Agency Conflicts, Investment, and Asset Pricing*

Rui Albuquerque[†] Neng Wang[‡]

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Abstract

Corporations in most countries are run by controlling shareholders whose cash flow rights are substantially smaller than their control rights in the firm. This separation of ownership and control allows the controlling shareholders to pursue private benefits at the cost of outside minority investors by diverting resources away from the firm and distorting corporate investment and payout policies. We develop a dynamic stochastic general equilibrium asset pricing model that acknowledges the implications of agency conflicts through imperfect investor protection on security prices. We show that countries with weaker investor protection have more overinvestment, lower market-to-book equity values, larger expected equity returns and return volatility, higher dividend yields, and higher interest rates. These predictions are consistent with empirical findings. We develop new predictions: countries with high investment-capital ratios have both higher variance of GDP growth and higher variance of stock returns. We provide evidence consistent with these hypotheses. Finally, we show that weak investor protection causes significant wealth redistribution from outside shareholders to controlling shareholders.

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[†]Simon School of Business, University of Rochester, Rochester, NY 14627. Email: albuquerque@simon.rochester.edu. Tel.: 585-275-3956.

[‡]Columbia Business School, 3022 Broadway, Uris Hall 812, New York, NY 10027. Email: neng.wang@columbia.edu. Tel.: 212-854-3869.

1 Introduction

Separation of corporate control from ownership is one of the main features of modern capital markets. Among its many virtues, it allows for the participation of small investors in the equity market, thereby increasing the supply of funds, dissipating risks across the economy, and lowering the cost of capital for firms. Its major drawback is the agency conflict that arises between corporate insiders who run the firm and can extract private benefits of control, and outside minority investors who have cash flow rights on the firm, but no control rights (e.g., Berle and Means (1932) and Jensen and Meckling (1976)). This agency conflict is the focus of a voluminous body of research in corporate finance, as recurrent corporate scandals constitute an ever-present reminder of the existence of these conflicts and the private benefits exploited by insiders even in the least suspicious markets.

Following Shleifer and Vishny (1997) and La Porta et al. (1998), a large empirical literature has firmly established the existence of large shareholders in many corporations around the world (La Portal et al. (1999)). These shareholders have much larger control rights within the firm compared to their cash flow rights as they obtain effective control through dual-class shares, pyramid ownership structures, or cross ownership (Bebchuk et al. (2000)). With the separation of control from ownership, controlling shareholders have an incentive to expropriate outside minority shareholders. This conflict of interest is at the core of agency conflicts in most countries and is only partially remedied by regulation aimed at protecting minority or outside investors. Indeed, considerable empirical evidence suggests that stock market prices reflect the magnitude of the private benefits derived by controlling shareholders, with firm value increasing in both the extent of minority investors' protection, and the stock ownership of controlling shareholders.[1] While it is intuitive that weak investor protection lowers equity prices, the effect of investor protection on equity returns and the interest rate is less obvious.

In this paper, we study the effect of agency conflicts through imperfect investor protection on equilibrium asset pricing. Our model departs from traditional production-based (investment-based) equilibrium asset pricing models in three important ways. First, we acknowledge that controlling shareholders are able to extract private benefits and therefore make firm investment decisions that are in their own interest. Second, we embed the separation of ownership and control into an equilibrium asset pricing model in which both the controlling shareholder and outside investors optimize their consumption and asset allocations. Hence, the equilibrium asset prices affect the investment and payout decisions of the controlling shareholder through his preference to smooth consumption over time and, in turn, these investment and payout decisions affect the equilibrium asset prices. Third, we follow Keynes (1936) and Greenwood,

[1] For empirical work, see La Porta et al. (1999), La Porta et al. (2002), Claessens et al. (2002), Baek et al. (2004), Doidge et al. (2004), and Gompers et al. (2003). For theoretical work, see La Porta et al. (2002), Shleifer and Wolfenzon (2002), and Lan and Wang (2004). See La Porta et al. (2000) for a survey of the investor protection literature.

Hercowitz, and Huffman (1988) in assuming that economy-wide output fluctuations arise from shocks to the marginal efficiency of investment as opposed to shocks to the productivity of installed capital.

These new features imply that the controlling shareholder's trade-offs associated with the corporate investment decision in our model differ from the standard value-maximizing trade-offs. First, the controlling shareholder's private marginal benefit of investment is higher than that of outside shareholders because of the private benefits of control. In addition, in both the model and the data (Barclay and Holderness (1989)), the level of private benefits increases with firm size.[2] Second, in our model the controlling shareholder's marginal cost of investment has two parts; one is the traditional marginal cost of postponing consumption, and the other is a new term reflecting the interaction between the controlling shareholder's risk aversion and our assumption that shocks shift the marginal efficiency of investment. Incremental investment is subject to shocks that shift its productivity, thereby increasing the volatility in the capital accumulation process. With a risk-averse controlling shareholder the additional volatility of capital accumulation is costly as it lowers the controlling shareholder's value function, ceteris paribus. To the best of our knowledge, our paper is the first to acknowledge this effect of shocks to the marginal efficiency of investment à la Keynes (1936) and Greenwood, Hercowitz, and Huffman (1988) on the investment decisions of a risk-averse agent and on the firm's Tobin's q (as shown later).

The usual technological assumption of productivity shocks attached to the production function implies that shocks shift the productivity of capital of all vintages in the same way. In contrast, we follow Keynes (1936) and Greenwood, Hercowitz, and Huffman (1988) in modeling shocks as shifting the productivity of new capital goods only, leaving the productivity of installed capital unchanged. Greenwood, Hercowitz, and Huffman (1988) argue that these shocks may be important determinants of business cycle fluctuations. Greenwood, Hercowitz, and Krusell (1997, 2000) posit that shocks to the marginal efficiency of investment may arise from shocks to the relative price of investment goods and quantify their relevance. Greenwood et al. (1997) find that approximately 60% of postwar-U.S. growth can be attributed to shocks to the marginal efficiency of investment, whereas at the business cycle frequency, using a calibration exercise Greenwood et al. (2000) find that shocks to the marginal efficiency of investment account for about 30% of output fluctuations in the postwar-U.S. period. Using an econometric approach, Fisher (2003) finds that shocks to the marginal efficiency of investment account for 50% of U.S. business cycle fluctuations well above the role played by neutral technology shocks.[3]

[2] Intuitively, the controlling shareholder in charge of a conglomerate is more likely to fly private jets than one heading a small firm.

[3] The formulation in Greenwood et al. (1988) is a stochastic version of Solow (1960). Equivalently, our formulation may be viewed as a version of the stochastic installation function, in which the productivity of new investments depends on how compatible they are with existing vintages of capital. Under this interpretation, our model extends the deterministic installation function proposed by Hayashi (1982) and Uzawa (1969) to a stochastic setting.

The controlling shareholder has an incentive to increase investment when investor protection weakens because the total amount of private benefit extraction increases with firm size. However, greater investment increases the volatility of capital accumulation, which is costly for a risk-averse controlling shareholder. In equilibrium the effect induced by the extraction of private benefits dominates. This leads to the model prediction that weak investor protection generates excessive investment and a high expected output growth rate in spite of higher volatility of both investment and output in the economy. Overinvestment by the controlling shareholder is in line with Jensen's (1986) free cash flow and empire building hypothesis.[4] However, our model differs from Jensen's in that it generates overinvestment endogenously, with the degree of overinvestment being mitigated by both the degree of investor protection and the controlling shareholder's firm ownership. To the extent that we do not model nonpecuniary private benefits from running a large corporation, the model is conservative on the size of overinvestment, and thus on the quantitative asset pricing and wealth redistribution implications. Finally, the model prediction on a higher expected output growth rate for countries with low investor protection is in line with the evidence in Castro, Clementi, and MacDonald (2004) for closed economies.

Minority investors solve an intertemporal consumption and portfolio choice problem à la Merton (1971) by taking dividends and security prices as given. Recall that under imperfect investor protection, the controlling shareholder extracts private benefits from the firm's revenue. This reduces firm value from the perspective of minority shareholders, which implies that Tobin's q is lower under imperfect investor protection. Consistent with the empirical evidence cited above, improvements in investor protection in the model alleviate the agency conflicts, reduce overinvestment, increase payouts, and increase firm value.

One of the model's key predictions is that the expected excess equity return is higher in countries with weaker investor protection. Weaker investor protection implies higher agency conflicts and thus more incentives to overinvest as argued earlier. Because the marginal efficiency of investment is stochastic, the dividend and stock price, which in equilibrium are proportional to the aggregate capital stock, grow faster and are more volatile under weaker investor protection. The covariation between the stock payout (dividend plus price) and consumption is thus greater in countries with weaker investor protection. Therefore, weaker investor protection increases the volatility of stock returns (via overinvestment) and implies a higher risk premium.

The model prediction on excess equity returns is consistent with the empirical evidence. Hail and Leuz (2004) find that countries with strong securities regulation and enforcement mechanisms exhibit lower cost of capital levels than countries with weak legal institutions. Daouk, Lee, and Ng (2004) document that improvements in their index of capital market

[4] See also Baumol (1959) and Williamson (1964). For evidence on overinvestment, see, for example, Lang, Stulz, and Walking (1991), Blanchard, López-de-Silanes, and Shleifer (1994), Lamont (1997), and Harford (1999). Gompers et al. (2003) and Philippon (2004) document that U.S. firms with low corporate governance have higher investment.

governance are associated with lower equity risk premia. Using the cross-country data on excess returns in Campbell (2003), we find that civil law countries –those with weaker investor protection (La Portal et al. (1998))– have higher average excess equity returns than common law countries. Harvey (1995), Bekaert and Harvey (1997), and Bekaert and Urias (1999) show that emerging markets display higher volatility of returns and larger equity risk premia. Similarly, Erb et al. (1996) find that expected returns, as well as volatility, are higher when country credit risk is higher. Since emerging market economies have on average weaker corporate governance, this empirical evidence lends further support to our theory.

The model also predicts that countries with weaker investor protection not only observe overinvestment, but also higher interest rates. Overinvestment (associated with weak investor protection) implies a larger future output; intertemporal consumption smoothing motivates agents to finance current consumption by borrowing, which leads to a higher current equilibrium interest rate. However, overinvestment also makes capital accumulation more volatile and implies a stronger precautionary saving effect, thus exerting downward pressure on the current equilibrium interest rate. The former effect dominates for low values of the investment-capital ratio, implying that interest rates are higher under weaker investor protection. Using the interest rate data in Campbell (2003), we find that civil law countries –those with weaker investor protection (La Portal et al. (1998))– have higher average interest rates than common law countries. The effect of investor protection on the dividend yield depends on the elasticity of intertemporal substitution. When the elasticity of intertemporal substitution is smaller than unity, as most estimates indicate, the substitution effect is dominated by the income effect. Thus, the lower interest rate that results from stronger investor protection gives rise to a smaller demand for current consumption and thus a lower dividend yield, ceteris paribus.

We present a calibration of the model that allows us to derive quantitative predictions regarding asset prices as well as quantify how much minority investors will gain, and how much controlling shareholders will lose, by moving to perfect investor protection. We calibrate the model to the United States and South Korea to match estimates of private benefits in the two countries. The agency distortions imply that moving to perfect investor protection leads to a stock market revaluation of 2% for the U.S. and 15% for Korea. Our calibration also shows that minority investors in the U.S. (Korean) are willing to give up 1% (10%) of their wealth to move to a perfect investor protection world. U.S. (Korean) controlling shareholders are willing to give up 1.7% (6.2%) of their wealth in order to maintain the status quo. These simple calculations imply significant wealth redistribution from controlling shareholders to outside investors when investor protection is strengthened. Of course, realizing the political reform necessary to improve investor protection is by no means an easy task, precisely because of the significant wealth redistribution that it entails. 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.

We test two new empirical predictions. Our model predicts a positive association between the investment-capital ratio and both the variance of GDP growth, and the variance of stock returns, after controlling for exogenous volatility sources. We construct measures of the long-run investment-capital ratio and test our hypotheses on a cross-section of 44 countries. We provide evidence consistent with both hypotheses. We also find some evidence that the effect of investor protection on volatility is subsumed in the investment-capital ratio, particularly for the volatility of stock returns.

Related Literature

Our model is cast in an agency-based asset pricing framework. This is in contrast with the majority of asset pricing models, which are constructed for pure exchange economies (Lucas (1978) and Breeden (1979)). Our approach also contrasts with the existing literature linking asset prices to physical investment decisions. Cox, Ingersoll, and Ross (CIR) (1985) and Sundaresan (1984) provide a theory of equilibrium asset prices based on a firm's value maximization. Cochrane (1991) links the marginal rate of transformation to the cost of capital. These production-based asset pricing models abstract away from agency conflicts and hence do not generate any predictions on asset returns across countries that would result from variation in the quality of corporate governance. We incorporate the effect of agency costs on equilibrium asset prices. Obviously, our model also relates to the heterogeneous-agent equilibrium asset pricing literature,[5] in which the heterogeneity arises from the different income streams and choice variables for the controlling shareholders and outside investors.

The paper that is most closely related to ours is Dow et al. (2004). Dow et al. (2004) develop a model in which the manager has an empire building preference as in Jensen (1986); the manager wants to invest all of the firm's free cash flow if possible. As a result, the shareholder needs to use some of the firm's resources to hire auditors to constrain the manager's empire building incentives. In contrast, our paper is motivated by the empirical observation that managers in most countries around the world are often controlling shareholders who themselves have cash flow rights in the firm and who trade off the gains from pursuing private benefits with the cost of decreasing their share of firm value. The critical determinant of this trade-off is the extent of investor protection, as convincingly documented by the large empirical research indicated above. Our model generates an increasing relation between firm value and investor protection. Intuitively, stronger investor protection implies lower agency cost and thus higher Tobin's q, as observed empirically. This differs from Dow et al. (2004), who predict that Tobin's q is equal to one, independent of agency.

A second point of departure from Dow et al. (2004) is that they assume that all firm claimants are identical. The manager partly decides on the cash flow paid to shareholders, but

[5] Asset pricing models with investor heterogeneity have mostly been worked out in the paradigm of endowment economies, with studies analyzing heterogeneity in preferences, endowments, and beliefs. See Campbell (2003) for a recent survey.

has no role in affecting the equilibrium discount factor. Moreover, the equilibrium marginal rate of substitution of the representative consumer in their paper is determined by setting the representative consumer's consumption equal to the dividend. In contrast, our paper explicitly incorporates the consumption and asset allocation decisions of both the controlling shareholders and outside minority investors. This brings us to the third main difference between the two models. In our model, the corporate investment decisions of the controlling shareholder are affected by the equilibrium security prices; the consumption and asset allocation decisions of all agents affect the equilibrium prices, which in turn determine the willingness of the controlling shareholder to smooth consumption through the capital accumulation and payout policies of the firm. One key implication of Dow et al. (2004) is that the risk premium is lower in their agency setting than in the no-agency benchmark. However, and consistent with the evidence provided above, our paper predicts a higher risk premium in countries with low corporate governance.

