post-war U.S. growth (Greenwood, Hercowitz, and Krusell (2000)) and 30% of output fluctuations in the post-war U.S. period (Greenwood, Hercowitz, and Krusell (1997)). Using an econometric approach that relaxes the identification in Greenwood, Hercowitz, and Krusell (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 a TFP decline, that is, technical regress, which has met substantial skepticism among macroeconomists (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 those in CIR and Sundaresan (1984) are subject to shocks, unlike the conventional specification. However, unlike in CIR and Sundaresan (1984), where uncertainty of capital accumulation is proportional to the level of capital stock K, here uncertainty of capital accumulation is proportional to the level of investment I. We will show that this difference has an important implication for Tobin's q in Section II.

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 fully entrenched and has complete control over the firm's investment and payout policies. We refer readers to Bebchuk, Kraakman, and Triantis (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, López-de-Silanes, and Shleifer (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 $\eta s hK$ 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 summarize, we have 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). Below we show that the interaction of these two assumptions generates the key results and insights of our paper.

Controlling Shareholder. The controlling shareholder has lifetime utility over consumption process C given by

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

where $u(C)$ is constant relative risk averse (CRRA) utility, that 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. The scale-invariance property of CRRA utility proves useful in keeping our model analysis tractable (as in Merton (1971), for example).

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:

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

Let C_1 and W_1 denote the controlling shareholder's consumption and wealth processes, respectively. 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 equals his risk-free holdings: $W_1(t) = B_1(t)$. Let $r(t)$ be the risk-free interest rate at t. The controlling shareholder's

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wealth evolves according to

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

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

In summary, the controlling shareholder chooses $\{D(t), s(t), C_1(t) : t \geq 0\}$ to maximize his lifetime utility defined in (4) and (5), subject to the capital accumulation process (1), flow-of-funds equations (3) and (6), his wealth accumulation process (7), and a transversality condition specified in the Appendix, with firm investment $\{I(t) : t \geq 0\}$, firm capital stock $\{K(t) : t \geq 0\}$, and liquid wealth $\{W_1(t) : t \geq 0\}$ being determined by (3), (1), and (6)-(7).

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 processes 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

$$dD(t) = \mu_D(t)D(t)\,dt + \sigma_D(t)D(t)\,dZ(t), \tag{9}$$

$$dP(t) = \mu_P(t)P(t)\,dt + \sigma_P(t)P(t)\,dZ(t), \tag{10}$$

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

the outside shareholders and the controlling shareholder may trade the risk-free asset. Later

we solve for the drift processes μ_K, μ_D, and μ_P, the volatility processes σ_K, σ_D, and σ_P, and

the equilibrium interest rate r. While μ_K, μ_D, μ_P, σ_K, σ_D, σ_P, and r can be stochastic and

path dependent, in Section III. we show that all these processes are deterministic and constant

in equilibrium. As we discuss later, this result depends on the assumptions of constant returns-

to-scale production technology, linearity of the stealing technology in K, and CRRA utility,

among others.

Outside Shareholders. Outside shareholders have the same preferences given in (4) and

(5), evaluated at the consumption process $C_2(t)$. Each outside shareholder 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

outside shareholder accumulates his wealth as follows:

$$dW_2(t) = (r(t)W_2(t) - C_2(t) + \omega(t)W_2(t)\lambda(t))\,dt + \sigma_P(t)\omega(t)W_2(t)dZ(t), \qquad (11)$$

with $W_2(0) = 0$. The outside shareholders' risk-free holdings are $B_2(t) = (1 - \omega(t))W_2(t)$.

Each outside shareholder chooses $\{C_2(t), \omega(t) : t \geq 0\}$ to maximize his lifetime utility func-

tion subject to the wealth dynamics (11) and a transversality condition specified in the Ap-

pendix. In solving this problem, each outside shareholder takes the equilibrium dividend, firm

value, and interest rate processes as given.

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

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

(iii) the risk-free asset market clears (i.e., $B_1(t) + B_2(t) = 0$):

$$W_1(t) + (1 - \omega(t)) W_2(t) = 0, \quad \text{for all } t; \tag{12}$$

(iv) the stock market clears for outside shareholders that is

$$1 - \alpha = \omega(t) W_2(t) / P(t), \quad \text{for all } t; \text{ and,} \tag{13}$$

(v) the consumption goods market clears, in that

$$C_1(t) + C_2(t) + I(t) = hK(t) - \Phi(s(t), hK(t)), \quad \text{for all } t. \tag{14}$$

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, in 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 relegated to the appendix.

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

$$C_2(t) = (1 - \alpha) D(t). \tag{15}$$

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

$$s(t) = \phi \equiv \frac{1 - \alpha}{\eta}. \tag{16}$$

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 $C_1(t)/K(t) = M(t)/K(t) = m$, $I(t)/K(t) = i$, $D(t)/K(t) = d$. In equilibrium, we have

$$m = \alpha\left[(1 + \psi)h - i\right] > 0, \tag{17}$$

$$i = \frac{1 + (1 + \psi)h\epsilon^2}{(\gamma + 1)\epsilon^2}\left[1 - \sqrt{1 - \frac{2(\gamma + 1)\epsilon^2\left((1 + \psi)h - \rho - \delta(1 - \gamma)\right)}{\gamma\left[1 + (1 + \psi)h\epsilon^2\right]^2}}\right] > 0, \tag{18}$$

$$d = (1 - \phi)h - i > 0, \tag{19}$$

where $\psi = (1 - \alpha)^2/(2\alpha\eta)$. 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 given by

$$\mu_D = \mu_K = \mu_P = i - \delta, \tag{20}$$

$$\sigma_D = \sigma_K = \sigma_P = i\epsilon. \tag{21}$$

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

$$q = \left(1 + \frac{1 - \alpha^2}{2\eta\alpha d}h\right)^{-1} \frac{1}{1 - \gamma\epsilon^2 i}. \tag{22}$$

The equilibrium interest rate is

$$r = \rho + \gamma(i - \delta) - \frac{\epsilon^2 i^2}{2}\gamma(\gamma + 1). \tag{23}$$

The key insight behind the results of our model is that no trade occurs between controlling shareholders and outside shareholders in equilibrium. We leave a detailed discussion of the result to Section III. Before delving into an analysis of the model's predictions, we first discuss the model's results under the benchmark model of perfect investor protection.

