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INSTITUTIONAL WEAKNESS AND STOCK PRICE VOLATILITY

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ABSTRACT

We find an empirical regularity that stronger creditor protection reduces the volatility of stock market prices. We analyze two distinct mechanisms that characterize equity price volatility: government guarantees and creditor protection. Using a Tobin q model, we demonstrate that weak creditor protection that gives rise to government guarantees and tightens credit constraints, increases stock price volatility. Empirically, accounting for the probability of financial crises, we find that government guarantees and weak institutions that tighten credit constraints increase aggregated stock price volatility.

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1 Introduction

The paper addresses links between cross-country differences in institutional strength and macroeconomic performance. Specifically, we ask how creditor protection and government guarantees affect the volatility of stock market prices.

A series of works have studied the impact of creditor protection on the firm's external finance availability. La Porta et. al. (1997) examine a sample of 49 countries and find that countries with poor creditor protection have, on average, smaller debt markets. Levine (2004) confirms these findings after including a variety of additional control variables. Djankov, McLiesh, and Shleifer (2005) expand the external finance volatility analysis to 129 countries. Again, they find that creditor protection is associated with higher ratio of private credit to GDP. Better creditor protection has also been shown to lower the firm's borrowing cost. La Porta et al. (2000) find that the cost of capital is higher, and the firm valuation lower, in countries with weak property rights. Bae and Goyal (2003) use data from 37 countries to examine how creditor rights affect loan spreads (over the LIBOR or the prime rate) in international bank loans. They find that banks charge higher loan spreads when property rights are weak.

Creditor protection affects also other aspects of the economy. Nenova et al. (2000) analyze more than 11,000 firms in 46 countries and find that stronger creditor rights reduce the cash-flow risk, operating income variability, and the operating leverage. Galindo (2001) studies the impact of creditor rights on the credit cycle. He finds that creditor rights play an important role, by exacerbating credit risk in countries where creditor rights are weakly protected, and hence inducing an over-reaction of credit markets to exogenous shocks. Burger and Warnock (2004) examine foreign participation in 49 local bond markets, and find that countries with strong creditor rights have on average more developed local bond markets, and they also rely less on foreign-currency-denominated bonds. Moreover, more developed bond markets have a distribution of returns characterized by high variance and negative skewness, factors eschewed by U.S. investors. Shleifer (2003) further argues that for sovereign debt market to survive, the rights of creditors need to be protected effectively.

However, most of these studies focus on the credit market and much less on the stock market. In this paper, we try to fill a gap by looking at how creditor rights and government guarantees affect the stock return volatility for market aggregates. As a theoretical rationale behind the empirical link between institutional features and asset price volatility, we analyze two distinct mechanisms. First, we consider government guarantees that lead to moral hazard. Such moral hazard may increase stock price volatility. Second, we argue that creditor protection that may relax credit constraints is also associated with equity price volatility, and the institutional weakness in the credit market exacerbates the volatility. There have been earlier studies on how corporate control affects the dispersion of stock prices with a market. For example, Morck, Yeung and Yu (2000) look at the stock price co-movement within a country. They find that co-movement is more pronounced in poor economies than in rich economies, which they contribute to cross-country differences in property rights. Our work is not concerned with the idiosyncratic dispersion of stock prices, but rather with the instability in the aggregate. We expect that better creditor protection could reduce market volatility.

The paper is organized as follows. Section 2 examines empirical regularities associated with the link between creditor rights and stock market volatility. Section 3 analyzes two candidate mechanisms behind the empirical regularities: government guarantees and institutional features which affect credit constraints. Section 4 attempts to empirically separate these two mechanisms in the data. Section 5 concludes.

2 Empirical Regularities

2.1 Data

In this section, we look at the correlation between creditor rights, stock price volatility and credit growth volatility . Our creditor protection index comes from La Porta, et al. (1998).[1] The creditor rights index ranges from 0 to 4 and is formed by adding one when the country imposes restrictions, such as creditor consent or minimum dividends to file for reorganization. In addition when secured creditors are able to gain possession of their security once the reorganization petition has been approved (no automatic stay); secured creditors are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and the debtor does not retain the administration of its property pending the resolution of the reorganization. Therefore, higher creditor rights index is associated with better protection for creditors.

In some analysis we also use the index of shareholder rights from La Porta et al. (2000). This index ranges from zero to six and is formed by adding one when: the country allows shareholders to mail their proxy vote to the firm; shareholders are not required to deposit their shares prior to the General Shareholders Meeting; cumulative voting or proportional representation of minorities in the board of directors is allowed;

[1] See http://post.economics.harvard.edu/faculty/shleifer/Data/l&fweb.xls

an oppressed minorities mechanism is in place; the minimum percentage of share capital that entitles a shareholder to call for an Extraordinary Shareholders Meeting is less than or equal to 10 percent (the sample median); shareholders have preemptive rights that can only be waved by a shareholders vote.