There are now several papers linking agency to firm investment decisions. The analysis of Shleifer and Wolfenzon (2002) is set in a general equilibrium context. Their assumption of risk-neutral agents implies that the model is silent with respect to how agency affects the economy's risk premium. Both Shleifer and Wolfenzon (2002) and Castro, Clementi, and MacDonald (2004) focus on the implications of weak investor protection on the equilibrium interest rate rather than the risk premium. In contrast to what we find, both these papers predict that countries with better investor protection have higher interest rates (see also Gorton and He (2003)). In a partial equilibrium context with risk neutrality, La Porta et al. (2002) provide an explanation for the observed direct relation between Tobin's q and investor protection. Lan and Wang (2004) extend their analysis to a dynamic equilibrium analysis with entrepreneurs and outside minority investors. Himmelberg, Hubbard, and Love (2002) analyze a risk-averse controlling shareholder's investment decision under imperfect investor protection in a two-period partial equilibrium setting and derive implications on the firm's cost of capital. Their model predicts that ownership is more concentrated under weaker investor protection (see also Shleifer and Wolfenzon (2002)), and a higher ownership concentration in the presence of the firm's idiosyncratic risk induces underinvestment and a higher cost of capital.

In another related agency setting, Holmstrom and Tirole (2001) propose an equilibrium asset pricing model by assuming that the entrepreneur is able to extract private benefits from the firm and cannot promise to fully return investors' funds. As a result, collateralizable assets that can be seized by investors when the firm is in financial trouble command a premium. This generates an ex ante desire to hoard liquidity in order to increase funding, thereby leading to a liquidity premium. Cooley et al. (2004) build a model of financing constraints that are endogenously generated because of weak creditor protection à la Albuquerque and Hopenhayn (2004) and derive implications for aggregate volatility. Gomes et al. (2004) link costly external financing to asset prices.

The remainder of the paper is organized as follows. Section 2 presents the model and states the main theorem. Section 3 characterizes the equilibrium outcome and the agents' optimality conditions in detail. Section 4 presents the perfect investor protection benchmark and Section 5 gives the model's main predictions on interest rates, equity prices, and returns. Section 6 provides a calibration and supplies quantitative predictions of the model. Section 7 presents empirical evidence on some of the model's new predictions. Section 8 concludes. The Appendix contains technical details and proofs of the propositions in the paper.

2 The Model

The economy is populated by two types of agents, controlling shareholders and minority investors. Each controlling shareholder operates a firm. Minority investors are all identical, and all firms and their controlling shareholders are assumed to be identical and subject to the same shocks.[6] Both types of agents have infinite horizons and time is continuous. Without loss of generality, we only need to analyze the decision problems for a representative controlling shareholder and a representative outside minority investor. Let the total mass of both the controlling shareholders and minority investors be unity.

Next, we describe the consumption and production sides of the economy, and the objectives and choice variables of both the controlling shareholder and the minority investors.

2.1 Setup

Production and Investment Opportunities. The firm is defined by a production technology. Let K be the firm's capital stock process. We assume that K evolves according to

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

where $\epsilon > 0$, $\delta > 0$ is the depreciation rate, $Z(t)$ is a Brownian motion, $I(t)$ represents the firm's gross investment, and $K(0) > 0$. Gross investment is given by

$$I(t) = hK(t) - D(t) - s(t)hK(t). \tag{2}$$

Firms use capital stock $K(t)$ to produce gross output $hK(t)$ at each point in time t by using a constant returns to scale technology. Since the focus of our paper is on how agency conflicts affect capital accumulation and equilibrium asset pricing, we simplify the production technology by focusing on capital. In this setting, we interpret the value of output hK as the revenue net of labor costs. While our model does not explicitly model labor choice in production, we can generalize it to account for labor as a factor of production.[7] Gross investment I equals gross

[6] Firms can differ in their initial capital stock, but are otherwise identical.

[7] Consider a standard constant returns to scale Cobb-Douglas production function $AK^{\upsilon}L^{1-\upsilon}$, where L is the labor input measured in terms of efficiency units and $0 < \upsilon < 1$. Let w be the real wage rate. In each period the firm chooses its labor demand by solving $\max_L \left\{AK^{\upsilon}L^{1-\upsilon} - wL\right\}$. The optimal level of labor demand is

output hK minus the sum of dividends D, and the private benefits extracted by the controlling shareholder shK.

The capital accumulation process (1) is stochastic with shocks proportional to gross investment I. Our model follows Keynes (1936) and Greenwood, Hercowitz, and Huffman (1988) in assuming that productivity shocks shift the marginal efficiency of investment as opposed to the productivity of existing capital as in more traditional approaches. To make the link to Greenwood, Hercowitz, and Huffman (1988) more transparent, consider a discretized version of (1) over one period

$$K(t+1) = (1-\delta) K(t) + I(t) (1 + \epsilon w(t+1)), \tag{3}$$

where $w(t+1) = Z(t+1) - Z(t)$ is an innovation given by the standard normal distribution. One important source of shifts to the marginal efficiency of investment identified in Greenwood et al. (1997, 2000) is the relative price of the investment good, whereby the aggregate innovation $w(t+1)$ affects all firms equally. Greenwood et al. (1997) provide evidence that shocks to the marginal efficiency of investment account for 60% of postwar-U.S. growth. At the business cycle frequency, using a calibration exercise, Greenwood, Hercowitz, and Krusell (2000) find that shocks to the marginal efficiency of investment account for 30% of output fluctuations in the postwar-U.S. period (see also Christiano and Fisher (2003)). Using an econometric approach, Fisher (2003) shows that 50% of U.S. fluctuations are accounted for by shocks to the marginal efficiency of investment.[8]

It is worth noting that our model specification of capital accumulation differs from those in CIR (1985) and Sundaresan (1984).[9] Unlike their models in which capital accumulation is subject to shocks that are proportional to the capital stock, our model postulates that capital accumulation is subject to shocks that are proportional to newly invested goods. As a result, we show later that our model predicts that Tobin's q is greater than unity, while their models predict that Tobin's q equals unity. However, it will become apparent as well that the dynamics of capital accumulation in our model and in CIR (1985) and Sundaresan (1984) are observationally equivalent. Note that the result that Tobin's q is greater than unity arises from risk aversion on the part of the decision maker and volatility in capital accumulation, rather than the standard adjustment cost (Abel (1983) and Hayashi (1982)).

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proportional to the capital stock and is given by $L = (A(1-v)/w)^{1/v} K$. Thus, the revenue function net of labor payments is $(A(1-v)/w)^{1/v} wv/(1-v) K \equiv hK$. To pin down the equilibrium wage rate in this setting, assume that labor supply in efficiency units is proportional to the capital stock, in that $\bar{L}(t) = l\bar{K}(t)$ where $l > 0$ and $\bar{L}$ and $\bar{K}$ are the aggregate counterparts to L and K and are exogenous to each firm. In equilibrium, homogeneity of firms gives $\bar{K} = K$ and $L = \bar{L}$ (recall that there is a unit mass of firms). Thus, the equilibrium wage rate is constant, given by $w = A(1-v)/l^v$. Using the equilibrium wage rate we can express the productivity parameter $h = vAl^{1-v}$.

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

[9] Sundaresan (1984) extends CIR into a two-good economy with a Cobb-Douglas production function.

Next, we discuss the controlling shareholder's objective and his decision variables. We are motivated by the large amount of empirical evidence around the world in delegating the firm's decision making to the controlling shareholder.

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

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

where C_1 denotes the flow of consumption of the controlling shareholder, and the period utility function is given by

$$u(C) = \begin{cases} \frac{1}{1-\gamma}\left(C^{1-\gamma}-1\right) & \gamma \geq 0, \gamma \neq 1 \\ \log C & \gamma = 1 \end{cases}. \tag{5}$$

The rate of time preference is $\rho > 0$, and γ is the coefficient of relative risk aversion. Throughout the paper, we use the subscripts "1" and "2" to index variables for the controlling shareholder and the minority investor, respectively.

The controlling shareholder owns a fixed fraction $\alpha < 1$ of the firm's shares. This ownership share gives him control over the firm's investment and payout policies. In real economies, control rights generally differ from cash flows rights: a fraction of votes higher than that of cash flow rights can be obtained by owning shares with superior voting rights, by ownership pyramids, by cross-ownership, or by controlling the board. We refer readers to Bebchuk et al. (2000) for details on how control rights can differ from cash flow rights.[10] For now, we treat α as constant and nontradable. This assumption is consistent with La Porta et al. (1999) who argue that the controlling shareholder's ownership share is extremely stable over time, but is not needed. In Section 3.3, we allow the controlling shareholder to optimize over his ownership stake and show that the no-trade outcome is indeed an equilibrium.[11]

We assume that the controlling shareholder can only invest his wealth in the risk-free asset. Let W_1 denote the controlling shareholder's tradable wealth. The risk-free asset holdings of the controlling shareholder are $B_1\left(t\right) = W_1\left(t\right)$. We assume that the controlling shareholder's initial tradable asset holding is zero, in that $W_1\left(0\right) = 0$. Therefore, the controlling shareholder's tradable wealth $W_1\left(t\right)$ evolves according to

$$dW_1(t) = \left[r(t)W_1(t) + M\left(t\right) - C_1(t)\right]dt\,, \tag{6}$$

where $M\left(t\right)$ is the flow of goods that the controlling shareholder obtains from the firm, either

[10] Giving all the control rights to a controlling shareholder is in line with evidence provided in La Porta et al. (1999), who document for many countries that the control of firms is often heavily concentrated in the hands of a founding family.

[11] It is possible to endogenize the decision for the initial share ownership of the controlling shareholder. This is done in Shleifer and Wolfenzon (2002) in a static model and Lan and Wang (2004) in a dynamic setting. In these models weaker investor protection leads to more concentrated ownership, ceteris paribus.

through dividend payments $\alpha D(t)$ or through private benefits:[12]

$$M(t) = \alpha D(t) + s(t)hK(t) - \Phi(s(t), hK(t)). \tag{7}$$

Private benefits of control are modeled as a fraction $s(t)$ of gross output $hK(t)$, with $h > 0$ being the productivity of capital. While we assume that all the controlling shareholder's private benefits are pecuniary in nature, it is conceivable that the controlling shareholder may derive nonpecuniary private benefits as well. For example, the controlling shareholder may simply enjoy running a larger firm as in Jensen (1986).[13] Expropriation is costly to both the firm and the controlling shareholder and, ceteris paribus, for the controlling shareholder pursuing private benefits, is more costly when investor protection is stronger. If the controlling shareholder diverts a fraction s of the gross revenue $hK(t)$, then he pays a cost

$$\Phi(s, hK) = \frac{\eta}{2} s^2 hK. \tag{8}$$

The cost function (8) is increasing and convex in the fraction s of gross output that the controlling shareholder diverts for private benefits. The convexity of $\Phi(s, hK)$ in s guarantees that it is more costly to divert increasingly large fractions of private benefits. For the remainder of the paper, we use the word "stealing" to mean "the pursuit of private benefits by diverting resources away from the firm." The cost function (8) also assumes that the cost of diverting a given fraction s of cash from a larger firm is assumed to be higher, because a larger amount shK of gross output is diverted. That is, $\partial\Phi(s, hK)/\partial K > 0$. However, the total cost of stealing the same level shK is lower for a larger firm than for a smaller firm. This can be seen by rewriting the cost of stealing as $\Phi(s, hK) = \eta (shK)^2 / (2hK)$.

Following Johnson et al. (2000) and La Porta et al. (2002), we interpret the parameter η as a measure of investor protection.[14] A higher η implies a larger marginal cost ηshK of diverting cash for private benefits. In the case of $\eta = 0$, there is no cost of diverting cash for private benefits and the financing channel breaks down because investors anticipate no payback from the firm after they sink their funds. As a result, ex ante, no investor is willing to invest in the firm. In contrast, in the limiting case of $\eta = \infty$, the marginal cost of pursuing a marginal unit of private benefit is infinity and minority shareholders are thus fully protected from expropriation. We show later that in this case, in the equilibrium we analyze the incentives of the controlling shareholder are perfectly aligned with those of the minority investors.

In summary, the objective for the controlling shareholder is to maximize his lifetime utility defined in (4) and (5), subject to the firm's capital stock dynamics given in (1)-(2), the

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

[13] It is easy to extend our analysis to include these nonpecuniary private benefits. Modeling nonpecuniary private benefits increases the incentives to overinvest, thus amplifying the mechanisms described in our paper.

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

controlling shareholder's wealth accumulation dynamics (6)-(7), the cost function (8) for the controlling shareholder to pursue his private benefits, and the transversality condition specified in the Appendix. In solving his optimization problem, the controlling shareholder chooses $\{C_1(t), s(t), I(t), K(t), D(t), W_1(t) : t \geq 0\}$ and takes the equilibrium interest rate process $\{r(t) : t \geq 0\}$ as exogenously given.

Let D and K be the dividend and firm's capital stock process chosen by the controlling shareholder. Without loss of generality, we may write both the dividend and capital stock processes as

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

and

$$dK(t) = \mu_K(t)K(t)\,dt + \sigma_K(t)K(t)\,dZ(t), \tag{10}$$

where the drift processes μ_D and μ_K and the volatility processes σ_D and σ_K are chosen by the controlling shareholder.

Financial Assets. Outside minority investors trade equity shares on the firm. While the controlling shareholder chooses the dividend stream, the price of the firm's stock is determined in equilibrium by rational minority investors. We write the equilibrium stock price process as

$$dP(t) = \mu_P(t)P(t)\,dt + \sigma_P(t)P(t)\,dZ(t), \tag{11}$$

where μ_P and σ_P are the equilibrium drift and volatility processes for stock prices, respectively.

In addition to firm stock traded by minority investors, there is also a risk-free asset available in zero net supply. Both minority investors and the controlling shareholder may trade the risk-free asset. Let $r(t)$ be the short term interest rate paid on this risk-free asset. We determine r, μ_P, and σ_P simultaneously in equilibrium in Section 3.

Minority Investors. Minority investors have preferences with the same functional form as (4) and (5). They jointly own $(1-\alpha)$ of the firm's shares and can sell or buy these shares in competitive markets with other minority investors at the equilibrium price $P(t)$. They can also invest in the risk-free asset, earning the equilibrium interest rate. Each minority investor's optimization problem is a standard consumption-asset allocation problem in the spirit of Merton (1971). Unlike Merton (1971), however, in our model, both the stock price and the interest rate are endogenously determined in equilibrium.

Each minority investor accumulates his wealth as follows:

$$dW_2(t) = \left[r(t)W_2(t) - C_2(t) + \omega(t)W_2(t)\lambda(t)\right]dt + \sigma_P(t)\omega(t)W_2(t)dZ(t), \tag{12}$$

where $\lambda(t)$ is the excess stock return inclusive of dividend payments $D(t)$, in that $\lambda(t) \equiv \mu_P(t) + D(t)/P(t) - r(t)$, and $\omega(t)$ is the fraction of wealth invested in the firm's stock. We use the subscript '2' to denote variables chosen by minority investors, when it is necessary to differentiate these from the corresponding variables for the controlling shareholder. For example, in the wealth accumulation equation (12), $C_2(t)$ is the flow of consumption of the minority investor. The risk-free asset holdings of the minority investors are $B_2(t) = (1 - \omega(t)) W_2(t)$. Finally, each minority investor's initial wealth is $W_2(0) > 0$.

Each minority investor chooses $\{C_2(t), W_2(t), \omega(t) : t \geq 0\}$ to maximize his lifetime utility function subject to his wealth accumulation dynamics (12) and the transversality condition specified in the Appendix. In solving this problem, the minority investor takes as given the equilibrium dividend process, the firm's stock price, and the interest rate.

2.2 Definition and Existence of Equilibrium

We are now ready to define an equilibrium in our economy and state the theorem characterizing the equilibrium.