II. 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 the benchmark model with an asterisk.) 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 technology 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

$$q^* = \frac{1}{1 - \epsilon^2 \gamma i^*} > 1, \tag{24}$$

where i^* is given by (18) 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 costs, and the production function has constant returns to scale. More generally, in equilibrium Tobin's q is larger than unity when capital accumulation is subject to shocks ($\epsilon > 0$) and investors are risk averse ($\gamma > 0$). 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 the capital stock K: $dK = (I - \delta K) \, dt + \nu K \, dZ_t$. 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 capital 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. To the best of our knowledge, our neoclassical equilibrium model à la CIR is the first to generate Tobin's q larger than unity in the absence of technological

frictions such as adjustment costs or investment irreversibility. Thus, unlike Abel and Eberly (1994) and Hayashi (1982), who use adjustment costs to make Tobin's q larger than unity, the investment-specific technology shocks in the capital accumulation process and the investor's risk aversion jointly generate $q > 1$ in equilibrium. Our work therefore provides a view on the determinants of q, complementing the adjustment cost-based investment literature.

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

III. Understanding the Equilibrium Solution

In this section, we provide intuition for the model's no-trade equilibrium.[9] We show that (i) both the controlling and the outside shareholders find it optimal not to trade the risk-free asset under the conjectured dividend and price processes, (ii) the conjectured price processes clear the markets, and (iii) the conjectured dividends are consistent with the production decisions of controlling shareholders.

A. *The Controlling Shareholder's Optimization Problem*

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

$$\rho J_1(K) = \max_{D,s} \left\{ u(M) + (I - \delta K) J_1'(K) + \frac{\epsilon^2}{2} I^2 J_1''(K) \right\}, \tag{25}$$

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where the optimization is subject to (6) and (3).

The left side of (25) is the flow measure of the controlling shareholder's value function. The right side of (25) 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 (25). The first-order conditions with respect to dividend payout D and diversion s are:

$$M^{-\gamma}\alpha - \epsilon^2 I J_1''(K) = J_1'(K), \tag{26}$$

and

$$M^{-\gamma}\left(hK - \eta shK\right) - \epsilon^2 I J_1''\left(K\right)hK = J_1'\left(K\right)hK. \tag{27}$$

Equation (26) 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 (see equation (1)).

Equation (27) 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 (26) into (27) 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 conflicts of interest are larger (smaller α).

We now turn to the outside shareholder's problem.

B. *Outside Shareholder's Optimization*

To continue with 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, the outside shareholder solves a standard Merton-style consumption and portfolio choice problem. The investor optimally allocates a constant fraction ω of his total wealth to equity, where

$$\omega(t) = \frac{\lambda}{\gamma \sigma_P^2}. \tag{28}$$

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 outside shareholder also needs to hold all his wealth in equity ($\omega = 1$). Using (28) and imposing equilibrium yields

$$\lambda = \gamma \sigma_P^2 = \gamma \epsilon^2 i^2. \tag{29}$$

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 (21)).

C. *Intuition Behind the No-trade Equilibrium*

Under the no-trade conjecture, the outside shareholder's total wealth consists of his equity holdings. Each share of equity offers both the outside shareholder and the controlling shareholder dividends at the rate dK, where the dividend-capital ratio d is given in (19). In addition, the controlling shareholder receives 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:

$$\frac{m}{\alpha}K = (d + (\psi + \phi)h)K = \left(d + \frac{1 - \alpha^2}{2\alpha\eta}h\right)K. \tag{30}$$

Equation (30) shows that for each unit of dividends that the outside shareholder 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 the outside shareholder 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 case 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

$$e^{-\rho(s-t)}\frac{U'(C_1(s))}{U'(C_1(t))} = e^{-\rho(s-t)}\left(\frac{M(s)}{M(t)}\right)^{-\gamma} = e^{-\rho(s-t)}\left(\frac{D(s)}{D(t)}\right)^{-\gamma}. \tag{31}$$

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

$$e^{-\rho(s-t)}\frac{U'(C_2(s))}{U'(C_2(t))} = e^{-\rho(s-t)}\left(\frac{D(s)}{D(t)}\right)^{-\gamma}. \tag{32}$$

Combining (31) and (32) allows us to conclude that the marginal rates of substitution for the controlling shareholder and the outside shareholder are equal under the no-trade conjecture.

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Therefore, both controlling shareholders and outside shareholders have the same risk attitudes toward securities such as the risk-free asset in equilibrium. However, controlling shareholders and outside shareholders disagree in terms of the firm's investment decisions, as we show in Section IV. Because outside shareholders only receive their pro rata share of dividends from the firm, if they were able to run the firm, they would choose the first-best investment rule. Instead, controlling shareholders are able to extract private benefits of control in addition to firm dividends, which generates an investment distortion.

In our model, the controlling shareholder is required to hold an underdiversified position in his own firm and may trade only the risk-free asset to smooth his consumption. Therefore, he needs to solve an incomplete markets (self-insurance) problem, which admits no closed-form solutions for the consumption rule and the value function when utility is of the CRRA type (Zeldes (1989)). Moreover, in general, the equilibrium analysis of incomplete markets with production is rather complicated. In our model, the controlling shareholder's optimality and the equilibrium resource allocations and prices are all solved in closed form and are well defined because of the specific structure of the optimization problems. The following assumptions or properties of the model are useful in delivering the analytically tractable no-trade equilibrium: (i) A constant return to scale production and capital accumulation technology as 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 outside shareholder have identical and homothetic preferences. The built-in linearity implies that in equilibrium the economy grows stochastically on a balanced path. As such, in the remainder of the paper we focus on variables scaled by capital stock, that is, the investment-capital ratio $i = I/K$ and

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the dividend-capital ratio $d = D/K$.

