Agency Conflicts, Investment and Asset Pricing

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Motivation

- The separation of ownership and control gives power to the controlling shareholders to extract private benefit from the firm.
- Regulation only mitigates the problem without solving it
- Cross country analysis shows that less regulated countries have more volatile GDP growth and more volatile market returns

The model: basic ingredients and intuition

- Two type of agents: insider (or controlling) shareholders who own α shares of the firm and minority investors who own $1-\alpha$ shares. They have the same preferences and they are both risk averse. Horizon is infinite.
- The shock driving the result is not the classical TFP, but it is an investment specific shock a la Greenwood et al.
- **TRADE-OFF FOR THE INSIDER:** Incremental investment
  - subject to shocks $\Rightarrow$ the insider's value function will lower ceteris paribus
  - firm's size increases $\Rightarrow$ insider can steal more

.

The model: technology

$$dK(t) = (I(t) - \delta K(t))dt + \epsilon I(t)dZ(t) \quad (1)$$

$$I(t) = (1 - s(t))hK(t) - D(t) \quad (2)$$

Discrete time analogous

$$K_{t+1} = (1 - \delta)K_t + (1 - \epsilon(Z_{t+1} - Z_t))I_t \quad (3)$$

$$I_t = (1 - s_t)hK_t - D_t \quad (4)$$

$$(Z_{t+1} - Z_t) \sim N(0, 1)$$

Insider's problem

- Utility function $E[\int_0^\infty e^{-\rho t} u(C_1(t))dt)]$
- He can only invest in a risk-free asset, $B_1(t) = W_1(t)$
- Evolution of wealth

$$
\begin{aligned}
dW_1(t) &= [r(t)W_1(t) + M(t) - C_1(t)]dt \qquad (5) \\
M(t) &= \alpha D(t) + s(t)hK(t) - \Phi(s(t), hK(t))) \\
\Phi(s(t), hK(t))) &= \frac{\eta}{2} s(t)^2 hK(t) \qquad \textit{(cost of stealing)}
\end{aligned}
$$

- η measures the degree of investor protection, $\eta \in [0, \infty]$
- Choice variables $\{C_1(t), s(t), I(t), K(t), D(t), W_1(t) : t \geq 0\}$
- Equilibrium interest rate process as given

Capital, Dividends and Prices

- The choice of $D(t)$ and $K(t)$ by the insider will also determines the drift and volatility coefficients for the dividend and capital processes:

$$dD(t) = \mu_D(t)D(t)dt + \sigma_D(t)D(t)dZ(t) \tag{6}$$
$$dK(t) = \mu_K(t)K(t)dt + \sigma_K(t)K(t)dZ(t) \tag{7}$$

- Minority investors are the ones who price assets in equilibrium, the equilibrium price is:

$$dP(t) = \mu_P(t)P(t)dt + \sigma_P(t)P(t)dZ(t) \tag{8}$$

Minority investor's problem

- $w(t)$ is the fraction of wealth invested in firm's stock
- Evolution of wealth

$$
\begin{aligned}
dW_2(t) &= \Big[r(t)(1-w(t))W_2(t) - C_2(t) + \big(\mu_P(t) + \frac{D(t)}{P(t)}\big)w(t)W_2(t)\Big]dt \\
&\quad +\sigma_P(t)w(t)W_2(t)dZ(t) \\
\lambda(t) &= \mu_P(t) + \frac{D(t)}{P(t)} - r(t) \qquad \textit{(excess return)}
\end{aligned}
$$

- Choice variables $\{C_2(t), W_2(t), w_2(t) : t \geq 0\}$
- Equilibrium interest rate, dividend and stock price processes as given

Equilibrium

An equilibrium for this environment has the following properties:

1. $\{C_1(t), s(t), I(t), K(t), D(t), W_1(t) : t \geq 0\}$ solves the insider's problem given r
2. $\{C_2(t), W_2(t), w_2(t) : t \geq 0\}$ solves minority shareholder problem given r, dividend payout and stock price
3. the bond market clears
4. the stock market clears $(1 - \alpha) = w(t)\frac{W_2(t)}{P(t)}$ for all t
5. the consumption goods market clears $C_1(t) + C_2(t) + I(t) = hK(t) - \Phi(s(t), hK(t))$