Definition 1 *An equilibrium has the following properties:*

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

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

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

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

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

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

(v) the consumption goods market clears, in that

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

The goods market clearing condition states that the total available resource generated in the economy at time t, $hK(t) - \Phi(s(t), hK(t))$, must be either consumed by the controlling shareholder or outside investors, or invested in the firm.

Note that a complication with our model is the presence of heterogeneous investors. In general, with heterogeneous investors, agents keep track of the wealth distribution in the economy $(W_1(t), W_2(t))$ in addition to the level of physical capital invested in the firm $K(t)$. In our model though this problem is greatly simplified. First, in all equilibria with a constant interest rate, the tradable part of the controlling shareholder's wealth $W_1(t)$ equals zero. Second, the wealth of the minority investors is proportional to $K(t)$. This feature significantly reduces the dimensionality of the problem from three state variables to one. The theorem introduced below completely characterizes the equilibrium.

Theorem 1 *Under Assumptions 1-5 listed in the Appendix, there exists an equilibrium with the following properties. The outside minority investors hold no risk-free asset ($B_2(t) = 0$), and therefore hold only stock ($\omega(t) = 1$). Minority investors' consumption equals their entitled dividends:*

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

The controlling shareholder holds no risk-free asset ($B_1(t) = 0$). He steals a constant fraction of gross revenue, in that

$$s(t) = \phi \equiv \frac{1-\alpha}{\eta}. \tag{13}$$

The controlling shareholder's consumption $C_1(t)$, firm's investment $I(t)$, and firm's dividend payout $D(t)$ are all proportional to the firm's capital stock $K(t)$, in that $C_1(t)/K(t) = M(t)/K(t) = m$, $I(t)/K(t) = i$, $D(t)/K(t) = d$, where

$$m = \alpha[(1+\psi)h - i] > 0, \tag{14}$$

$$i = \frac{1+(1+\psi)h\epsilon^2}{(\gamma+1)\epsilon^2}\left[1-\sqrt{1-\frac{2(\gamma+1)\epsilon^2((1+\psi)h-\rho-\delta(1-\gamma))}{\gamma[1+(1+\psi)h\epsilon^2]^2}}\right] > 0, \tag{15}$$

$$d = (1-\phi)h - i > 0, \tag{16}$$

and ψ is a measure of agency costs, given by

$$\psi = \frac{(1-\alpha)^2}{2\alpha\eta}. \tag{17}$$

The equilibrium dividend process (9), the capital accumulation process (10), and the stock price process (11) all follow geometric Brownian motions, with the same drift and volatility coefficients; that is,

$$\mu_D = \mu_K = \mu_P = i - \delta, \tag{18}$$

$$\sigma_D = \sigma_K = \sigma_P = i\epsilon, \tag{19}$$

where i is the constant equilibrium investment-capital ratio given in (15). The equilibrium firm value is also proportional to the firm's capital stock, in that $P(t) = qK(t)$, where the coefficient q, known as Tobin's q, is given by

$$q = \left(1+\frac{1-\alpha^2}{2\eta\alpha d}h\right)^{-1}\frac{1}{1-\gamma\epsilon^2 i}. \tag{20}$$

The equilibrium interest rate is given by

$$r = \rho + \gamma\mu_D - \frac{\sigma_D^2}{2}\gamma(\gamma+1). \tag{21}$$

The parameter ψ given in (17) summarizes the relevance of investor protection and the controlling shareholder's cash flow rights for firm investment. In particular, ψ is a decreasing function of the cost of stealing η and of the equity share of the controlling shareholder α.

In equilibrium, financial and real variables – price P, dividend D, controlling shareholder's consumption C_1 and wealth W_1, firm investment I, minority investor's consumption C_2, and wealth W_2 –are all proportional to the firm's capital stock K. That is, in our model, the economy grows stochastically on a balanced path. In order to deliver such an intuitive and analytically tractable equilibrium, the following assumptions or properties of the model are useful: (*i*) a constant returns to scale production and capital accumulation technology specified in (1); (*ii*) optimal "net" private benefits that are linear in the firm's capital stock (arising from the assumptions that the controlling shareholder's benefit of stealing is linear in s and his cost of stealing is quadratic in s); and (*iii*) the controlling shareholder and the minority investors have preferences that are homothetic with respect to the firm's capital stock. We think the key intuition and results of our model are robust to various generalizations. Since the economy is on a balanced growth path, in the remainder of the paper we focus primarily on scaled variables such as the investment-capital ratio i and the dividend-capital ratio d.

In the next section, we prove Theorem 1, present the derivations of equilibrium prices and quantities, and highlight the intuition behind the construction of the equilibrium (see the Appendix for details).

3 Equilibrium Characterization

The natural and direct way to solve for the model's equilibria in our economy is to solve the controlling shareholder's consumption and production decisions and the minority investor's consumption and asset allocation problem for a general price process and to aggregate the demands for the stock, the risk-free asset, and the consumption good. However, this approach is technically quite complicated and analytically not tractable. The controlling shareholder's optimization problem is one with both an incomplete markets consumption-savings problem and a capital accumulation problem with agency costs. We know from the voluminous consumption-savings literature that there is no analytically tractable model with constant relative risk aversion utility (Zeldes (1989)). If solving even a subset of such an optimization problem is technically difficult, we naturally anticipate the joint consumption and production optimization problem for the controlling shareholder to be intractable, not to mention finding the equilibrium fixed point.

Here we adopt the alternative approach by directly conjecturing, and then verifying, the equilibrium allocations and prices. Specifically, we conjecture an equilibrium in which the interest rate is constant and there is no trading of the risk-free asset. We then show that such an equilibrium satisfies all the optimality and market clearing conditions. We start with the controlling shareholder's optimization problem.

3.1 The Controlling Shareholder's Optimization

We conjecture that the controlling shareholder holds zero risk-free assets in equilibrium, in that $B_1(t) = 0$ for all $t \geq 0$. Therefore, his consumption is given by $C_1(t) = M(t)$, where $M(t)$ is given in (7).We show that under this conjecture, the rate r that satisfies the controlling shareholder's optimality condition is equal to the equilibrium interest rate given in (21), presented in Theorem 1. In order to demonstrate that our conjectured interest rate is the equilibrium rate, we also need to verify that the optimality condition for the minority investors under the conjectured interest rate implies zero demand for the risk-free asset. We verify this later in the section.

Recall that the only tradable asset for the controlling shareholder in this economy is the risk-free asset. Therefore, together with our conjectured equilibrium demand for the risk-free asset by the controlling shareholder, we may equivalently write the controlling shareholder's optimization problem as the resource allocation problem

$$J_1(K_0) = \max_{D,s} E\left[\int_0^\infty e^{-\rho t} u(M(t))dt\right],$$

subject to the firm's capital accumulation dynamics (1)–(2), the cost of stealing (8), and the transversality condition specified in the Appendix.

The controlling shareholder's optimal payout decision D and stealing decision s solve the following Hamilton-Jacobi-Bellman equation:[15]

$$0 = \sup_{D,s}\left\{\frac{1}{1-\gamma}\left(M^{1-\gamma}-1\right) - \rho J_1(K) + (I-\delta K) J_1'(K) + \frac{\epsilon^2}{2} I^2 J_1''(K)\right\}. \tag{22}$$

The first-order conditions with respect to dividend payout D and cash diversion s are

$$M^{-\gamma}\alpha - \epsilon^2 I J_1''(K) = J_1'(K), \tag{23}$$

and

$$M^{-\gamma}(hK - \eta s h K) - \epsilon^2 I J_1''(K) hK = J_1'(K) hK. \tag{24}$$

Equation (23) describes how the controlling shareholder chooses the firm's dividend and investment policy. The left side of (23) is the marginal benefit of investment. Increasing the dividend payout by one unit gives the controlling shareholder an additional α units of dividend and consumption, thereby increasing utility by $M^{-\gamma}\alpha$. In contrast, the higher dividend payout and lower investment incurs the standard loss of indirect utility by the amount $J_1'(K)$ (the term on the right side of (23)). Unlike the traditional consumption Euler equation, there is an additional benefit of increasing dividends/reducing investment. Reducing investment decreases

[15] We verify the solution and provide technical regularity conditions in the appendix.

the volatility of future marginal utility. The intuition for 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 (Keynes (1936) and Greenwood et al. (1988)).

While there are two opposite effects of investment via the controlling shareholder's value function, the standard marginal benefit of postponing consumption given by $J_1'(K)$ outweighs the volatility effect given by $\epsilon^2\gamma i|J_2''(K)|$. To understand the intuition, we may rearrange equation (23) and note that the controlling shareholder optimally sets $J_1'(K) - \epsilon^2\gamma i|J_2''(K)| > 0$ to equal $M^{-\gamma}\alpha$, the marginal utility of consumption. Similar intuition behind the first-order condition (24) for the controlling shareholder's stealing decision may be obtained.

Solving (23) and (24) gives a constant solution for the stealing function, in that $s(t) = \phi \equiv (1-\alpha)/\eta$. Intuitively, stealing is higher when investor protection is worse (lower η) and the conflicts of interest are larger (smaller α).

Conjecture that the controlling shareholder's value function $J_1(K)$ is given by

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

where the coefficient A_1 is given in the Appendix. We verify this conjecture by solving the Hamilton-Jacobi-Bellman equation (22) and the associated first-order conditions (23)-(24) in the Appendix. We show that the controlling shareholder's consumption-capital ratio $M(t)/K(t)$, the investment-capital ratio $I(t)/K(t)$, and the dividend-capital ratio $D(t)/K(t)$ are all constant and are given by (14), (15), and (16), respectively.

The next proposition states the main properties of investment.

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

Under weaker investor protection, the controlling shareholder diverts a higher fraction of gross sales revenue, and thus derives more net private benefits of control (mathematically, $\phi = (1-\alpha)/\eta$ is higher for lower η). Thus, the rational forward-looking controlling shareholder values a larger firm more under weaker investor protection because it can generate even more private benefits. This effect dominates the volatility effect induced by the existence of shocks to the marginal efficiency of investment (see (23)).[16] Therefore, our model predicts that the incentive to build a larger firm is stronger under weaker investor protection in spite of higher volatility. This gives rise to overinvestment relative to the perfect investor protection benchmark.

[16] Note that (23) indicates that the volatility effect of the controlling shareholder's value function is smaller than the controlling shareholder's marginal value of investing, i.e., $J_1'(K) + \epsilon^2\gamma J_1''(K) > 0$. Moreover, the dependence of $J_1'(K)$ on investor protection is also stronger than the dependence of the risk aversion/volatility effect on investor protection.

The sensitivity of investment to investment shocks is also affected by the quality of investor protection. Consider the discrete-time approximation of the capital accumulation equation given in (3). It is immediate that given $K(t-1)$, $\partial I(t)/\partial w(t) > 0$ and $\partial^2 I(t)/\partial\eta\partial w(t) < 0$: positive shocks to the marginal efficiency of investment ($w(t) > 0$) increase investment more in the presence of weaker investor protection. Hence, lack of investor protection magnifies the business cycle fluctuations due to investment shocks as highlighted by Keynes (1936) and Greenwood et al. (1988).

It is worth noting that the controlling shareholder's incentive to overinvest in our model derives solely from the private benefits measured in monetary terms. In reality, controlling shareholders also receive nonpecuniary private benefits in the form of empire building/name recognition from running larger firms. The pursuit of such nonpecuniary private benefits exacerbates the controlling shareholder's incentive to overinvest (Jensen (1986)).[17] Also, controlling shareholders are often founding family members that have a desire to pass the 'empire' bearing their own name down to their offsprings (Burkart, Panunzi, and Shleifer (2003)). Because we ignore these nonpecuniary private benefits, the model provides a lower estimate of the degree of overinvestment.

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.[18] Pinkowitz, Stulz, and Williamson (2003) document that, after controlling for the demand for liquidity, one dollar of cash holdings held by firms in countries with poor corporate governance is worth much less to outside shareholders than that held by firms in countries with better corporate governance. Gompers et al. (2003) and Philippon (2004) document that U.S. firms with low corporate governance have higher investment. The overinvestment as a consequence of weak corporate governance result fits the evidence well not only for developed economies, but also many emerging market economies.

Indeed, for emerging market economies, the evidence abounds. In Korea and Thailand, there is evidence in support of overinvestment before the East Asian crisis. For example, the huge volume of non-performing loans of 25% of GDP for Korea and 30% of GDP for Thailand prior to the East Asian crisis in 1997 (Burnside et al. (2001)) is a strong indication that firms overinvested.[19] China is another example of a country with very large amounts of nonperforming loans in the banking sector, fruit of a government that tirelessly dumps cash into

[17] See also Baumol (1959) and Williamson (1964).

[18] See earlier papers by Lang, Stulz, and Walking (1991), Blanchard, López-de-Silanes, and Shleifer (1994), and Lamont (1997).

[19] While these local firms benefitted from government subsidies via, for example, a low borrowing rate, a lower 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.

inefficient state-owned enterprises. Allen et al. (2004) show that China has had consistently high growth rates since the beginning of economic reforms in the late 1970s, even though its legal system is not well developed and law enforcement is poor. Our paper argues that the incentives for the controlling shareholders to overinvest can at least partly account for China's high economic growth despite weak investor protection.[20]

In our model overinvestment arises because of the pursuit of private benefits by the controlling shareholder. This is likely to be a dominant issue for larger firms. There is a parallel line of research in corporate finance that highlights the role of costly external financing (Hubbard (1998)). That literature aims mostly at explaining the behavior of growth and exit of small firms, and highlights how financing frictions induce firms to underinvest. Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) provide important contributions to the general equilibrium implications of financing frictions. We view our research (as well as Dow et al. (2004)) as complementary to the financing friction based approach to business cycle and asset pricing.

We now return to our model's implication for the controlling shareholder's problem. We need to verify that the controlling shareholder's consumption rule (14) and the equilibrium interest rate (21) are consistent with the implication that his optimal risk-free asset holding is indeed zero. This can be done by showing that the interest rate implied by the marginal utility of the controlling shareholder when $C_1(t) = M(t)$ is the equilibrium rate. The controlling shareholder's marginal utility is given by $\xi_1(t) = e^{-\rho t} C_1(t)^{-\gamma}$. In equilibrium, $\xi_1(t) = e^{-\rho t} m^{-\gamma} K(t)^{-\gamma}$. Applying Ito's lemma gives the following dynamics for $\xi_1(t)$:

$$\frac{d\xi_1(t)}{\xi_1(t)} = -\rho dt - \gamma \frac{dK(t)}{K(t)} + \frac{\epsilon^2 i^2}{2} \gamma (\gamma + 1)\, dt = -r dt - \gamma i \epsilon \, dZ(t) \ .$$

In order for ξ_1 to be the equilibrium stochastic discount factor, the drift of ξ_1 needs to equal $-r\xi_1$. This equilibrium restriction gives the equilibrium interest rate in (21). We refer the reader to Section 5.1 below for a discussion of the properties of the equilibrium interest rate.

Next, we turn to the minority investor's optimization problem and his equilibrium security valuation.