IV.   Equilibrium Investment and Asset Pricing Implications

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

A.   *Real Investment*

Proposition 1 *The equilibrium investment-capital ratio i decreases in investor protection η and the controlling shareholder's cash-flow rights α, which $di/d\eta < 0$ 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 impact.[10] In summary, our model predicts that weak investor protection induces overinvestment relative to a perfect investor protection benchmark. 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 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, Ishii, and Metrick (2003) and Philippon (2004) document that U.S. firms with low corporate governance have higher investment.

The overinvestment-governance link fits the evidence not only in developed economies, but also across emerging market economies. A strong indicator that firms in Korea and Thailand overinvested is the documented volume of nonperforming loans prior to the East Asian crisis in 1997 (25% of GDP for Korea and 30% of GDP for Thailand; see Burnside, Eichenbaum, and Rebelo (2001)).[12] China is another example of a country with a very large volume of nonperforming loans in the banking sector. Allen, Qian, and Qian (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 with a desire to pass the "empire" bearing their names down to their offspring (Burkart, Panunzi, and Shleifer (2003)). Incorporating these nonpecuniary private benefits would increase the degree of over-investment and amplify the mechanism described in our paper.

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

B. *Tobin's q and Controlling Shareholder's Shadow (Tobin's) q*

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

Intuitively, both outright stealing and investment distortions lower firm value, as 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, Ishii, and Metrick (2003), and Doidge, Karolyi, and Stulz (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.

We now turn 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:

$$\hat{P}(t) = \frac{1}{\alpha} E_t \left[\int_t^\infty e^{-\rho(s-t)} M(s) \frac{M(s)^{-\gamma}}{M(t)^{-\gamma}} ds \right] = \frac{1}{1 - \epsilon^2 i\gamma} K(t). \tag{33}$$

Thus, we may interpret $\hat{q}$, given below, as the controlling shareholder's shadow Tobin's q:

$$\hat{q} = \frac{1}{1 - \epsilon^2 i \gamma}. \tag{34}$$

We make two observations. First, it is obvious that $\hat{q}$ is higher than q^*, which is Tobin's q under perfect investor protection as given in (24). By revealed preferences, 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 the case that $\hat{q} > q^*$. Second, using Proposition 2, we have $q^* > q$ for firms under imperfect investor protection. Combining these two results, it follows that shadow q is larger than the first-best Tobin's q, which in turn is larger than Tobin's q; $\hat{q} > q^* > q$. This shows that there is a the value transfer from outside shareholders to controlling shareholders when investor protection is imperfect. However, outside shareholders are rational in the model and hence pay the fair market prices for their shares.

C. Risk-Free Rate

The equilibrium interest rate r given in (23) is determined by three components: (i) The discount rate ρ; (ii) an economic growth effect, $\gamma (i - \delta)$; and (iii) a negative precautionary savings 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, raising 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 has 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 savings 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 long-run average interest rate 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) following La Porta et al. (1998). Consistent with the model, the average real interest rate for the sample of common law countries is 1.89% per year and statistically smaller than the average real interest rate for the sample of civil law countries of 2.35% per year. Obviously, a caveat is in order as these unconditional means do not control for other characteristics such as default risk or liquidity.

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

D. 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 generates incentives to invest. Because investment generates volatility in the capital accumulation process (through investment-specific technology 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

$$\lambda = \gamma \sigma_P^2 = \gamma \epsilon^2 i^2. \tag{35}$$

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]

There is evidence in support of Proposition 4. Hail and Leuz (2004) find that countries with strong securities regulation and enforcement mechanisms exhibit lower 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. Harvey (1995) shows 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. Since emerging market economies and countries with worse credit ratings have on average weaker corporate governance, this empirical evidence is consistent with our theory.

We now briefly provide a characterization of the dividend yield. Let y be the equilibrium dividend yield: $y = D/P = d/q$. We have the following proposition.

Proposition 5 *The dividend yield is given by*

$$y = \rho + (\gamma - 1) \left(i - \delta - \frac{\gamma}{2} \epsilon^2 i^2 \right). \tag{36}$$

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

Weaker investor protection gives rise to a higher investment-capital ratio, but also a more volatile dividend-output process. As we discuss earlier, the effect of investor protection on growth (via incentives to "steal and overinvest") is stronger than the effect on volatility (via precautionary savings). Therefore, whether the dividend yield y increases or decreases in η only depends on the sign of $\gamma - 1$. For logarithmic utility investors ($\gamma = 1$), the dividend yield is constant and equal to the investors' subjective discount rate ρ. This is the standard result: The logarithmic investor does not have an intertemporal 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 imperfect investor protection using our analytically tractable framework.

V. Quantifying the Effects of Investor Protection

In this section 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.

A. *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 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, 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.

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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 0.08. 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 to 2000 using data from the *World Bank World Development Indicators* (WDI) database. Using the WDI data set, 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), this is equal to $\alpha (\hat{q} - q)/q$) is set to 0.2% in the U.S. and 8.6% in Korea.[15] Using our calibrated values for α, we have that $(\hat{q} - q)/q$ is equal to 2.5% in the U.S. and 22% in Korea, respectively. The resulting calibrated parameters are $(\epsilon, \eta, h) = (\phi.25, 2325, \phi.0897)$ for the U.S. and $(\epsilon, \eta, h) = (\phi.397, 28.44, \phi.1187)$ for Korea. For both countries, these parameters imply that the model matches all three moments exactly.