Characterization of the Equilibrium

1. Only stocks are held in equilibrium
2. stealing fraction is constant $s(t) = \phi = \frac{1-\alpha}{\eta}$
3. $\frac{C_1(t)}{K(t)} = \frac{M(t)}{K(t)} = \alpha[(1+\psi)h - 1] > 0$
4. $\frac{I(t)}{K(t)} = i > 0 \qquad \frac{D(t)}{K(t)} = d = (1-\phi)h - i > 0$
5. ψ is a measure of agency costs given by $\psi = \frac{(1-\alpha)^2}{2\alpha\eta}$
6. the process for price, capital and dividend are the same, they have drift $i - \delta$ and volatility $i\epsilon$
7. $\frac{P(t)}{K(t)} = q = (1 + \frac{1-\alpha^2}{2\eta\alpha d} h)^{-1} \frac{1}{1-\gamma\epsilon^2 i} > 1$
8. $r = \rho + \gamma\mu_D - \frac{\sigma_D^2}{2}\gamma(\gamma+1) \qquad \lambda = \gamma\sigma_P^2 = \gamma\epsilon^2 i$

Benchmark: Perfect Investor Protection

- if $\eta \neq \infty$ then the equilibrium investment-capital ratio will always be bigger than i^*
- $q^* = \frac{1}{1-\gamma\epsilon^2 i}$, in the deterministic case $\epsilon = 0$ hence $q^* = 1$
- if there is a shock to investment: $q > 1$. Hence the value of installed capital is larger than the value of to-be-installed capital. Remember: investors are risk averse
- the consumption streams of the two types in the economy are equal to their entitled dividends

Equilibrium Asset Returns

- The equilibrium investment-capital ratio i decreases with investor protection η and the insider's cash flow rights
- Interest rate in an economy with imperfect investor protection higher if and only if $1 > \epsilon^2(\gamma + 1)i$
- Tobin's q increases with investor protection and with α
- The dividend yield increases with the degree of investor protection if and only if the agents are risk averse
- Expected returns including dividends, return volatility and risk premium all decrease if investor protection increases