3.2 Minority Investors' Optimization

Minority investors trade two securities, the stock and the risk-free asset. Each minority investor faces a standard consumption and asset allocation problem. The minority investor accumulates his wealth by either investing in the risky asset (firm asset) or the risk-free asset. His wealth accumulation process is given by

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

[20] A sizable portion of China's economy is state-owned enterprises. While we do not formally model state-owned enterprises in this paper, in practice these state-owned enterprises 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 government appointment of the manager. The managers in these firms are often government officials or their affiliates.

where $\lambda(t) = \mu_P(t) + D(t)/P(t) - r(t)$ is the equilibrium risk premium and ω is the fraction of wealth invested in the risky asset. Under the conjecture that both the equilibrium risk premium and the equilibrium interest rate are constant, we posit that the minority investor's value function is

$$J_2(W) = \frac{1}{1-\gamma}\left(A_2 W^{1-\gamma} - \frac{1}{\rho}\right), \tag{25}$$

where A_2 is the coefficient to be determined in the Appendix. We obtain the following standard consumption function and asset allocation solutions:

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

and

$$\omega(t) = \omega = -\frac{J_2'(W)}{W J_2''(W)}\frac{\lambda}{\sigma_P^2} = \frac{\lambda}{\gamma\sigma_P^2}.$$

In the proposed equilibrium, the minority investor only holds stock ($\omega = 1$), holding no risk-free asset. Hence, the equilibrium excess stock return must satisfy

$$\lambda = \gamma\sigma_P^2 = \gamma\epsilon^2 i^2. \tag{26}$$

The first equality is the usual result (e.g., Lucas (1978) and Breeden (1979)) that the equity premium commanded by investors to hold the stock is the product of the price of risk, given by the investor's coefficient of relative risk aversion, and the quantity of risk, as given by the infinitesimal variance of the stock return. The last equality states that the standard deviation of equity returns is proportional to the investment-capital ratio. A higher investment-capital ratio gives rise to a larger volatility of output and equity prices.

In equilibrium, with zero risk-free asset holdings, the minority investor's consumption is $C_2(t) = (1-\alpha) D(t)$. We apply Ito's lemma to the minority investor's marginal utility, $\xi_2(t) = e^{-\rho t} C_2(t)^{-\gamma} = e^{-\rho t}\left[(1-\alpha) dK(t)\right]^{-\gamma}$, to obtain the following dynamics of $\xi_2(t)$:

$$\frac{d\xi_2(t)}{\xi_2(t)} = -\rho dt - \gamma\frac{dK(t)}{K(t)} + \frac{\epsilon^2 i^2}{2}\gamma(\gamma+1) dt = -r dt - \gamma i\epsilon\, dZ(t). \tag{27}$$

Because ξ_2 is the equilibrium stochastic discount factor, the drift of ξ_2 needs to equal $-r\xi_2$, where r is the equilibrium interest rate. This equilibrium restriction and (27) together give the equilibrium interest rate in (21). Importantly, the implied equilibrium interest rate by the controlling shareholder's ξ_1 and the minority investor's ξ_2 are equal. We therefore verify that, like the controlling shareholder, minority investors find it optimal not to trade the risk-free asset at the equilibrium interest rate (21).

It remains to be shown that the price process (11), appropriately constructed, is an equilibrium process for equity trading among minority investors, and generates a constant excess stock return. Using the minority investor's marginal utility, we obtain the stock's price per share by dividing the discounted value of total dividends paid to minority investors by the number of shares $(1-\alpha)$

$$P(t) = \frac{1}{1-\alpha} E_t \left[\int_t^\infty \frac{\xi_2(s)}{\xi_2(t)} (1-\alpha) D(s) \, ds \right] = qK(t), \tag{28}$$

where Tobin's q, also known as the firm's market-to-book value, is given by (20). Note that because the relative price of capital is one, the replacement cost of the firm's capital is just $K(t)$.

Tobin's q is positive for $1 - \epsilon^2 i\gamma > 0$, which holds under Assumption 5. With constant q and dividend-capital ratio d, in equilibrium it is straightforward to show 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.

3.3 Equity Trading Between the Controlling Shareholder and Minority Investors

So far we exogenously assume that the controlling shareholder cannot trade equity with the minority investors. In this section, we extend our model by allowing both the controlling shareholder and outside minority investors to trade equity. We show that in equilibrium both the controlling shareholder and outside minority investors rationally choose not to trade with each other. The key in our analysis is to identify a free rider situation similar to the free rider problem identified in Grossman and Hart (1980) in the corporate takeover context. Lan and Wang (2004) propose such a free rider argument between a risk-neutral controlling shareholder and risk-neutral outside minority investors. Here, we apply the free rider argument to risk-averse agents.[21]

The key insight behind our proof for the no-trade result is that the controlling shareholder is unable to enjoy any surplus generated from increasing the firm's value (via a more concentrated ownership structure). The crucial assumption is that the controlling shareholder cannot trade anonymously. The inability to trade anonymously is realistic. For example, in almost all countries, insiders need to file a report before selling or buying their own firm's shares. We now provide more details for the no-trade result, leaving a formal proof to the Appendix.

Let α be the controlling shareholder's current ownership in the firm. Suppose the controlling shareholder considers the possibility of increasing his ownership from α to α', if it is in his interest to do so. With a slight abuse of notation, let $P_{\alpha'}$ and P_α denote the equilibrium equity price (resulting from competitive trading), when the controlling shareholder's ownership is α' and α, respectively. Because higher ownership concentration gives better incentive alignment,

[21] To the best of our knowledge, this is the first paper that identifies a free rider problem with risk-averse agents.

investors rationally anticipate $P_{\alpha'} > P_\alpha$, for $\alpha' > \alpha$ (see equation (28) above and Proposition 3 below). Obviously, the controlling shareholder will not buy any shares at prices above $P_{\alpha'}$. Moreover, we show in the Appendix that the most he is willing to pay is P_α.

Let us turn to the minority investor's decision problem. Consider the decision of a minority investor j facing a buy order from the controlling shareholder at price P_α. If sufficient shares are tendered to the controlling shareholder by other minority investors at any acceptable price to the controlling shareholder (which is obviously lower than $P_{\alpha'}$), then the deal will go through even if investor j does not sell. As a result, investor j enjoys a price appreciation and obtains a higher valuation by free riding on other investors. Because each minority investor is infinitesimal and therefore not a pivotal decision maker, the free rider incentive implies no trade in equilibrium.[22]

Before delving into the details on the relation between investor protection and asset returns, we first analyze equilibrium for the no agency cost setting. This neoclassical setting (with no agency cost) serves naturally as the benchmark against which we may quantify the effect of imperfect investor protection on asset prices and returns.

4 Benchmark: Perfect Investor Protection

This section summarizes the main results on both the real and financial sides of an economy under perfect investor protection.

When investor protection is perfect, the cost of diverting resources away from the firm is infinity, even if the controlling shareholder diverts a negligible fraction of the firm's resources. Therefore, the controlling shareholder rationally decides not to pursue any private benefits and maximizes firm value using the unique discount factor in the economy. That is, there are no conflicts of interest between the controlling shareholder and the outside minority investors. Our model is then essentially a neoclassical production-based asset pricing model similar to Cox, Ingersoll, and Ross (CIR) (1985). We highlight the main differences between our model and the CIR model later in this section.

The controlling shareholder chooses the first-best investment level $I^*(t) = i^* K^*(t)$, where the investment-capital ratio i^* is obtained from (15) by letting $\eta \to \infty$ and is

$$i^* = \left[\frac{1 + h\epsilon^2}{(\gamma+1)\epsilon^2}\right]\left[1 - \sqrt{1 - \frac{2(\gamma+1)\epsilon^2\left(h - \rho - \delta\left(1-\gamma\right)\right)}{\gamma\left(1 + h\epsilon^2\right)^2}}\right]. \tag{29}$$

Starred variables ("*") denote equilibrium values of the variables under perfect investor protection. From Proposition 1 we know that there is overinvestment under weak investor protection,

[22] The free rider argument developed here breaks down if the controlling shareholder, instead of buying a small number of shares, offers to buy the remaining outstanding shares. In this case, however, suppose that the controlling shareholder finances his acquisition by borrowing in the bond market. In a more general framework that incorporates weak investor protection in the bond market, these bonds would be bought at a premium possibly large enough to offset the gain from buying all the shares from the minority investors, in which case no trade would occur. We thank John Long for making this point.

$i^* < i$.

Tobin's q under this first-best benchmark is given by

$$q^* = \frac{1}{1 - \epsilon^2 \gamma i^*} \geq 1. \tag{30}$$

Before analyzing the stochastic case ($\epsilon > 0$), we briefly sketch the model's prediction when capital accumulation is deterministic ($\epsilon = 0$). It is easy to show that without volatility in the capital accumulation equation (1), Tobin's q is equal to unity.[23] This is implied by no arbitrage when both capital accumulation is deterministic and incurs no adjustment cost and the production function has the constant returns to scale property.

The key prediction of our model on the real side under perfect investor protection is that Tobin's q is larger than unity if capital accumulation is subject to shocks ($\epsilon > 0$). That is, the value of installed capital is larger than that of to-be-installed capital. The intuition is as follows. The shocks to the marginal efficiency of investment are described by the aggregate shock $\Delta Z(t)$. The effect of these shocks depends on the level of investment. Naturally, this production risk is systematic and thus must be priced in equilibrium. As a result, risk-averse investors view it as costly to adjust capital in equilibrium. This, in turn, drives a wedge between the price of uninstalled capital and the price of installed capital, and gives rise to a Tobin's q larger than unity.

One important difference between our model and the CIR model is the implication on Tobin's q. In the CIR model, the production technology is also constant returns to scale. However, in their model, the volatility of output does not depend on the level of investment. In other words, their model does not capture shocks to the marginal efficiency of investment. The price of capital in the CIR model is equal to unity. Dow et al. (2004) incorporate the manager's empire building incentive into the neoclassical production-based asset pricing framework such as the CIR model, retaining the feature that the price of capital is equal to unity.

Because outside minority investors and the controlling shareholder have the same utility functions, and markets are effectively complete in the perfect investor protection case, we naturally expect that both the controlling shareholder and outside minority investors hold no risk-free asset in equilibrium, investing all of their wealth in the risky asset in equilibrium. The minority investors' and the controlling shareholder's consumption plans are equal to their respective entitled dividends, in that $C_2^*(t) = (1-\alpha) D^*(t)$, $C_1^*(t) = \alpha D^*(t)$, and $D^*(t) = d^* K^*(t)$, with the first-best dividend-capital ratio given by $d^* = h - i^*$.

The equilibrium interest rate under perfect investor protection, r^*, is given by (21), which is associated with the first-best investment-capital ratio i^*. Equation (21) indicates that the interest rate r^* is constant and is determined by the following three components: (i) the investor's subjective discount rate ρ, (ii) the net investment-capital ratio $(i - \delta)$, and (iii) the

[23] The first-best investment-capital ratio when $\epsilon = 0$ is given by $i^* = [h - \rho - \delta(1-\gamma)]/\gamma$, by applying L'Hôpital's rule to (29).

precautionary saving motive. In a risk-neutral world, the interest rate must equal the subjective discount rate in order to clear the market. This explains the first term. The second term captures the economic growth effect on the interest rate. A higher net investment-capital ratio $(i - \delta)$ implies that more resources are available for consumption in the future and thus raises demand for current consumption relative to future consumption. To clear the market, the interest rate must increase. This effect is stronger when the agent is less willing to substitute consumption intertemporally, which corresponds to a lower elasticity of intertemporal substitution $1/\gamma$.[24] The third term captures the precautionary savings effect on interest rate determination. A high net investment-capital ratio increases the riskiness of the firm's cash flows, and thus makes agents more willing to save. This preference for precautionary savings reduces current demand for consumption and lowers the interest rate, ceteris paribus.

In this benchmark case, the equilibrium stock price P^* is given by the geometric Brownian motion (11) with drift $\mu_P^* = i^* - \delta$ and volatility $\sigma_P^* = i^* \epsilon$.

Next, we analyze how different degrees of investor protection affect asset prices and returns.

5 Equilibrium Asset Returns

We first analyze the equilibrium interest rate and then turn to the stock return.

5.1 Risk-Free Rate

The next proposition relates the interest rate under imperfect investor protection to that of the benchmark case.

Proposition 2 *Worse investor protection or a lower share of equity held by the controlling shareholder are associated with a higher risk-free interest rate if and only if* $1 > \epsilon^2 (\gamma + 1) i$. *Specifically, the interest rate in an economy with imperfect investor protection is higher than that under perfect investor protection if and only if* $1 > \epsilon^2 (\gamma + 1) i$.

Changes in the degree of investor protection produce two opposing effects on the equilibrium interest rate. Both effects result from investment being higher under weaker investor protection. First, because of the effect of economic growth on the interest rate, higher investment implies larger output in the future and intertemporal consumption smoothing makes the agent willing to finance his current consumption by borrowing. This leads to a higher current equilibrium interest rate. Second, higher investment makes capital accumulation more volatile and implies a stronger precautionary saving effect, which in turn pushes down the current equilibrium

[24] In expected utility framework, elasticity of intertemporal substitution is equal to the inverse of the coefficient of relative risk aversion. In a recursive utility as an Epstein-Zin utility, the elasticity of intertemporal substitution and the coefficient of risk aversion may be partially disentangled. In such recursive utility framework, the coefficient for the growth-investment term is the inverse of the elasticity of intertemporal substitution.

interest rate to clear the market, ceteris paribus. The proposition illustrates that the growth effect dominates the precautionary effect if and only if $1 > \epsilon^2 (\gamma + 1)\, i$, that is, in the region in which the equilibrium interest rate increases with the investment-capital ratio. As demonstrated in the Appendix this condition is satisfied for sufficiently low ϵ, h, or ψ, and holds in all our calibrations below. It implies that the growth effect dominates and thus interest rates are higher under weaker investor protection. The cross-country interest rate data on 11 developed countries in Campbell (2003) suggests that civil law countries, those with weaker investor protection, have higher interest rates than common law countries. The average interest rate on his sample of common law countries is 1.89%, statistically smaller than the 2.35% average interest rate on his sample of civil law countries.

We now turn to equilibrium valuation from both the controlling shareholder's and the minority investor's perspectives.

5.2 Firm Valuation and Returns

Controlling Shareholder's Shadow Equity Valuation. Even though the controlling shareholder cannot trade firm equity with outside minority investors, the controlling shareholder nonetheless has a shadow value for equity. Let $\hat{P}(t)$ denote this shadow price of equity for the controlling shareholder. We compute $\hat{P}(t)$ as

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

The equilibrium shadow market-to-book value of the firm to the controlling shareholder, or shadow Tobin's q, is therefore given by

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

We note that the shadow value $\hat{q}$ is higher than q^*, the Tobin's q under perfect investor protection. The intuition is as follows. The controlling shareholder distorts the capital accumulation decision in pursuit of his private benefits and thus obtains a shadow value for the firm higher than q^*. By revealed preference, the controlling shareholder could set the investment-capital ratio to i^* and steal nothing $s = 0$, which would imply $\hat{q} = q = q^*$. Therefore, by choosing $s > 0$, the controlling shareholder's decisions $(i > i^*)$ must imply that his valuation is $\hat{q} > q^*$. Alternatively, we note that $\hat{q} > q^*$ is solely attributed to the overinvestment result $(i > i^*)$. Intuitively, overinvestment induces a larger (undiversifiable) risk associated with shocks to the marginal efficiency of investment (Greenwood et al. (1988) and Greenwood et al. (1997)). Therefore, a risk-averse controlling shareholder values the existing capital stock in terms of to-be-installed capital by an even greater amount under weaker investor protection. This induces a higher shadow Tobin's q $(\hat{q})$ for the controlling shareholder under weaker investor protection. We turn next to the minority investor's valuation.