The calibrated model implies a stealing fraction ($\phi = (1 - \alpha)/\eta$) of 0.04% for the U.S. and 2.14% for Korea, which is 54 times higher than that of the U.S. The flow costs of stealing as a

fraction of gross output $(\Phi\left(s,hK\right)/hK=\left(1-\alpha\right)^2/2\eta)$ are 0.02% for the U.S. and 0.65% for Korea, respectively. Note that under the calibration ownership concentration is much higher in Korea than in the U.S., consistent with empirical evidence that ownership is higher in countries with weaker investor protection (La Porta, López-de-Silanes, and Shleifer (1999)).[16]

B. *A Stock Market Analysis of Imperfect Investor Protection*

Consider the hypothetical experiment of improving investor protection to the perfect benchmark level ($\eta=\infty$). Using our calibrated baseline parameters, the model predicts that moving to perfect investor protection produces a U.S. stock market revaluation (measured by $(q^*-q)/q$) of 2.49% and a Korean stock market revaluation of 21.96%. The dollar value of these stock market revaluations can be obtained by multiplying the numbers above by the respective stock market capitalization. Using the 1997 market capitalization values from Dahlquist et al. (2003), the stock market revaluation results in an increase of $281 billion (i.e., 2.49%×$11.3 trillion) in U.S. stock market capitalization and $9.2 billion (i.e., 21.96%×$42 billion) in Korean stock market capitalization.

These numbers suggest that agency conflicts have a significant effect on firm value. Moreover, the size of the stock market revaluation accompanying the improvement in investor protection matches closely the controlling shareholder's private benefits of control. The following approximation sharpens the intuition behind the determinants of the stock market revaluation:

$$\frac{q^*-q}{q}\approx\frac{\hat{q}-q}{q}-\gamma\epsilon^2\left(i-i^*\right).\tag{37}$$

The size of the revaluation is thus approximately equal to the ratio of the private benefits to firm value, $(\hat{q}-q)/q$, plus a term that reflects the difference of the volatility/risk aversion

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effects under imperfect versus perfect investor protection. The 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.

C. A Welfare Analysis of Imperfect Investor Protection

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

For the outside shareholder, we compute the fraction of capital stock $(1 - \zeta_2)$ that the outside shareholder is willing to give up for a costless and permanent improvement in investor protection from the current level η to the first-best level of $\eta = \infty$. We measure the welfare effects of changing investor protection as a fraction of the capital stock rather than the wealth level because the latter involves a valuation that depends on the current level of investor protection. The outside shareholder is indifferent if and only if the following equality holds:

$$J_2^*(\zeta_2 K_0) = J_2(K_0), \tag{38}$$

where $J_2(\cdot)$ and $J_2^*(\cdot)$ are the outside shareholder's value functions in terms of capital stock under the current level of investor protection η and perfect investor protection $\eta = \infty$, respectively, and K_0 is the current capital stock level. Using the explicit value function formula for $J_2(K)$ in the Appendix, we obtain

$$\zeta_2 = \frac{d}{d^*} \left(\frac{y^*}{y} \right)^{\frac{1}{1-\gamma}}, \tag{39}$$

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

While the outside shareholder loses from weak investor protection, the controlling shareholder benefits. For the controlling shareholder, we compute the fraction of capital stock $(\zeta_1 - 1)$ that he needs in order for him to voluntarily give up the *status quo* of imperfect investor protection in exchange for perfect investor protection $\eta = \infty$. Therefore, we have

$$J_1^*(\zeta_1 K_0) = J_1(K_0), \tag{40}$$

where K_0 is the current capital stock level. Using $J_1(\cdot)$ given in the appendix, we may solve (40) and obtain:[17]

$$\zeta_1 = \frac{m}{m^*} \left(\frac{y^*}{y} \right)^{\frac{1}{1-\gamma}}. \tag{41}$$

The following proposition characterizes the comparative static properties of ζ_2 and ζ_1 with respect to investor protection η.

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

Outside shareholders are willing to give up a substantial part of the capital stock that they own for stronger investor protection. Even for the U.S., outside shareholders are willing to give up 0.38% of their capital stock if U.S. investor protection can be made perfect. In Korea, outside shareholders are willing to give up 11.17% of their capital stock to adopt perfect investor protection. The utility losses for outside shareholders associated with weak investor protection are due to both stealing and investment distortions.

Clearly, in terms of the percentage of their owned capital stock, Korean outside shareholders value the enhancement of investor protection more than U.S. investors do. However, the total welfare gain for outside shareholders from improving investor protection is much larger in the U.S. than in Korea because of the much higher capital stock in the U.S. To express the welfare gains in dollar terms, we compute $(1 - \zeta_2) q K_0$, where q is the value of Tobin's q under the status quo. The adjustment for q expresses the welfare gains as a fraction of the market value of the capital stock as opposed to its book value. Our calculations show that outside shareholders gain $43 billion (i.e., ϕ .38%×$11.3 trillion) and $4.7 billion (i.e., 11.17%×$42 billion) in the U.S. and Korea, respectively, if investor protection can be made perfect. The total dollar value gain for outside shareholders in the U.S. is about 10 times the gain for outside shareholders in Korea. These calculations indicate that the benefits of improving investor protection are economically significant. Next, we show that our quantitative results on welfare costs are robust.

Table I presents results from various calibrations of the model that depart from the above baseline model calibration in the following way. With each new value of ρ, γ, or δ, we re-calibrate ϵ, η, and h to ensure that the model matches the three moments used in the baseline calibration (the real interest rate, the standard deviation of output growth, and the ratio of private benefits to firm value). The conclusion from Table I is clear. Provided that the model

is required to match empirically observed private benefits among other moments, the welfare cost of imperfect investor protection to U.S. or Korean investors is quite robust across different calibrations.

[Table I here.]

While we show that the utility gain from increasing investor protection is large for outside shareholders, 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 reduces the benefits to incumbents. The resulting wealth redistribution is significant with controlling shareholders in the U.S. (Korea) losing about 2.1% (8.4%) of their capital stock when moving to the benchmark case of perfect investor protection. Moreover, the controlling shareholders are less subject to the collective action problem than outside shareholders are because there are fewer controlling shareholders than outside shareholders, 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*, since they enjoy the large private benefits at the cost of outside outside shareholders and future entrepreneurs.