Investment-capital ratio and $\sigma(\Delta GDP)$

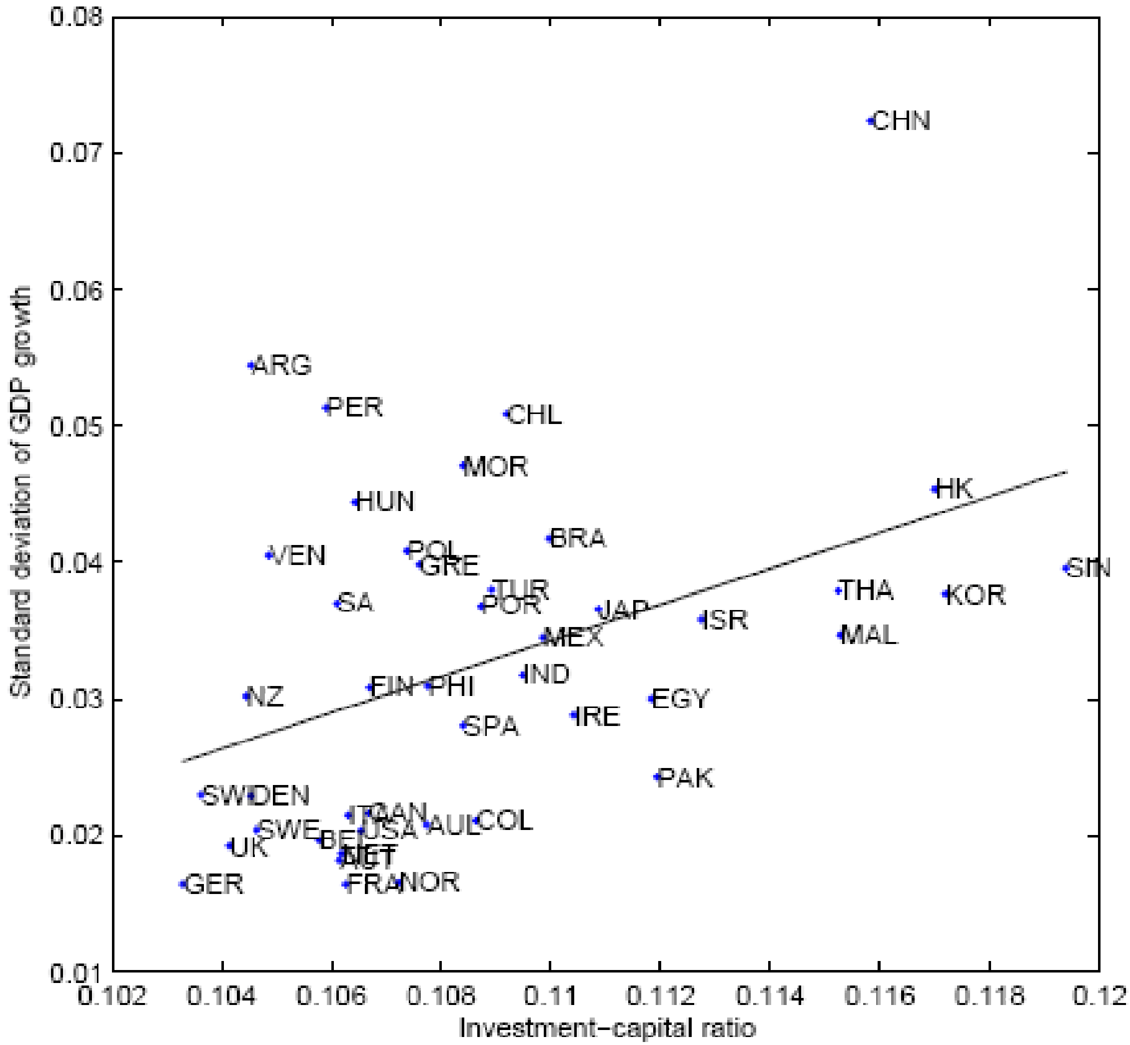

Figure 4: Scatter plot and linear fit of the volatility of GDP growth on the investment-capital ratio across countries. See main text for country abbreviations.

Investment-capital ratio and σ(Stock Returns)