Minority Investors' Valuation. Theorem 1 shows that the equilibrium price for firm equity is proportional to the capital stock and is given by $P(t) = qK(t)$, where q measures Tobin's q also known as the market-to-book ratio. The next proposition characterizes the monotonic relationship between q and investor protection.

Proposition 3 *Tobin's q increases with investor protection, in that $dq/d\eta > 0$, and increases with the controlling shareholder's cash flow rights, in that $dq/d\alpha > 0$.*

Proposition 3 demonstrates that the model is consistent with the evidence offered in La Porta et al. (2002), Gompers et al. (2003), and Doidge et al. (2004) on the relationship between firm value and investor protection. The model also predicts that firm value increases with the controlling shareholder's ownership α. This 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, and with the evidence for Korea in Baek et al. (2004), which documents that non-chaebol firms experienced a smaller reduction in their share value during the East Asian crisis.

Firm value increases with the degree of investor protection, because under weaker investor protection, the controlling shareholder extracts more private benefits today and distorts investment in order to pursue higher private benefits in the future. La Porta et al. (2002) and Shleifer and Wolfenzon (2002) explain lower Tobin's q under worse investor protection via the private benefits argument in a static setting with risk-neutral agents. Lan and Wang (2004) extend the analysis to a dynamic equilibrium analysis with risk-neutral entrepreneurs and outside minority investors. Ours is the first paper to explain this empirical evidence while computing firm value in a dynamic stochastic general equilibrium asset pricing model with risk-averse agents.

We next turn to the dividend yield. Let y be the equilibrium dividend yield, in that $y = D/P = d/q$. Recall that the equilibrium dividend D follows a geometric Brownian motion with a constant drift rate μ_D and volatility σ_D. Adjusting for risk, the dynamics of the dividend process (under the risk-neutral probability measure) are given by[25]

$$dD(t) = gD(t)dt + \sigma_D D(t)d\tilde{Z}(t)\,, \tag{31}$$

where $\tilde{Z}(t)$ is the Brownian motion under the risk-neutral probability measure and g is the risk-adjusted growth rate of the dividend:

$$g = \mu_D - \lambda = \mu_D - \gamma\sigma_D^2 = i - \delta - \gamma i^2 \epsilon^2. \tag{32}$$

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

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

Using the pricing formulae gives firm value as[26]

$$P(t) = E_t \left[\int_t^{\infty} \frac{\xi_2(s)}{\xi_2(t)} D(s) ds \right] = \tilde{E}_t \left[\int_t^{\infty} e^{-r(s-t)} D(s) ds \right] = \frac{D(t)}{r-g}. \tag{33}$$

We thus have the following expression for the dividend yield:

$$y = r - g = \rho + (\gamma - 1) \left(\mu_D - \frac{\gamma}{2} \sigma_D^2 \right), \tag{34}$$

using the equilibrium interest rate formula (21).

The pricing formula (33) reminds us of the Gordon dividend growth model, which is widely taught in the MBA classrooms. Unlike the standard Gordon model, both the interest rate and the risk-adjusted growth rate are endogenous equilibrium quantities. The risk-adjusted dividend growth rate g is lower than the expected dividend growth rate $\mu_D = i - \delta$. This difference $\mu_D - g = \gamma \epsilon^2 i^2$ depends on the degree of risk aversion and firm investment. While we interpret the dividend yield as the difference between r and risk-adjusted dividend growth rate g, we may also write the dividend yield y as $y = (r + \lambda) - \mu_D$, where $(r + \lambda)$ is the total expected rate of return on firm value and μ_D is the expected dividend growth rate.

The next proposition summarizes the main predictions of our model on the dividend yield.

Proposition 4 *The dividend yield decreases (increases) with the degree of investor protection if and only if $\gamma > 1$ ($\gamma < 1$).*

The key step behind Proposition 4 derives from the result that there is more overinvestment and higher growth under weaker investor protection, all else equal, in that

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

Therefore, one immediately notes that the effect of investor protection on the dividend yield depends on the elasticity of intertemporal substitution.[27] First, in the case in which investors have logarithmic utility, the dividend yield is equal to the investors' subjective discount rate ρ, directly implied by (34). This reflects the myopic nature of logarithmic utility investors. From (33), when $\gamma > 1$, the effect of investor protection on the interest rate r is stronger than the effect on the risk-adjusted growth rate g. As a result, the dividend yield decreases with investor protection. This result can also be explained using the properties of consumption. When $\gamma > 1$, the elasticity of intertemporal substitution is less than unity and the income effect is stronger than the substitution effect. The result of lower interest rates associated with better investor protection is to motivate a decrease in current consumption (netting the income and

[26] The first equality in (33) 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 (31) under the risk-neutral probability measure.

[27] The elasticity is equal to the inverse of the coefficient of relative risk aversion.

substitution effects) and thus of the dividend yield.[28] In practice, whether γ is interpreted as the risk aversion coefficient or the inverse of the elasticity of intertemporal substitution, empirical estimates of γ are in general larger than unity.[29] Therefore, with a plausible estimate of $\gamma > 1$, the model predicts a higher dividend yield in countries with weaker investor protection and higher interest rates.

The next proposition gives our main results on equilibrium returns.

Proposition 5 *Expected return inclusive of dividends, return volatility σ_P, and risk premium λ, all decrease in investor protection η and ownership α.*

The intuition behind this proposition is as follows. Weaker investor protection implies increased agency conflicts and gives the controlling shareholder a greater incentive to overinvest, as discussed earlier. The dividend and stock price, which in general equilibrium are shown to be proportional to the aggregate capital stock, not only grow faster, but are also more volatile. The covariation between the stock return (dividend yield plus capital gains) and consumption is thus greater in countries with weaker investor protection. Therefore, weaker investor protection increases the riskiness of the stock to minority investors and thus implies a higher risk premium.[30] A simple way to write the equity risk premium is by noting the relation

$$\lambda = \gamma\sigma_P^2 = \gamma\epsilon^2 i^2 = -\left(-1\right) \times \left(\gamma\epsilon i\right) \times \left(\epsilon i\right) ,$$

where the last equality details the standard argument that the risk premium is given by the minus of the product of the following three items: (i) the instantaneous correlation between the stochastic discount factor and the instantaneous stock return, which is minus unity (only one (aggregate) shock in the model), (ii) the market price of risk (the Sharpe ratio), $\gamma\epsilon i$, and (iii) the volatility of instantaneous stock returns, ϵi.

There is evidence in support of Proposition 5. Hail and Leuz (2004) find that countries with strong securities regulation and enforcement mechanisms exhibit lower levels of cost of capital than countries with weak legal institutions. Daouk, Lee, and Ng (2004) create an index of capital market governance that captures differences in insider trading laws, short-selling restrictions, and earnings opacity. They model excess equity returns using an international capital asset market model that allows for varying degrees of financial integration. Consistent with Proposition 5, they show that improvements in their index of capital market governance are associated with lower equity risk premia.

The cross-country data in Campbell (2003) indicates that civil law countries, those with weaker investor protection, have higher excess equity returns than common law countries. The

[28] Note that in equilibrium $C_2/W_2 = y$.

[29] See Hansen and Singleton (1982), for example.

[30] As indicated in Proposition 4, not all of the excess returns come necessarily from higher capital accumulation (as a result of overinvestment) and subsequent price appreciation. For plausible parameter values ($\gamma > 1$), the dividend yield is also higher under weaker investor protection.

average excess equity return on his sample of common law countries is 4.12%, smaller than the 6.97% average excess equity return on his sample of civil law countries.

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

The minority investors in our model behave much like the investors in a traditional consumption capital asset pricing model augmented to include a production sector. However, minority investors are not the ones choosing the investment-capital ratio, and further, they are faced with too much capital accumulation and demand for savings. These predictions differ from production models in which the minority investors are the ones choosing the capital accumulation path and they can use the investment-capital ratio to smooth out business cycle fluctuations. In these other models, as in the benchmark model described above, the volatility of dividends is smaller and the economy's risk premium is smaller. Hence, our model here generates a higher risk premium than do traditional neoclassical asset pricing models with production such as the CIR (1985) model.

Because firm equity is priced by outside minority investors, the relevant consumption data to feed into the risk premium calculations is that of minority investors and not aggregate consumption. Our approach is thus similar to Mankiw and Zeldes (1991) who focus on consumption data of a smaller sample of stockholders. Relative to Mankiw and Zeldes (1991), our model suggests computing the risk premium directly by working with production (investment) data and avoiding consumer data, which generally produces very noisy estimates. Specifically, our model predicts that for equal risk aversion γ and volatility ϵ parameters, the percentage difference in equity premia between any two countries should be of the same order of magnitude as the percentage difference in squared investment-capital ratios. We pursue two related predictions below in Section 7.

Naturally, the disagreement in valuation between the controlling shareholder and outside minority investors approaches zero as investor protection increases because $q \to q^*$ and $\hat{q} \to q^*$ as $\eta \to \infty$. In the case of perfect investor protection, the controlling shareholder is homogeneous to the minority investors and investment and dividend policies chosen by the former coincide with what the later would do.

Despite the disagreement between minority investors and the controlling shareholder on the firm's market-to-book value under imperfect investor protection, they agree on expected returns. The instantaneous shadow return to the controlling shareholder is

$$\frac{d\hat{P}(t) + (M(t)/\alpha)\ dt}{\hat{P}(t)} = \left(i - \delta + \frac{m}{\alpha \hat{q}}\right) dt + \epsilon i dZ(t) = (\mu_P + y)\, dt + \sigma_P\, dZ(t).$$

Therefore, the instantaneous shadow return is equal to $\mu_P + y$, the expected stock return (including the dividend component) for outside minority investors. Intuitively, the economy grows stochastically on a balanced path. Both the controlling shareholder and outside minority investors share the same marginal valuation.

While we focus here on equity prices and returns and the risk-free rate, our model can be used to price financial securities with any given feature of cash flows, including equity options and futures. This is due to the fact that our model is effectively one of complete markets with an endogenously determined stochastic discount factor.

We now take our model's implications and quantify the economic significance of imperfect investor protection on asset returns and the utility costs.

6 Quantitative Predictions

Our model is quite parsimonious in that it has only seven parameters from both the production and investor sides of the economy. The choice of parameter values is determined in one of two ways. Some parameters are obtained by direct measurements conducted in other studies. These include the risk aversion coefficient γ, the depreciation rate δ, the rate of time preference ρ, and the equity share of the controlling shareholder α. The remaining three parameters (η, ϵ, h) are selected so that the model matches three relevant moments in the data.

6.1 Calibration

We calibrate the model for the United States and South Korea. Starting with the first set of parameters, we choose the coefficient of relative risk aversion to be 5. The depreciation rate is set to an annual value of 0.07, and the subjective discount rate is set to $\rho = 0.01$ based on empirical estimation results such as those reported in Hansen and Singleton (1982). 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 from Dahlquist et al. (2003), to represent the percentage of overall market capitalization that is closely held.

Turning now to the second set of parameters, we calibrate the investor protection parameter η, the volatility parameter ϵ, and the productivity parameter h so that the model matches the following three moments of the data: (*i*) the real interest rate, (*ii*) the standard deviation of stock returns, and (*iii*) the ratio of private benefits to firm equity value. For the U.S. real interest rate, we use 0.9% from Campbell (2003). We use 3.7% for the real interest rate for Korea, which is obtained as the average annual real prime lending rate during 1980-2000 using data from the

World Bank World Development Indicators database. We set the annual standard deviation of stock returns in the US to be at 15.6% from Campbell (2003). For South Korea, we set the annual stock return volatility to be 30%, based on monthly volatility.[31] Finally, the ratio of private benefits to firm equity value (in the model, equal to $(\hat{q} - q)/q$) is taken to be 2% for the U.S. and 15.7% for Korea.[32] The resulting calibrated parameters are $(\epsilon, \eta, h) = (.28, 2510, .081)$ for the U.S. and $(\epsilon, \eta, h) = (.47, 24.3, .115)$ 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 2.5% for Korea –over sixty times higher than that of the U.S. The flow cost of stealing as a fraction of gross output ($\Phi(s, hK)/hK = (1-\alpha)^2/2\eta$) is quite small: 0.02% for the U.S. and 0.8% for Korea. One measure of agency cost that summarizes both the benefit and the cost of stealing for the controlling shareholder is $\psi = (1-\alpha)^2/(2\alpha\eta)$, the net private benefits of control per unit of ownership. For the U.S. and Korea, we have $\psi = 0.2\%$ and $\psi = 2\%$, respectively. The investment-capital ratios obtained in the calibrated model are 7.1% for the U.S. and 8% for Korea, and Tobin's q is 1.01 for the US and 0.95 for Korea.

6.2 Results

We now report numerical results for Tobin's q and the risk premium. Each figure below contains four plots. The top plots contain the results for the U.S. and the bottom plots contain the results for South Korea. The two left plots give the model's comparative statics with respect to the degree of investor protection (reported as changes in the optimal stealing fraction ϕ), whereas the two plots on the right describe the comparative statics with respect to the equity share of the controlling shareholder.

Consider the market valuation of minority investors and the implied market-to-book value. Figure 1 displays the model's comparative statics on $(q^* - q)/q$, the size of the stock market revaluation if moving to an otherwise identical world of perfect investor protection.Figure 1 shows that Tobin's q increases in investor protection as proved in Proposition 3. A sufficiently low stealing fraction (i.e., large η) or large α takes Tobin's q closer to the benchmark case. With our calibrated baseline parameters, the U.S. stock market revaluation of moving to perfect investor protection is 2% and for Korea the revaluation is 15.6%. This confirms that agency conflicts have a significant effect on security prices.

[31] We use the fact that the monthly stock return volatility is about twice larger than that of the U.S. We do not use the annual stock return volatility directly because of data limitation. For example, the annual stock return volatility reported in the Morgan Stanley Capital International (MSCI) country index for Korea is based on only ten years of data.

[32] Dyck and Zingales (2004) estimate that the private benefits as a fraction of firm value are 1.8% 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.

[Figure 1 here.]

Next we quantify the effect of investor protection on the risk premium. Recall that Proposition 5 shows that the benchmark case of perfect investor protection displays a smaller risk premium than the imperfect investor protection case. Here, we investigate the quantitative significance of the mechanism. Figure 2 plots $(\lambda - \lambda^*)/\lambda$ against the stealing fraction (as η changes) and the ownership share α (note that in the two plots on the right, the benchmark level of the risk premium also changes with α). The ratio $(\lambda - \lambda^*)/\lambda$ gives the fraction of the risk premium that is attributed to weak investor protection. The figure indicates that 0.1% of the U.S.'s risk premium is due to weak investor protection, but for South Korea, 1.1% of its equity premium in the stock market is due to low levels of corporate governance. Since our model does not incorporate the controlling shareholders' nonpecuniary incentives to overinvest (such as Jensen's empire building managers), our model thus likely provides a lower estimate on the effect of investor protection on the risk premium. Suppose that the stealing fraction ϕ is 1% in the US, then roughly 2.6% of the U.S. risk premium would be explained by low corporate governance.

[Figure 2 here.]