VI.   Empirical Evidence

In this section, we empirically explore the following implications from our technological assumptions (equation (1)) and the equilibrium balanced growth solution (Theorem 1):

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 (ii) the standard deviation of stock returns is positively correlated with the investment-capital ratio. We control for other sources of uncertainty that may arise from cross-country variations in ϵ.[18]

A.   *Data*

We use the World Bank's *World Development Indicators* (WDI) annual real per capita GDP for the 1960 to 2000 period to measure the volatility of GDP growth. All available data by country are used to estimate the volatility of GDP growth. We measure the volatility of stock returns by using the monthly return series from MSCI (starting in January of 1970 for some countries). We 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 variable DCIVIL is not available for Hungary, Morocco, Poland, and China, these countries are excluded from the analysis, leaving 40 observations.[19]

We estimate a country's long-run average investment-capital ratio using aggregate data. Because the model's capital-GDP ratio is constant, that is, $dY(t)/Y(t) = dK(t)/K(t)$, we can use the capital accumulation equation (1) to obtain the long-run GDP 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 0.08. 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 well match those computed using the perpetual inventory method.

We conduct our tests controlling for several variables that may directly or indirectly affect volatility. First, we control for measures of investor protection using a country's legal origin (DCIVIL = 1 for a civil law country and 0 for a common law country) and the anti-director rights variable from La Porta et al. (1998) (ANTIDIR assigns a higher score for better investor protection.) Second, we control for sources of volatility that can capture cross-country variation in ϵ. As measures of aggregate uncertainty, we use the volatility of real exchange rate returns (SDRER),[20] and the degree of openness as given by the 1960 ratio of exports plus imports to GDP (OPEN).

B. *Results*

Figure 1 and columns (1) to (5) in Table II 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 II shows that the significance of this association survives the inclusion of control variables. Regression (1) in Table II 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.[21] In regressions (2) to (5), we add several controls for other sources of volatility, one at a time. The coefficients for the investment-capital ratio across regressions (1) to (5) vary a little, but are all significant. Controlling for the volatility of the exchange rate

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return (SDRER) contributes the most explanatory power (regression (4)), where the coefficient on SDRER has a p-value less than.001 and the regression displays an adjusted $\bar{R}^2$ equal to 0.441.

[Figure 1 and Table II here.]

Figure 2 and columns (6) to (10) in Table II present the results for the association between the standard deviation of stock returns and the investment-capital ratio. (For an analysis of conditional volatility, see Bekaert and Harvey (1997).) As predicted by the model, Figure 2 illustrates a positive (unconditional) association between these variables. Regression (6) in Table II gives the numbers underlying the statistical association in Figure 2. (The slope coefficient is 2.288, with a p-value of 0.038.) This estimate implies that 31% of the stock return volatility difference between the U.S. and Korea is due to the different investment-capital ratios in the two countries.[22] In regressions (7) through (10), we add controls for other sources of volatility, one at a time. The significance of I/K remains despite some variation in the estimated coefficients, mainly when SDRER or OPEN are included in the regressions. Again, adding SDRER contributes the most explanatory power (p-value < 0.001 and $\bar{R}^2 = 0.312$).

[Figure 2 here.]

VII.   Conclusions

Corporate governance is a first-order issue in many countries where firms are often run by controlling shareholders. Much empirical work documents the effects of imperfect investor protection on private benefits and firm value around the world. However, there is limited

theoretical research on the effects of investor protection on capital accumulation, asset pricing, and welfare costs in an equilibrium context.

We develop one of the first dynamic stochastic general equilibrium frameworks to study the effects of conflicts of interest between controlling shareholders and outside shareholders on welfare and equilibrium asset pricing when investor protection is imperfect. Despite the conflicts of interest and the heterogeneity of investment opportunities between the controlling shareholders and outside shareholders, we are able to characterize the equilibrium asset prices and resource allocation in closed form. The analytical formulae allow us to derive precise theoretical predictions on investment and asset prices and to generate new economic intuition on the relevant economic mechanisms. The key insights are as follows. Weaker investor protection implies higher levels of private benefits, which in turn produce stronger incentives for overinvestment. A larger level of investment induces higher capital accumulation volatility (due to investment-specific shocks), which is priced in equilibrium via a higher risk premium. In equilibrium, the agency channel (of pursuing private benefits) dominates the risk aversion/volatility effect. As a result, weaker investor protection leads to lower Tobin's q, a higher interest rate, higher volatility of asset returns, and a higher risk premium. These predictions are consistent with existing evidence.

Moreover, our model allows us to make quantitative statements on the significance of weak investor protection on investors' welfare and market valuation. We show that strengthening investor protection produces a significant wealth redistribution effect from controlling shareholders to outside shareholders. Outside shareholders in Korea are willing to give up 11.2% of their capital stock holdings, or $4.7 billion of current wealth, in exchange for perfect investor protection. In the U.S., outside shareholders are willing to give up 0.38% of their capital stock

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holdings, or $43 billion of current wealth. Our quantitative results on welfare are quite robust but hinge upon the empirically observed large private benefits of control, as reported by Dyck and Zingales (2004). However, the political process to improve investor protection is naturally difficult because the political power of controlling shareholders and incumbent entrepreneurs is much stronger than that of outside investors and future entrepreneurs.

It is worth emphasizing that our key insights depend on the controlling shareholders' incentives to overinvest and on the assumption of investment-specific technology shocks, but do not depend crucially on the model's analytical tractability. That said, our model does not capture other prominent features of asset prices, such as time variation in risk premia and volatility. Extending our paper to generate more realistic time-series properties of asset prices is an interesting avenue for future research.