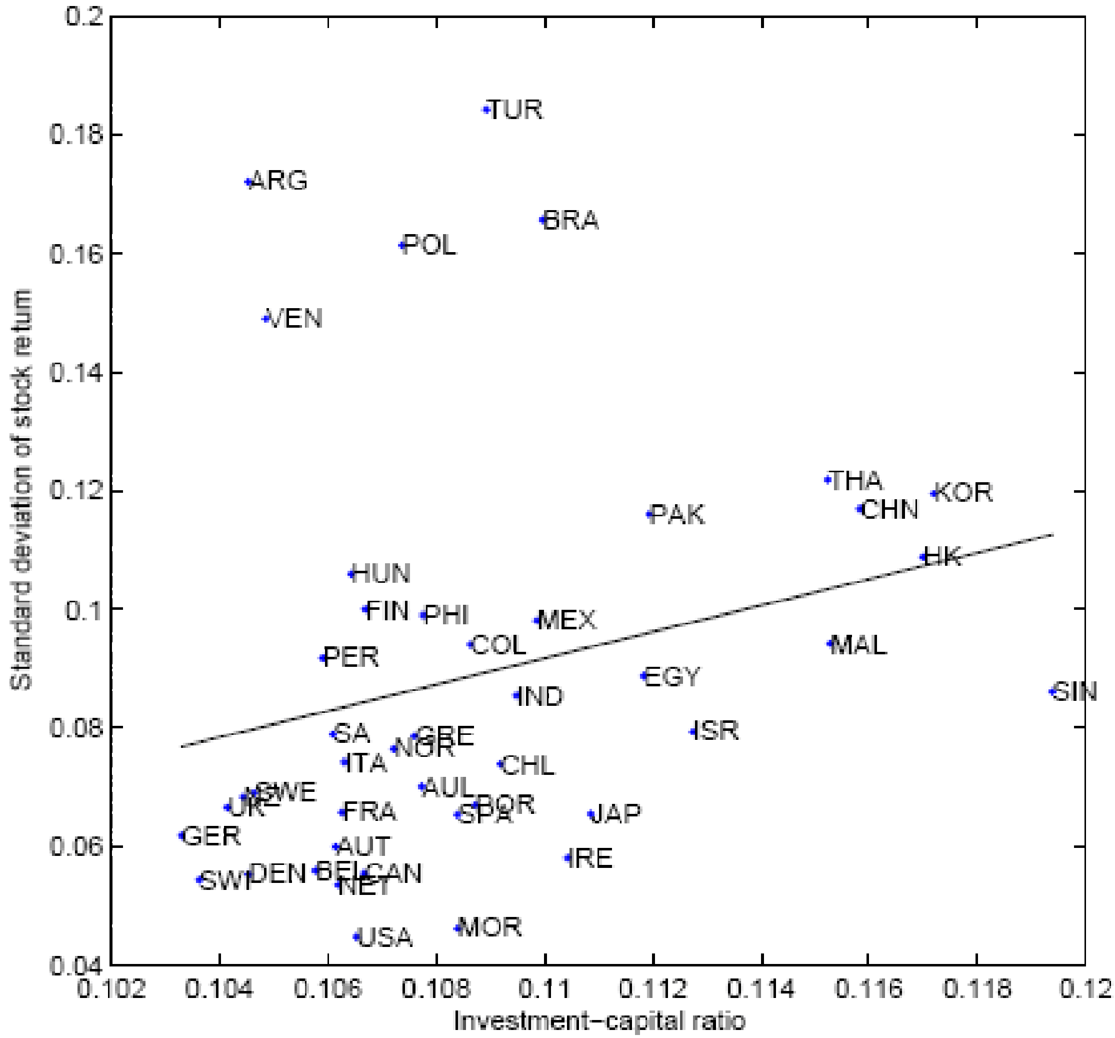

Figure 5: Scatter plot and linear fit of the volatility of stock returns on the investment-capital ratio across countries. See main text for country abbreviations.

Calibration

$\{\eta, \epsilon, h\}$ are estimated to match US and Korea data: real interest rate, standard deviation of stock returns and the ratio of private benefit to firm equity value.

	US	KOREA
α	0.08	0.39
ρ	0.01	0.01
γ	5	5
δ	0.07	0.07
η	2510	24.3
ϵ	.28	.47
h	.081	.115
r	0.9%	3.8%

Implied stealing: $\phi_{US} = 0.04\%$ $\phi_{Korea} = 2.5\%$
Implied agency costs: $\psi_{US} = 0.2\%$ $\psi_{Korea} = 2\%$