The objective of this paper is to study the effect of imperfect investor protection on asset pricing and wealth redistribution, we intentionally choose a minimalist approach in setting up the model. Therefore, we construct an investment-based asset pricing model with separation of ownership and control by building on the investor protection literature, with minimal deviation from the classical CIR model. One important and analytically convenient implication of our minimalist approach is that the equilibrium marginal rate of substitution (the stochastic discount factor) is observationally equivalent to the marginal rate of substitution in a representative agent endowment economy (Lucas (1978)). Therefore, the *level* of the risk premium under our proposed baseline calibration is small, though as illustrated above, higher than in the absence of agency conflicts.

So far, we focus on the asset pricing implications of weak investor protection. We next turn to both the aggregate and redistribution effects of weak investor protection for the economy.

6.3 The Cost of Imperfect Investor Protection

The equilibrium in our model is not socially optimal because the controlling shareholder spends resources wastefully in order to pursue his private benefits. The resources spent are not enjoyed by any party in the society and hence constitute a deadweight loss. Moreover, investment is distorted as well. One approach to quantify the net effect of lacking investor protection on the aggregate economy is to use a welfare criterion that weights the utility levels of the controlling shareholder and outside shareholders. However, this welfare approach is rather subjective. We instead calculate how much the controlling shareholder gains from maintaining the status quo and how much outside shareholders are willing to pay for improving investor protection. These two measures jointly quantify the wealth redistribution from outside investors to the controlling shareholders, and do not require us to make any subjective assumptions on welfare weights.

We measure wealth redistribution effects by computing measures of equivalent variations for both outside investors and the controlling shareholders. For minority investors, we ask what fraction of personal wealth is each investor willing to give up for a permanent improvement of investor protection from the current level η to the benchmark (first-best) level of $\eta = \infty$. While the outside investors lose from lacking strong investor protection, the controlling shareholder benefits from imperfect investor protection. For controlling shareholders, we ask what fraction of personal wealth is each controlling shareholder to be paid in order to voluntarily give up the status quo and move to the benchmark level of investor protection $\eta = \infty$.

Let $(1 - \zeta_2)$ denote the fraction of wealth that a minority investor is willing to give up for such a permanent increase in the quality of investor protection. Then, the minority investor is indifferent if and only if the following equality holds:

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

where J_2 is the minority investor's value function and W_0 is some initial wealth level.[33] Since the minority investor's wealth W is proportional to the firm's capital stock K in equilibrium, $(1 - \zeta_2)$ is also the fraction of the capital stock that the minority investors own and are willing to give up in exchange for better investor protection. Using the value function formula given in Section 3, we may calculate the cost of imperfect investor protection in terms of ζ_2 and obtain[34]

$$\zeta_2 = \left(\frac{y}{y^*}\right)^{1/(1-\gamma)} \frac{d}{d^*}. \tag{35}$$

We now turn to the controlling shareholder's perspective. Let $(\zeta_1 - 1)$ denote the additional fraction of wealth that the controlling shareholder needs under perfect investor protection ($\eta = \infty$) in order for him to achieve the same level of utility that he has under the status quo. For any positive initial wealth level W_0, ζ_1 solves

$$J_1^*(\zeta_1 W_0) = J_1(W_0). \tag{36}$$

[33] We use J_2^* to denote the corresponding value function for minority investors under perfect investor protection.

[34] By applying L'Hopital's rule to (35) around $\gamma = 1$, we obtain the formula for ζ_2 for logarithmic utility. With some algebra, it can be verified that

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

Solving for ζ_1 gives[35]

$$\zeta_1 = \left(\frac{y}{y^*}\right)^{-\gamma/(1-\gamma)}. \tag{37}$$

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

Figure 3 plots $(\zeta_1 - 1)$ and $(1 - \zeta_2)$ against various levels of the optimal stealing fraction (which varies as investor protection η varies), holding ownership fixed in each of the two left panels, and plots $(\zeta_1 - 1)$ and $(1 - \zeta_2)$ against the controlling shareholder's ownership α, holding investor protection η fixed in the plots on the right.

The results are quite striking. Minority investors are willing to give up a substantial part of their own wealth for stronger investor protection. This is true even for the U.S. whose minority investors are willing to give up 1% of their wealth to move to perfect investor protection. In Korea, minority investors are willing to give up 10% of their wealth to realize perfect investor protection.

In our model, the controlling shareholder distorts firm value through both outright stealing and overinvestment. The controlling shareholder's incentive to overinvest derives solely from his expectation of higher future private benefits if future firm size is larger. Hence, there would be no overinvestment if there were no stealing. We can nonetheless quantify the separate effects of stealing and overinvestment on the welfare costs of low investor protection for minority investors by decomposing ζ_2 into a component that measures only the investment distortion (by setting the stealing fraction to zero and the investment-capital ratio to that given in (15)), and the residual. Based on this metric, investment distortions alone explain 70% of the utility cost measured by ζ_2 in the U.S. and 25% in Korea. The investment distortion plays a more important role compared to the stealing distortion in the U.S. than in Korea. This difference arises because the equilibrium stealing rate in Korea is much larger than that in the U.S., but the investment rate increases less than proportionally to the equilibrium stealing rate.

These benefits of increasing investor protection are economically large and derive mostly from the fact that investor protection distorts the expected growth rate of the economy. We argue that our model is likely to provide a conservative estimate on the utility cost because we only consider the controlling shareholders' pecuniary components of private benefits. In general, controlling shareholders have a preference for a larger firm, ceteris paribus (Jensen (1986)). The empire building incentive and associated name recognition for the controlling

[35] By applying L'Hopital's rule to (36) around $\gamma = 1$, we obtain the formula for ζ_1 for logarithmic utility:

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

shareholder further distorts the controlling shareholders' capital accumulation decision upward and thus implies a greater utility cost to outside investors.

[Figure 3 here.]

While we show that the utility gain from increasing investor protection is large for outside investors, we do not view policy interventions to improve investor protection as an easy task. This is not surprising, since improving investor protection involves a difficult political reform process that may reduce the benefits of incumbents. Figure 3 shows that this wealth redistribution is significant, with controlling shareholders in the U.S. (Korea) losing about 1.7% (6.2%) of their wealth when moving to the benchmark case of perfect investor protection. Figure 3 also shows that controlling shareholders stand to loose more than minority investors if their equity stake is small, and incentive alignment is weaker along this dimension as well. Moreover, the controlling shareholders are less subject to the collective action problem than outside investors are, because there are fewer controlling shareholders than outside investors and the amount of rents at stake for each controlling shareholder is substantial. Thus, incumbent entrepreneurs and controlling shareholders are often among the most powerful interest groups in the policy making process, particularly in countries with weaker investor protection. It is in the vested interests of controlling shareholders to maintain the status quo, since they enjoy the large private benefits at the cost of outside minority investors and future entrepreneurs.

7 Empirical Evidence

In this section, we further explore the model's implications by testing two new predictions that are unique to our model. Toward that end, it is useful to restate the implications of the model on volatility (see Theorem 1).

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

Specifically, we investigate the predictions that, conditional on exogenous sources of uncertainty (arising from cross-country variation in ϵ), (*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.[36] We further provide comple-

[36] Note that the investment-capital ratio is invariant to a first order with respect to ϵ. Mathematically, the derivative of the investment-capital ratio with respect to ϵ is approximately zero when evaluated at realistically low values of ϵ (i.e., $di/d\epsilon = 0$ at $\epsilon = 0$). This means that our model predicts that if all of the cross-country variation in the highlighted volatility measures comes from variation in ϵ, then we should not be able to detect any association between the volatility measures and the investment-capital ratio, even if we do not control for ϵ in the regressions. Provided we find such an association we can then reasonably conclude that it is not solely due to cross-country variation in ϵ. Intuitively, cross country variation in ϵ in the model 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.

mentary evidence that the impact of investor protection on volatility appears to be subsumed in the investment-capital ratio, especially so in the case of the volatility of stock returns.

7.1 Data

To measure the volatility of GDP growth we use the World Bank's annual real per capita GDP. To measure the volatility of stock returns we use the total monthly return series from MSCI (starting in January of 1970 for some countries). Our sample consists of 44 countries for which an MSCI index exists and the ratio of market capitalization to GDP is at least 10% by the year 2000.[37]

To test our predictions, we estimate a country's long-run average investment-capital ratio using aggregate data. Because the model's capital-GDP ratio is constant, i.e., $dY(t)/Y(t) = dK(t)/K(t)$, we can use the capital accumulation equation (1) to obtain the long-run GDP 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, which we take to be 0.07. Annual real GDP data is obtained from the World Bank World Development Indicators database for the period of 1960 to 2000. Note that the premise of this procedure is that of a constant capital-GDP ratio within a country, but not across countries. Following King and Levine (1994), we estimate the long-run mean GDP growth rate using a weighted average of the country's average GDP growth rate and the world's average GDP growth rate with the weight on world growth equal to 0.75. The weighting of growth rates is meant to account for mean-reversion in growth rates. In spite of the balanced growth path assumption underlying this estimate, King and Levine (1994) show that it produces estimates of investment-capital ratios that match quite well those computed using the perpetual inventory method.

We conduct our tests controlling for several investor protection variables, which we divide into two subsets. The first set measures investor protection rules through the antidirector rights variable introduced in La Porta et al. (1998) (ANTIDIR is higher with better investor protection) and a country's legal origin (DCIVIL= 1 for a civil law country and 0 for a common law country). In the second set of variables, we capture the notion that law enforcement is as important, if not more so, than the rules themselves in constraining opportunistic behavior. These variables describe the efficiency of the judicial system (JUDICIAL), the rule of law (LAW), and government corruption (CORRUPTION).[38] While CORRUPTION does not directly reflect the

[37] The countries (and country abbreviations) are Argentina (ARG), Australia (AUL), Austria (AUT), Belgium (BEL), Brazil (BRA), Canada (CAN), Chile (CHL), China (CHN), Colombia (COL), Denmark (DEN), Egypt (EGY), Finland (FIN), France (FRA), Germany (GER), Greece (GRE), Hong Kong (HK), Hungary (HUN), India (IND), Ireland (IRE), Israel (ISR), Italy (ITA), Japan (JAP), Malaysia (MAL), Mexico (MEX), Morocco (MOR), the Netherlands (NET), New Zealand (NZ), Norway (NOR), Pakistan (PAK), Peru (PER), Philippines (PHI), Poland (POL), Portugal (POR), Singapore (SIN), South Africa (SA), South Korea (KOR), Spain (SPA), Sweden (SWE), Switzerland (SWI), Thailand (THA), Turkey (TUR), UK, USA, and Venezuela (VEN). The variable ANTI-DIR is not available for three countries (Hungary, Morocco, and Poland) and the variable RISKEXP is not available for those three countries plus China.

[38] See La Porta et al. (1998) for a complete description of these variables obtained from the Business Interna-

quality of law enforcement, it is nonetheless related as it pertains to the government's attitude towards the business community. For the enforcement-type variables, a higher score means better investor protection.

In all regressions, we use control variables to account for other exogenous sources of volatility (targeted at capturing cross-country variation in ϵ). As measures of aggregate uncertainty, we use the long-run means of the volatility of inflation (SDINF) and of the volatility of changes in the real exchange rate (SDRER) (see Pindyck and Solimano (1993)).[39] To account for volatility induced by government policies we use the long-run mean share of total government spending in GDP (G/GDP) and an index of outright confiscation or forced nationalization from the Political Risk Services Group (RISKEXP). A high score for RISKEXP means less risk of expropriation. Finally, we control for the initial level of real GDP per capita in logs (GDP1960) and for the degree of openness as given by the 1960 ratio of exports plus imports to GDP (OPEN).

7.2 Results

Figure 4 and Table 1 report the results for the relation between the standard deviation of output growth and the investment-capital ratio. Figure 4 illustrates a positive (unconditional) association as predicted by the model. Table 1 shows that the significance of this association survives the inclusion of control variables. Regression (1) in Table 1 documents the association illustrated in Figure 4 (the coefficient on I/K is 1.319 with a p-value of 0.006). The estimated coefficient implies that 81% of the volatility differential between the U.S. and Korea is due to the different investment-capital ratios in these countries.[40] In regression (2) we add several controls for exogenous sources of volatility. The coefficient on the investment-capital ratio increases slightly to 1.48 and remains significant (p-value of 0.002). Higher SDINF and SDRER are associated with higher volatility of GDP growth, but only the first variable has a significant coefficient (p-value of 0.01). Richer economies in 1960 also display greater volatility (p-value on GDP1960 is 0.085). The effect of the government is mixed. Higher share of spending on GDP lowers variance (perhaps because several rich countries have large governments, and counteracting the effect of GDP1960), but higher risk of expropriation (lower RISKEXP) increases variance.

[Table 1 and Figure 4 here.]

tional Corporation (JUDICIAL) and the International Country Risk Guide of the Political Risk Services Group (LAW and CORRUPTION).

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

[40] The investment-capital ratios in the U.S. and Korea are, respectively, 0.107 and 0.117, and the volatility numbers for these countries are 0.0204 and 0.0377. Hence, $0.81 = 1.319 \times (0.117 - 0.107) / (0.0377 - 0.0204)$.

In regression (3) we regress the volatility of GDP growth on the investment-capital ratio and the enforcement-type variables of investor protection. The investment-capital ratio displays a lower estimated coefficient, but maintains its significance (p-value of 0.075). The investor protection variables are also jointly significant with a p-value of 0.0121. In regression (4) we add the volatility controls to these other independent variables. Both the investment-capital ratio and the investor protection variables are still significant (p-values of 0.002 and 0.056, respectively). The variables SDINF and SDRER are now both significant (p-values of 0.003 and 0.054, respectively) and so are the government variables (p-value on G/GDP is 0.034 and on RISKEXP is 0.003); GDP1960 is no longer significant.

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

In summary, the evidence from Table 1 suggests that the volatility of output growth is strongly associated with the investment-capital ratio, but we cannot reject an independent role for the investor protection variables on output growth volatility (see regressions (3) and (4)).

Figure 5 and Table 2 present the results for the association between the standard deviation of stock returns and the investment-capital ratio. As predicted by the model, Figure 5 illustrates a positive (unconditional) association between these variables. Regression (1) in Table 2 gives the numbers for the statistical association apparent in Figure 5 (slope coefficient of 2.22 and p-value of 0.033). This estimate implies that 31% of the stock return volatility differential between the U.S. and Korea is due to the differential investment-capital ratios in these countries.[41] In regression (2) we add controls for exogenous volatility. The significance of I/K remains (p-value of 0.008) and in contrast to the volatility of output growth, only G/GDP and RISKEXP are significant (p-values of 0.07 and 0.049, respectively).

[Table 2 and Figure 5 here.]

Similarly to the results in Table 1, Table 2 shows that the enforcement variables have more predictive power than the antidirector rights (ANTIDIR) and legal origin (DCIVIL) variables. In regression (3), we combine the enforcement variables with the investment-capital ratio as predictors of the stock return volatility. While the investment-capital ratio loses its significance (p-value of 0.506), the three investor protection variables are still jointly significant (p-value of

[41] The investment to capital ratios in the U.S. and Korea are, respectively, 0.107 and 0.117, and the standard deviations of stock returns for these countries are 0.0447 and 0.1195. Hence, $0.31 = 2.22 \times (0.117 - 0.107)/(0.1195 - 0.0447)$.

0.001). In particular, JUDICIAL (p-value of 0.046) indicates that countries with better investor protection have lower volatility. This is reversed in regression (4) when we add controls for exogenous causes of volatility. The investment-capital ratio is then significant at the 3% level, but the investor protection variables have a joint significance p-value of 0.2042. This suggests that the impact of the investor protection variables occurs through the investment-capital ratio only, as predicted by the model. Of the volatility controls SDINF and RISKEXP are significant (p-values of 0.031 and 0.093, respectively).