Another limitation of our model is that all firms and controlling shareholders are identical. This restrictive assumption is made for analytical convenience. Allowing for heterogeneity across firms within a country permits the study of other interesting and important issues, such as cross-sectional firm equity returns. For example, the controlling shareholder's risk sharing motives and induced time-varying equilibrium wealth distribution will have additional effects on welfare and asset pricing. We think that the mechanism proposed here remains important in this more general and complex setting, although the magnitudes of the mechanism are likely to change. The firm-homogeneity assumption naturally implies no dynamic interactions between firms. In a model in which capital is allocated across firms and the funds available for investment are scarce, overinvestment in one firm with weaker governance suggests underinvestment in other firms. This generates additional welfare losses for the economy, in line with Rajan and Zingales (1998), who provide empirical evidence that capital does not always flow to its most productive

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use in countries with lower financial development.

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 $:h > \rho + \delta (1 - \gamma)$.

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

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

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

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

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 real investment and positive dividends, respectively. Assumption 5 gives rise to finite 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 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

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

where A_1 is a constant to be determined. The first-order condition (26) 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. Substituting 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. Substituting (A.1) and (A.2) into the HJB equation (25) 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

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

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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

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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 outside shareholder. Let $J_2(K)$ denote the outside shareholder's value function in terms of the firm's capital stock K. Under the no-trade equilibrium conjecture, we can verify that the outside

shareholder's value function is given by

$$
\begin{aligned}
J_2(K_0) &= E\left[\int_0^\infty e^{-\rho t}\frac{1}{1-\gamma}\left([(1-\alpha)\,dK(t)]^{1-\gamma}-1\right)dt\right]\\
&= \frac{1}{1-\gamma}\left([(1-\alpha)\,dK_0]^{1-\gamma}\frac{1}{y}-\frac{1}{\rho}\right)=\frac{1}{1-\gamma}\left(A_2 W_0^{1-\gamma}-\frac{1}{\rho}\right),
\end{aligned}
$$

where $A_2 = q\,(1-\alpha)^{1-\gamma}/d^\gamma$. Following Merton (1971), we can conclude that the outside share-holder's consumption rule is given by

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

where we use $W_2(t) = (1-\alpha)\,qK(t)$. The portfolio rule is reported in (28). The transversality condition for the outside shareholder is

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

Recall that in equilibrium, the outside shareholder's wealth is all invested in firm equity and thus his initial wealth satisfies $W_2(0) = (1-\alpha)\,qK_0$. Since the outside shareholder'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 the outside shareholder is also met if and only if the dividend yield y is positive, as stated in Assumption 5.

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

following 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 outside shareholder's ξ_2 are equal. This confirms the leading assumption that the controlling shareholders and the outside shareholders 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 shareholders):

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

Using the definitions $\xi_2(t) = e^{-\rho t} C_2(t)^{-\gamma} = e^{-\rho t} (yW_2(t))^{-\gamma}$, $D(t)/K(t) = d$, and $W_2(t)/K(t) = (1-\alpha)q$, we can 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 (17), 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, that is, $\mu_D = \mu_P = \mu_K = i - \delta$, and the volatility coefficients for dividend, stock price, and capital stock are also the same, that is, $\sigma_D = \sigma_P = \sigma_K = \epsilon i$. 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

$$f(x) = \frac{\gamma(\gamma+1)}{2}\epsilon^2 x^2 - \left[1 + (1+\psi)h\epsilon^2\right]\gamma x + (1+\psi)h - \rho - \delta(1-\gamma). \tag{A.11}$$

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 (A.11) to define the equilibrium investment-capital ratio implicitly as $f(i, \psi) = 0$. Taking the total differential of f with respect to ψ and using the implicit function theorem, we obtain

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

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 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 (36) 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 3. Differentiate (23) 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

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

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

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. $\blacksquare$

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) is as follows:[23]

$$dD(t) = gD(t)dt + \sigma_D D(t)d\tilde{Z}(t), \tag{A.12}$$

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[24]

$$P(t) = E_t\left[\int_t^\infty \frac{\xi_2(s)}{\xi_2(t)}D(s)ds\right] = \tilde{E}_t\left[\int_t^\infty e^{-r(s-t)}D(s)ds\right] = \frac{D(t)}{r - g}. \tag{A.13}$$

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

Differentiating the dividend yield y with respect to ψ, we obtain

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

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

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

where the inequality uses $di/d\eta < 0$ (from Proposition 1) and $\hat{q} > q$. Because $d\zeta_2/d\eta > 0$ and $\lim_{\eta \to \infty} \zeta_2 = 1$, we have $\zeta_2 < 1$ for any $\eta < \infty$. Differentiating $\log \zeta_1$ with respect to η gives

$$
\begin{aligned}
\frac{d \log \zeta_1}{d\eta} &= \frac{d \log m}{d\eta} - \frac{1}{1-\gamma} \frac{d \log y}{d\eta} \\
&= \frac{\alpha h}{m} \frac{d\psi}{d\eta} + \left(\frac{1 - \gamma\epsilon^2 i}{y} - \frac{\alpha}{m}\right) \frac{di}{d\eta} \\
&= \frac{\alpha h}{m} \frac{d\psi}{d\eta} < 0,
\end{aligned}
$$

where we use $d\psi/d\eta < 0$ and $m = \frac{\alpha y}{1 - \gamma\epsilon^2 i}$ (implied by (A.3)). Because $d\zeta_1/d\eta < 0$ and $\lim_{\eta \to \infty} \zeta_1 = 1$, we have $\zeta_1 > 1$ for any $\eta < \infty$. ∎