Risk Premium and Investor Protection

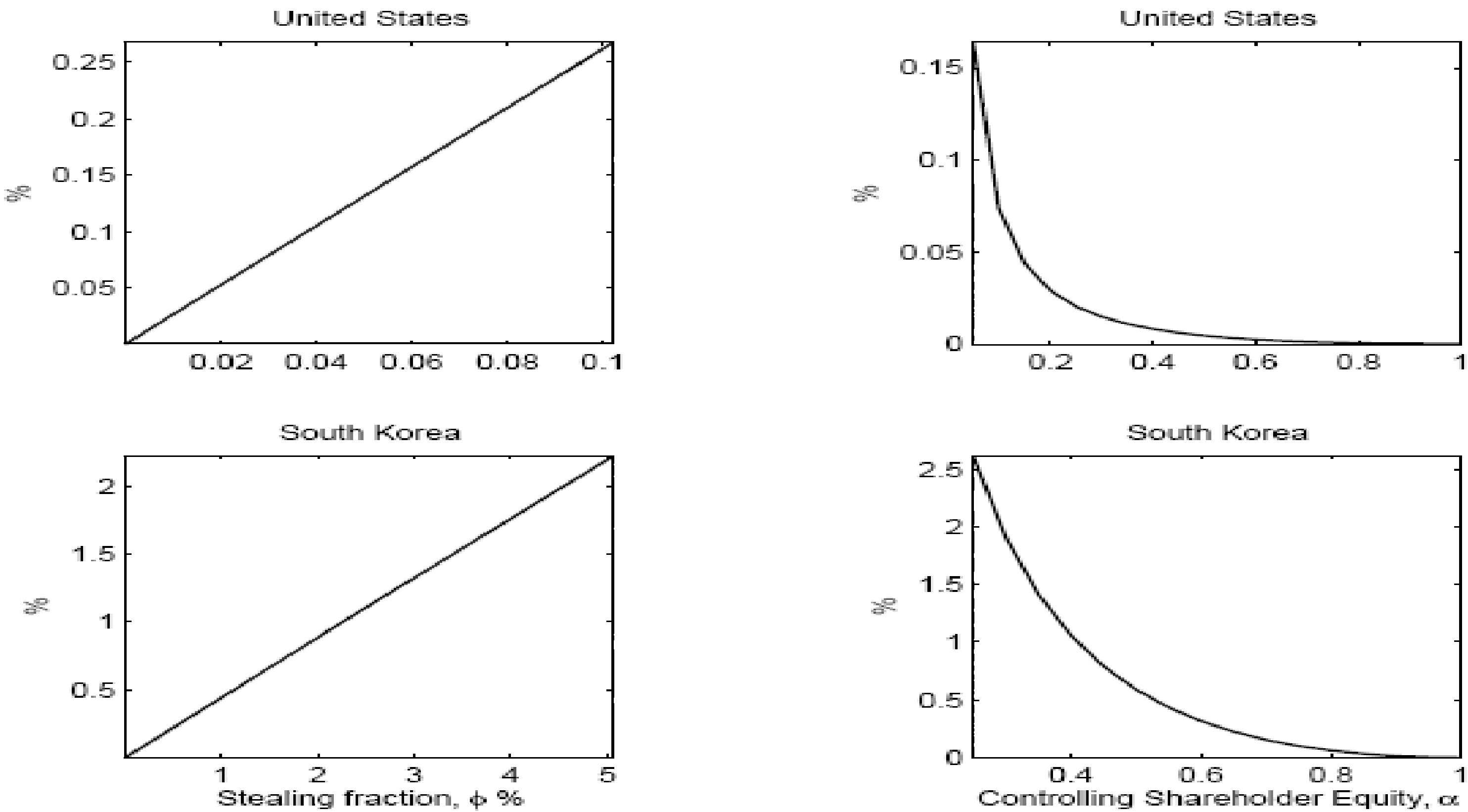

Figure 2: Fraction of the risk premium that is due to weak investor protection in percent, $100 \times (\lambda - \lambda^*)/\lambda$.

Solution Method

All variables proportional to capital stock, even if we have heterogeneous agents we do not need to keep track of the wealth distribution in the economy

Guess a constant interest rate and that insider has zero risk-free asset $\Rightarrow C_1(t) = M(t)$ and $J_1(K_0) = \max_{D,s} E[\int_0^\infty e^{-\rho t} u(M_1(t))dt)]$, then the HJB is:

$$0 = \sup_{D,s} \left\{ \frac{1}{1-\gamma}(M^{1-\gamma} - 1) - \rho J_1(K) + (1 - \delta K) J_1'(K) + \frac{\epsilon^2}{2} I^2 J_1''(K) \right\} \quad (9)$$

FOCs w.r.t D and s

$$\overbrace{M^{-\gamma}\alpha - \epsilon^2 I J_1''(K)}^{\text{M.B. of investment}} = \overbrace{J_1'(K)}^{\text{M.C . of investment}} \quad (10)$$

$$M^{-\gamma}(hK - \eta s h K) - \epsilon^2 I J_1''(K) hk = J_1'(K) hK \quad (11)$$

Then verify that consumption rule and equilibrium interest rate are consistent with zero risk-free asset holding

Solution Method

For the minority shareholders conjecture that risk free interest rate is constant, risk premium is constant and bond holding is zero. Verify that they optimally do not hold bond for the same constant interest rate implied by the insider problem. Then construct a price process such that equity trading among minority shareholders is an equilibrium and the risk premium is constant