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

In summary, the evidence from Table 2 strongly suggests that the variance of stock returns is positively related to the investment-capital ratio and that the impact on volatility of weak investor protection occurs through the investment-capital ratio.

8 Conclusions

Agency conflicts are at the core of modern corporate finance. The large corporate finance literature on investor protection has convincingly documented that corporations in most countries, especially those with weak investor protection, often have controlling shareholders. Controlling shareholders derive private benefits at the cost of outside minority shareholders, which means that firm value varies with investor protection regulations and enforcement.

Motivated by this vast literature, we construct a dynamic stochastic general equilibrium model in which the controlling shareholder makes all corporate decisions in his own interest and outside investors rationally formulate their asset allocation and consumption-saving decisions in a competitive way. Despite the heterogeneity between the controlling shareholder and outside investors, we are able to characterize the equilibrium in closed form. We show that the modeled agency conflicts lead to distorted corporate investment and payout policies, which in turn affect asset prices. In equilibrium, however, asset prices affect the ability of the controlling shareholder to smooth consumption and thereby affect corporate investment decisions. This differentiates our work from other asset pricing models based on endowment or production economies and homogeneous investors.

The model allows us to conveniently derive theoretical predictions on asset prices and returns. Among others, our model predicts that countries with weaker investor protection have lower firm value as measured by Tobin's q, a lower dividend payout ratio, more volatile stock returns, higher equilibrium interest rates, larger equity premia, and, for reasonable values of risk aversion, a larger dividend yield. We show that improving investor protection entails a significant wealth redistribution between insiders and outside investors. We also test two new model predictions that relate the volatility of GDP growth and the volatility of stock returns to the economy's investment-capital ratio, even after controlling for measures of investor protection.

In order to focus on how investor protection affects equilibrium asset prices and returns, we choose to study asset pricing for each country in isolation. Motivated by the empirical observation that currencies in countries with weaker investor protection experienced larger depreciations during the East Asian financial crisis, Albuquerque and Wang (2004) generalize the current setup to a two-country world with shocks to total productivity and shocks to the efficiency of new investment goods. They model these shocks as stationary regime switching processes to analyze the business cycle properties of asset prices including the exchange rate. Albuquerque and Wang (2004) show that investor protection has an economically significant effect on the equilibrium exchange rate that can explain the observed large depreciation of currencies in countries with weak investor protection.

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

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 and real investment and positive dividends, respectively. Assumption 5 gives rise to finite and positive Tobin's q and dividend yield. While we describe the intuition behind these assumptions, obviously we cannot take the intuition and implications of these assumptions in isolation. These assumptions jointly ensure that the equilibrium exists with positive and finite net private benefits, investment rate, dividend, and Tobin's q.

Proof of Theorem 1. The first-order condition (23) gives

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

where $m = M/K$ and $i = I/K$ are the controlling shareholder's equilibrium consumption-capital ratio, and the firm's investment-capital ratio, respectively. Plugging the stealing function into (7) 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 d is the dividend-capital ratio. Plugging (A.1) and (A.2) into the HJB equation (22) gives

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

The above equality implies the following relation:

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

where y is the dividend yield and is given by

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

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

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

This inequality will be used in proving the propositions.

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

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

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

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

where

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

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

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

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

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

We also solve for the value function coefficient A_1 and obtain

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

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

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

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

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

$$\begin{aligned} E\left(e^{-\rho T}K(T)^{1-\gamma}\right) &= E\left[e^{-\rho T}K_0^{1-\gamma}\exp\left((1-\gamma)\left(\left(i-\delta-\frac{\epsilon^2 i^2}{2}\right)T+\epsilon i Z(T)\right)\right)\right] \\ &= e^{-\rho T}K_0^{1-\gamma}\exp\left[(1-\gamma)\left(i-\delta-\frac{\epsilon^2 i^2}{2}+\frac{1-\gamma}{2}\epsilon^2 i^2\right)T\right]. \qquad \text{(A.11)} \end{aligned}$$

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

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

$$\lim_{T\to\infty} E\left(e^{-\rho T}|J_2(W(T))|\right) = 0\,. \qquad \text{(A.12)}$$

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

$$\begin{aligned} J_2(W_0) &= E\left[\int_0^\infty e^{-\rho t}\frac{1}{1-\gamma}\left([(1-\alpha)\,dK(t)]^{1-\gamma}-1\right)dt\right] \\ &= \frac{1}{1-\gamma}\left([(1-\alpha)\,dK_0]^{1-\gamma}\frac{1}{y}-\frac{1}{\rho}\right) = \frac{1}{1-\gamma}\left(W_0^{1-\gamma}\frac{1}{y^\gamma}-\frac{1}{\rho}\right), \qquad \text{(A.13)} \end{aligned}$$

where the second line uses (.1). Thus, the value function coefficient A_2 is given by $A_2 = 1/y^\gamma$. In Section 6.3, we use the explicit formula for the minority investor's value function $J_2(W_0)$ to calculate the utility cost of imperfect investor protection.

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

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

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

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

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

Using the definitions of $\xi_2(t) = e^{-\rho t} C_2(t)^{-\gamma} = e^{-\rho t}(yW_2(t))^{-\gamma}$, $D(t)/K(t) = d$, and $W_2(t)/K(t) = (1-\alpha)q$, we rewrite $P(t)$ as

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

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

Therefore, Tobin's q is given by

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

where the first equality uses (A.9), the second equality uses (14), and the third follows from simplification.

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

Proof of the Free Rider Argument in Section 3.3. We elaborate on the details of how our free rider argument gives rise to a constant ownership structure over time. We use $J_1(K;\alpha)$ to denote the explicit dependence of the controlling shareholder's value function on his ownership α. Using the envelope theorem, we have

$$\frac{d}{d\alpha} J_1(K;\alpha) = E \left[\int_t^\infty e^{-\rho(s-t)} M(s)^{-\gamma} D(s) \, ds \middle| K(t) = K \right] = A_1 K^{1-\gamma} \frac{d}{m} \ , \qquad \text{(A.14)}$$

where the last equality uses the functional form of the value function. The derivative in (A.14) describes the increase in the controlling shareholder's lifetime utility due to a marginal increase of his ownership. This is not his monetary valuation because the controlling shareholder is risk-averse ($\gamma > 0$). To derive his monetary valuation, or willingness to pay, we first note that in equilibrium, the controlling shareholder's stock market wealth is proportional to the firm's capital stock, in that $W = \alpha \hat{q} K$, where $\hat{q}$ is the controlling shareholder's shadow Tobin's q given in Section 5. Using the chain rule, we thus have

$$\frac{d}{dK} J_1(K;\alpha) = \alpha \hat{q} \frac{d}{dW} J_1 \left(\frac{W}{\alpha \hat{q}}; \alpha \right) = \alpha \hat{q} \frac{d}{dW} J_1(K;\alpha) \, .$$

Dividing $dJ_1/d\alpha$ by the marginal value function $dJ_1(W)/dW$ gives the controlling shareholder's willingness to pay for the incremental unit of the newly acquired shares:

$$\frac{\frac{d}{d\alpha} J_1(K;\alpha)}{\frac{d}{dW} J_1 \left(\frac{W}{\alpha \hat{q}}; \alpha \right)} = \frac{A_1 K^{1-\gamma} \frac{d}{m}}{\frac{1}{\alpha \hat{q}} A_1 \left(\frac{W}{\alpha \hat{q}} \right)^{-\gamma}} = \alpha \hat{q} \frac{d}{m} K = qK = P_\alpha,$$

where the penultimate equality uses the relation between Tobin's q and $\hat{q}$ (see (A.9)) and P_α is the time-t price per share set by minority shareholders. Note that $\hat{P}_\alpha$ as given in Section 5 represents the value of the *existing* shares for the controlling shareholder and is different from his willingness to pay as given by P_α when acquiring *additional* shares.

The free rider problem is now apparent. If the equilibrium is for all minority shareholders to sell at P_α, then by deviating from this equilibrium, an infinitesimal investor can gain because trading with other minority investors after the trade with the controlling shareholder has taken place yields a higher valuation $P_{\alpha'}$. This higher valuation results from a higher q due to a higher equity share of the controlling shareholder (see Proposition 3). Finally, note that selling by the controlling shareholder for consumption does not occur in equilibrium either. This is because the controlling shareholder would only sell at price P_α, but the minority investors, anticipating higher extraction of private benefits, would be willing to pay less than P_α. ∎

Proof of Proposition 1. Define

$$f(x) = \frac{\gamma(\gamma+1)}{2}\epsilon^2 x^2 - \left[1 + (1+\psi) h\epsilon^2\right]\gamma x + (1+\psi) h - \rho - \delta(1-\gamma). \tag{A.15}$$

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

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

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. Differentiate (21) 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 $(1+\psi)\,h-(\gamma+1)\left((1-\gamma)\,\delta+\rho\right)<0$; otherwise, it holds for sufficiently low ϵ, h, or ψ. ■

Proof of Proposition 3. We prove the proposition for investor protection. The case for the equity share of the controlling shareholder is then immediate. Use the expression for the dividend yield in (34) to express Tobin's q as the ratio between the dividend-capital ratio d and the dividend yield y. Differentiating $\log q$ with respect to investor protection gives:

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

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

Proof of Proposition 4. Differentiate the dividend yield with respect to ψ to obtain:

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

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

Proof of Proposition 5. Weaker investor protection or lower share of equity held by the controlling shareholder both lead to a higher agency cost parameter ψ. Proposition 1 shows that a higher ψ leads to more investment and hence both higher volatility of stock returns $\sigma_P^2=\epsilon^2 i^2$ and higher expected excess returns $\lambda=\gamma\sigma_P^2$. To see the effect of investor protection on total expected equity returns, we note that

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

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

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

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

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

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

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

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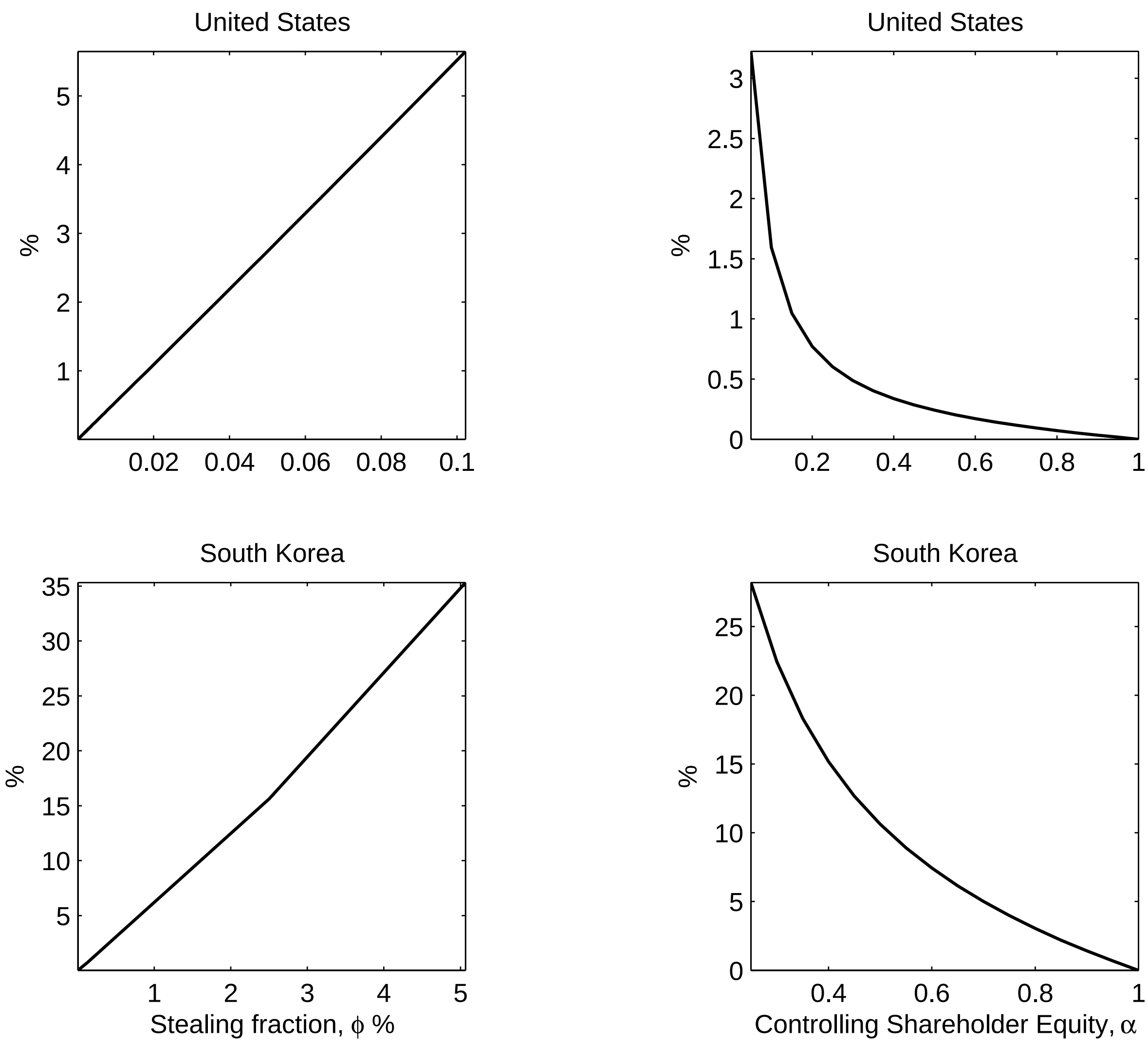

Figure 1: Stock market revaluation when moving to perfect investor protection, as measured by Tobin's q in percent, $100 \times (q^* - q)/q$.