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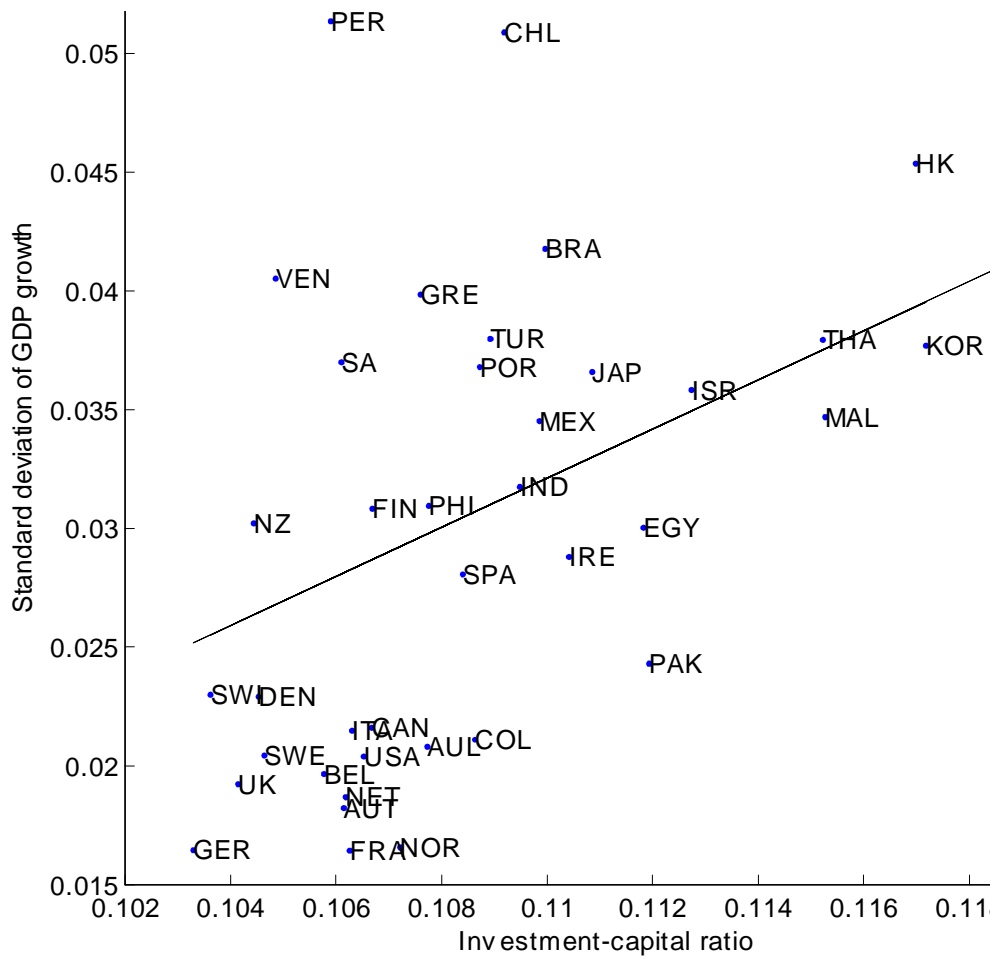
Figure 1: **Scatter plot and linear fit of the volatility of GDP growth on the investment-capital ratio across countries.** See the text for country abbreviations.
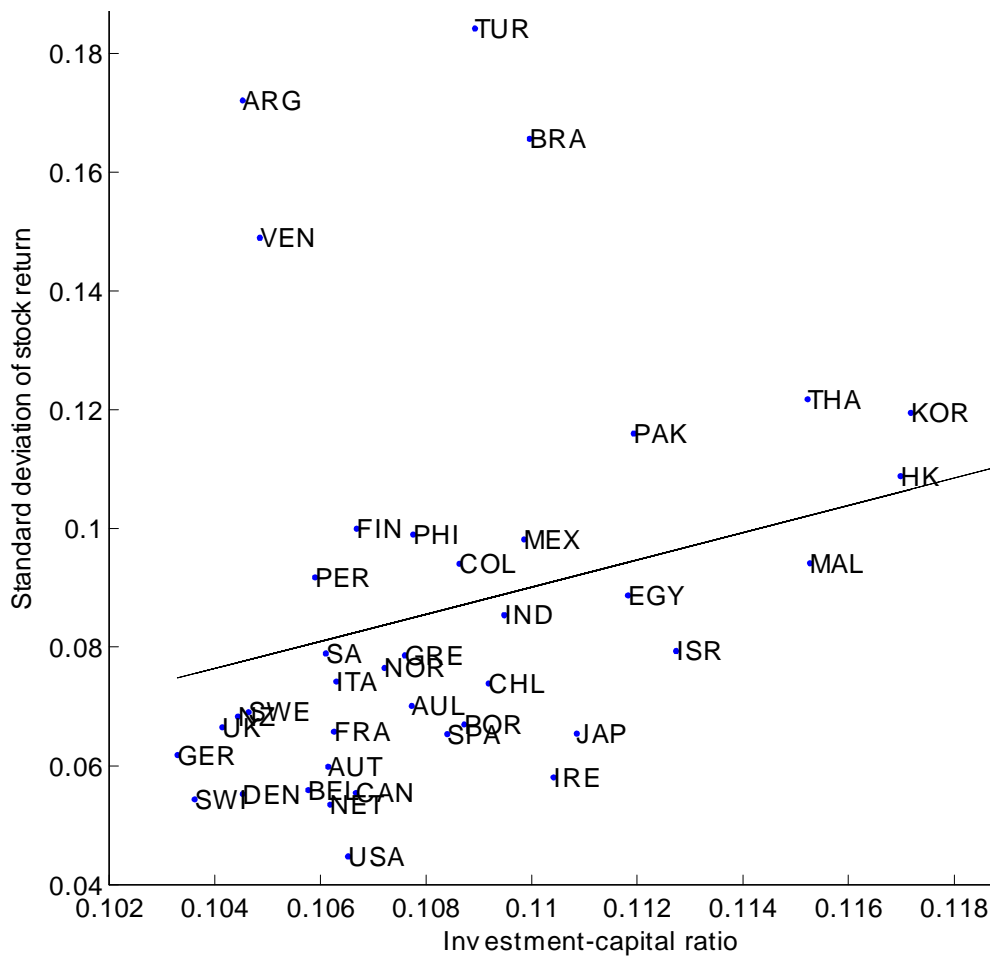
Figure 2: **Scatter plot and linear fit of the volatility of stock returns on the investment-capital ratio across countries**. See the text for country abbreviations.