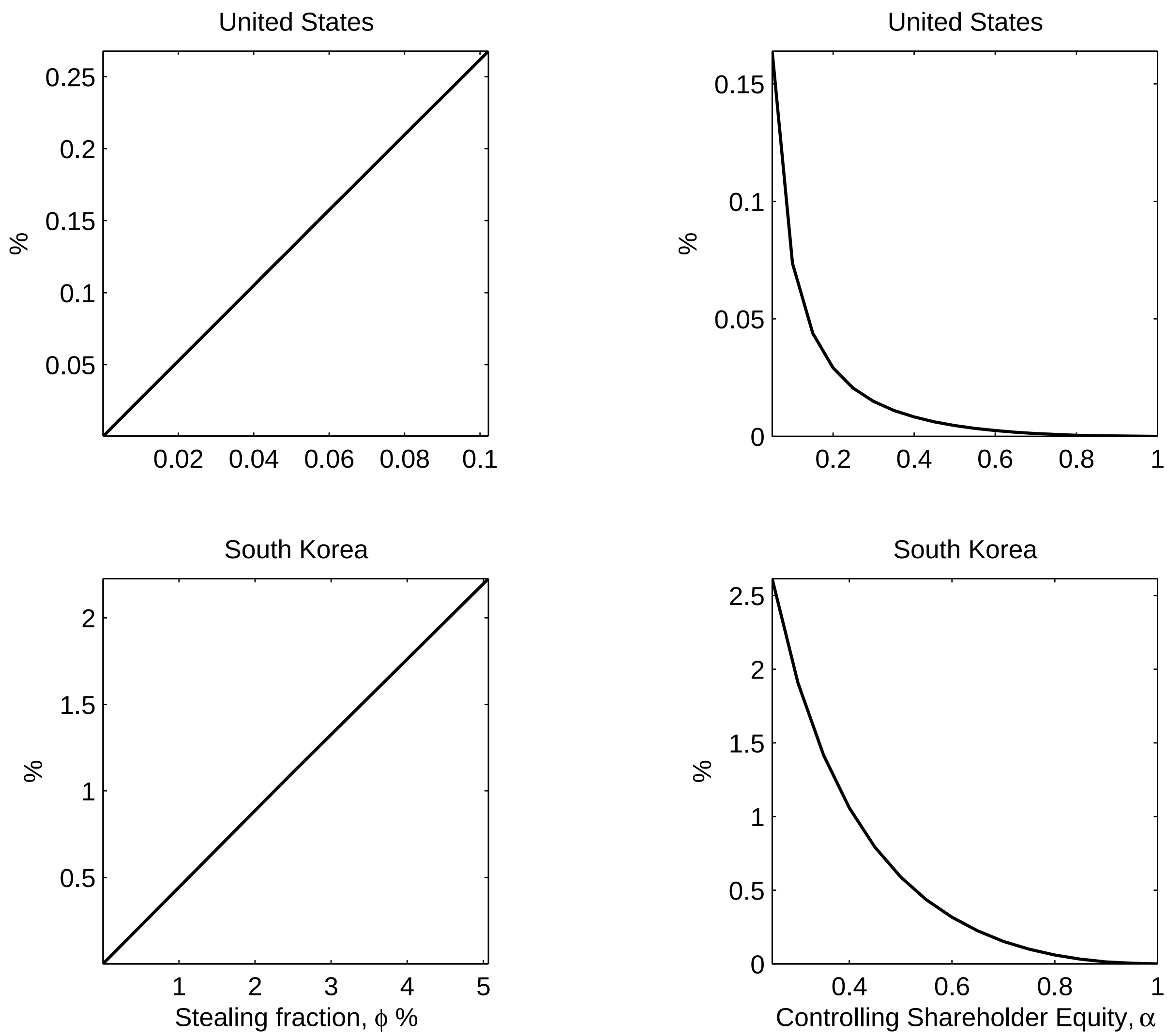

Figure 2: Fraction of the risk premium that is due to weak investor protection in percent, $100 \times (\lambda - \lambda^{*}) / \lambda$.

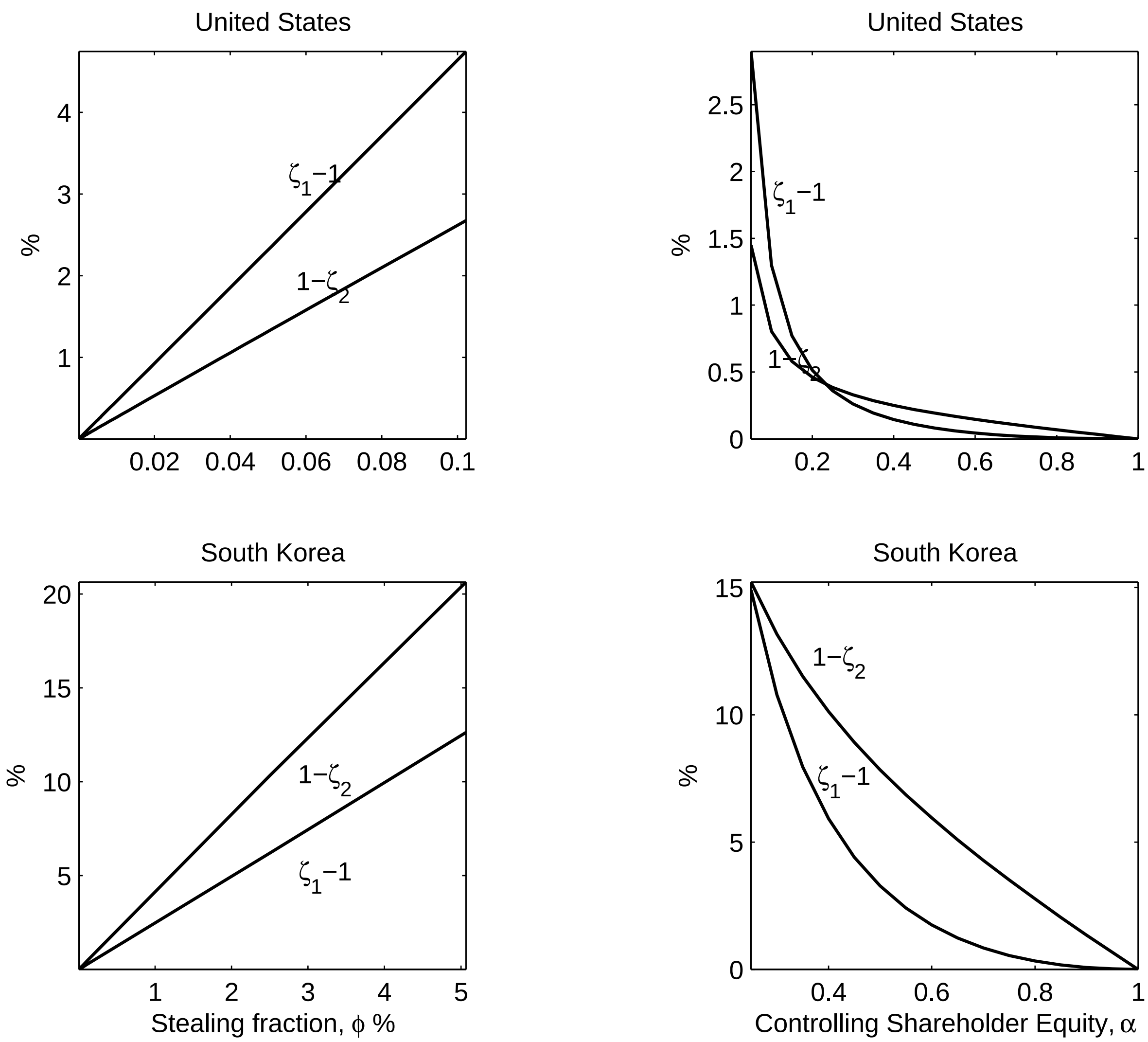

Figure 3: Utility cost of imperfect investor protection for minority investors $(1-\zeta_2)$ and utility benefit of controlling shareholders (ζ_1-1), expressed as percentage of own wealth, respectively.

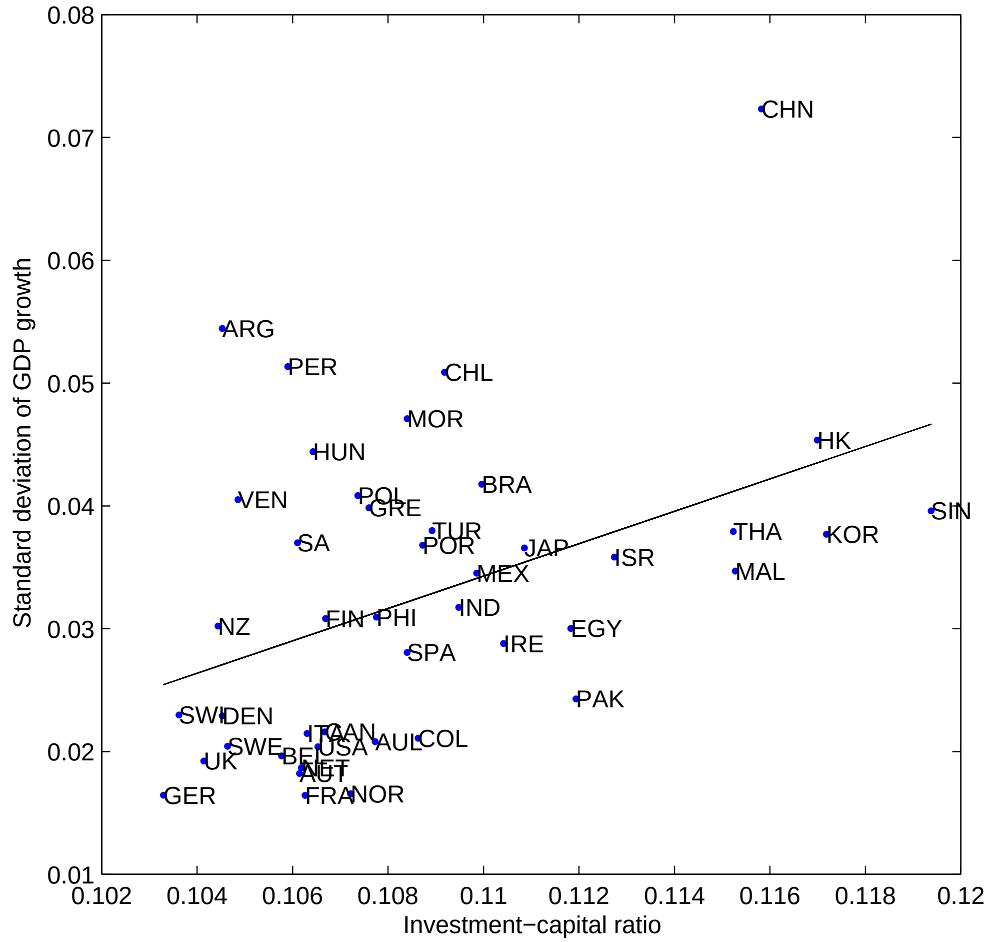

Figure 4: Scatter plot and linear fit of the volatility of GDP growth on the investment-capital ratio across countries. See main text for country abbreviations.

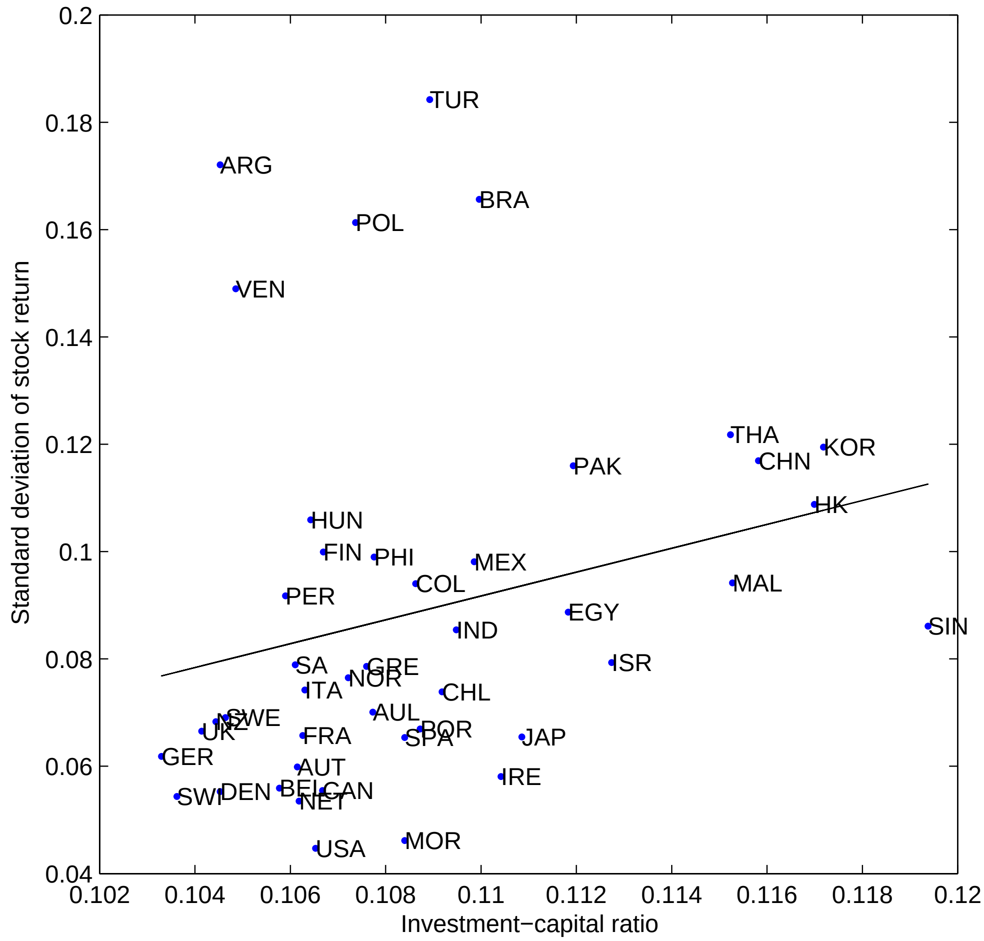

Figure 5: Scatter plot and linear fit of the volatility of stock returns on the investment-capital ratio across countries. See main text for country abbreviations.

Table 1

Ordinary Least Squares Regressions: Standard Deviation of Real GDP Growth

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
I/K	1.319	1.480	0.771	1.691	1.102	1.480
	0.006	0.002	0.075	0.002	0.001	0.001
CORRUPTION			0.001	0.004		
			0.744	0.028		
JUDICIAL			-0.001	-0.000		
			0.134	0.968		
LAW			-0.002	0.003		
			0.348	0.263		
ANTIDIR					0.002	0.001
					0.111	0.300
DCIVIL					0.008	-0.001
					0.043	0.719
SDINF		0.001		0.001		0.001
		0.010		0.003		0.059
SDRER		0.0314		0.058		0.056
		0.344		0.054		0.145
G/GDP		-0.055		-0.004		-0.051
		0.014		0.034		0.025
RISKEXP		-0.004		-0.006		-0.004
		0.031		0.003		0.033
OPEN		-0.001		-0.004		-0.001
		0.467		0.120		0.449
GDP1960		0.009		0.003		0.010
		0.085		0.695		0.093
Intercept	-0.111	-0.128	-0.036	-0.137	-0.101	-0.134
	0.032	0.030	0.489	0.042	0.004	0.019
Number of Obs.	44	40	40	40	40	40
Adjusted R^2	0.164	0.632	0.258	0.673	0.191	0.630
Joint Test			0.012	0.056	0.121	0.236

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

Table 2

Ordinary Least Squares Regressions: Standard Deviation of Stock Returns

Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
I/K	2.222	2.958	0.771	2.828	2.898	2.995
	0.033	0.008	0.506	0.031	0.008	0.010
CORRUPTION			-0.006	-0.001		
			0.366	0.908		
JUDICIAL			-0.008	-0.005		
			0.046	0.243		
LAW			0.0001	0.009		
			0.983	0.140		
ANTIDIR					-0.002	-0.005
					0.632	0.182
DCIVIL					0.015	-0.007
					0.072	0.441
SDINF		0.0002		0.001		0.001
		0.961		0.031		0.798
SDRER		0.175		0.155		0.119
		0.145		0.250		0.467
G/GDP		-0.141		-0.089		-0.184
		0.070		0.273		0.054
RISKEXP		-0.011		-0.013		-0.012
		0.049		0.093		0.046
OPEN		-0.104		-0.0053		-0.011
		0.200		0.543		0.171
GDP1960		0.014		0.012		0.016
		0.307		0.584		0.267
Intercept	-0.153	-0.181	0.090	-0.148	-0.232	-0.156
	0.177	0.183	0.526	0.349	0.037	0.258
Number of Obs.	44	40	40	40	40	40
Adjusted R^2	0.041	0.444	0.391	0.456	0.066	0.447
Joint Test			0.001	0.204	0.100	0.388

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