Table I

Welfare Costs of Imperfect Investor Protection

The table quantifies the welfare cost to outside shareholders from an absence of perfect investor protection under various calibrations. For the baseline case, we set $\rho = 0.01$, $\gamma = 2$, and $\delta = 0.08$ for both U.S. and Korea. To reflect different degrees of ownership concentration in the U.S. and Korea, we choose $\alpha = 0.08$ for the U.S. and $\alpha = 0.39$ for Korea (Dahlquist et al. (2003)). Column 2 reports the results under the baseline calibration. In columns 3 to 5, we recalibrate the values of the triplet (η, h, ϵ) to match the real interest rate, the standard deviation of output growth, and the ratio of private benefits to firm value each time we change ρ, γ, and δ. The remaining three parameters are the same as those in the baseline case.

Outside shareholders' welfare cost $(1 - \zeta_2)$	Baseline model	Discount rate, ρ		Risk aversion, γ		Depreciation rate, δ	
		0.02	0.03	1	3	0.07	0.09
U.S.	0.38%	0.38%	0.38%	0.39%	0.37%	0.38%	0.38%
Korea	11.17%	11.17%	11.17%	11.32%	11.13%	11.17%	11.17%

Table II

Investment-to-Capital Ratio and Aggregate Volatility

The table presents the regression results for (i) the volatility of real GDP growth and (ii) the volatility of stock returns. Independent variables are the investment-to-capital ratio (I/K), the antidirector rights index (ANTIDIR), a dummy for civil law countries (DCIVIL), the standard deviation of changes in the real exchange rate (SDRER), and the ratio of exports plus imports to GDP (OPEN). Each cell reports the coefficient estimate from ordinary least squares regressions and below it the corresponding White-corrected p-value on the null that the coefficient is zero. All regressions include an intercept term and use 40 (country) observations.

Independent	Standard Deviation of Real GDP Growth						Standard Deviation of Stock Returns			
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
I/K	1.033	0.963	1.167	1.478	1.177	2.288	2.615	2.842	3.626	3.413
	0.002	0.005	0.000	0.000	0.001	0.038	0.027	0.006	0.000	0.004
ANTIDIR		0.001					-0.004			
		0.422					0.235			
DCIVIL			0.004					0.018		
			0.099					0.034		
SDRER				0.137					0.413	
				0.000					0.000	
OPEN					-0.003					-0.021
					0.218					0.020
$\bar{R}^2$	0.133	0.126	0.148	0.441	0.123	0.049	0.056	0.087	0.312	0.104

Notes

[1]There are two layers of corporate governance determining the induced agency costs for any given firm, namely, there are country-wide regulatory and enforcement environment mechanisms, and firms-specific corporate governance rule. This paper focuses on differences in imperfect investor protection at the country level.

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

[3]Lan and Wang (2006) integrate imperfect investor protection as in La Porta et al. (2002) into an otherwise standard intertemporal investment model with adjustment costs (Abel and Eberly (1994)) and show that managers overinvest in order to increase future private benefits, which further reduces firm value. Himmelberg, Hubbard, and Love. (2002) consider a risk-averse controlling shareholder, but use an exogenously given stochastic discount factor to study the effects of imperfect investor protection on the firm's cost of capital.

[4]The formulation in Greenwood, Hercowitz, and Huffam (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 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) propose an international variation of the model analyzed in this paper, using TFP shocks. In that paper, we obtain results similar to those obtained in this paper. For example, the risk premium and the interest rate decrease with investor protection in both papers.

[6]We treat α as constant. We assume that the controlling shareholder cannot easily trade his shares due to an adverse price impact. The 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.

[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, Kang, and Kim (2002), Bertrand, Mehta, and Mullainathan (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, Gromb, Panunzi (1997)).

[9]The standard way to analyze the equilibrium is to solve the optimization problems of both the controlling shareholder and outside shareholder for postulated price processes, and then to aggregate agents' demands to find the prices that clear the markets. This approach generates a mapping whose fixed points are the equilibria of the model, but is computationally demanding for heterogeneous-agent models such as ours.

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

[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.

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

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

Note that $d\left(r + \lambda\right)/d\eta = \gamma \left(1 - \left(\gamma - 1\right) \epsilon^2 i\right) di/d\eta$ and $\left(1 - \left(\gamma - 1\right) \epsilon^2 i\right) > 0$ 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.

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

[16]Shleifer and Wolfenzon (2002), Burkart, Panunzi, and Shleifer (2003) and Lan and Wang (2006) provide theoretical explanations for this cross-country empirical finding. Mueller and Philippon (2006) show that the quality of labor relations across countries also plays an important role in determining the concentration of ownership, after controlling for cross-country variations in protection for outside investors.

[17]By applying L'Hopital's rule to (40) around $\gamma = 1$, we obtain the formula for ζ_1 for logarithmic utility:
$$\zeta_1 = \frac{m}{m^*} \exp\left[\frac{\left(\mu_D - \frac{1}{2}\sigma_D^2\right) - \left(\mu_D^* - \frac{1}{2}\sigma_D^{*2}\right)}{\rho} \right].$$
Similarly, when $\gamma = 1$, we have

$$\zeta_2 = \frac{d}{d^*} \exp\left[\frac{\left(\mu_D - \frac{1}{2}\sigma_D^2\right) - \left(\mu_D^* - \frac{1}{2}\sigma_D^{*2}\right)}{\rho} \right].$$

[18]Note that the investment-capital ratio is invariant to a first order with respect to ϵ. Mathe-

matically, 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), the U.K., the U.S., and Venezuela (VEN).

[20]Following the suggestions by Pindyck and Solimano (1993), we also try the volatility of inflation and obtained similar results.

[21]The investment-capital ratios in the U.S. and Korea are 0.107 and 0.117, respectively. The annual growth volatility for are 0.0204 and 0.0377 for the U.S. and Korea, respectively. Hence, we have $1.033 \times (0.117 - 0.107)/(0.0377 - 0.0204) = 0.6$.

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

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

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

[24]The first equality in (A.13) 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 (A.12) under the risk-neutral probability measure.