We also use the index for law and order from La Porta, et al. (1998), which ranges form zero to ten, with higher number associated with better law implementation. Table 1 reports these three indexes for 20 countries in our sample. These indexes do not vary over time and are assessed as of early 1990s, close to the beginning of our sample.

The data for stock market indexes come from Global Financial Data. We have monthly data (end of month closes, as calculated by central banks, national statistical agencies, or stock exchanges themselves). We study 20 developed and developing countries over the sample period from 1991 to 2000. The country coverage includes emerging economies (Argentina, Brazil, Chile, Hong Kong, Korea, Malaysia, Thailand, Singapore), as well as developed economies (Australia, Canada, Denmark, Finland, France, Italy, Japan, New Zealand, Sweden, Switzerland, UK and US).

2.2 Creditor Rights and Stock Price Volatility

To measure the stock return volatility, we use the Officer's method (Officer (1973)). The Officer method estimates the stock return standard deviation for month 1 to month 12; next estimate the standard deviation from month 2 to month 13; and then repeat the procedure, rolling the sample forward continuously. A potential problem with Officer's approach is that the use of overlapping observations will create a correlation between standard deviations at different points in time. An alternative is to use non–overlapping observations. That is, to compute the standard deviation using, say, months 1 through 12, 13 through 24, and so forth. The problem is that this procedure results in relatively few data points. We tried both methods and obtain similar results.

We estimate the equation:

$$\ln(\sigma_{it}) = \alpha_0 + \alpha_1 D_i + \varepsilon_{it}$$

where σ_{it} is the stock return standard deviation estimated from our Officer's non-overlapping method,[2] α_0 is the constant term, and the vector D_i includes the indexes for creditor protection and law and order. Owing to data limitation, D_i is however not time–varying.

[2]Thus we use only month 12 of each year.

Table 2 demonstrates the link between credit protection and stock return variability. We can see that better law and order and credit rights protection are associated with lower stock price volatility. We also find that the coefficient of multiple correlation between these two indexes and the variance of the stock price volatility is quite high. In the regression which excludes time fixed effects we obtain an R^2 of 0.30.

2.3 Creditor Rights and Credit Growth Volatility

It is possible that creditor protection reduces stock volatility because it reduces the volatility of private credit. In this subsection, we examine this explanation. We measure the annual standard deviation of the private credit growth as in Schwert (1989). For most countries, we have only annual private credit estimates for the period from 1980 to 2000. We therefore implement the following procedure:

First, we estimate a 2nd-order autoregression for the private credit growth rate m_t, using all the annual data available:

$$m_t = k_1 + \phi_1 m_{t-1} + \phi_2 m_{t-2} + \mu_{mt}$$

where μ_{mt} is the disturbance term.

We then estimate a 2nd-order autoregression for the absolute values of the errors from the above regression,

$$|\hat{\mu}_{mt}| = \rho_0 + \rho_1 |\hat{\mu}_{mt-1}| + \rho_2 |\hat{\mu}_{mt-2}| + \zeta_t$$

The fitted values, $|\tilde{\mu}_{mt}|$, from this regression measure the conditional standard deviation of m_t, given information available before time t.

We then regress $|\tilde{\mu}_{mt}|$ onto the creditor protection index, as well as the law and order index :

$$\ln(|\hat{\mu}_{mt}|) = \beta_0 + \beta_1 D_i + \eta_{it}$$

Results are presented in Table 3. We indeed find that both law and order and creditor protection are associated with lower volatility of private credit. This time the R^2 in the regression without time fixed effects is lower than before, 0.23, but still respectable. Thus, it is indeed possible that law and order and creditor protection affect stock market volatility only through credit volatility, a possibility we explore next.

2.4 Creditor Rights, Credit Growth Volatility and Stock Market Volatility

Finally, we estimate how the volatility of private credit affects stock return volatility. We follow Schwert (1989) by estimating a regression equation of the form

$$\ln(\sigma_{it}) = \alpha_0 + \alpha_1 D_{it} + \alpha_2 \ln(|\hat{\mu}_{mt}|) + \varepsilon_{it}.$$

Note that since $|\hat{\mu}_{mt}|$ is a linear prediction based on $|\hat{\mu}_{mt-1}|$ and $|\hat{\mu}_{mt-2}|$, the above equation is essentially a regression of $\ln(\sigma_{it})$ onto $|\hat{\mu}_{mt-1}|$ and $|\hat{\mu}_{mt-2}|$; which helps control for the potential endogeneity of credit volatility.

The estimation results are presented in Table 4. We find that credit growth volatility is indeed positively associated with stock price volatility. Moreover, creditor protection now is no longer significantly associated with stock market volatility (the associated P-value is now 0.33). Thus we find that one potential channel through which creditor protection may depress stock volatility is through reducing the volatility of private credit.

3 Theory

We analyze two Tobin-q models that demonstrate potential links between creditor rights and government guarantees and stock price volatility. We first present a model with government guarantees and we then proceed to a model with an institutional mechanism.

3.1 Credit Guarantees

Consider a small open economy, producing a single aggregate tradable good. The production function for that good, Y, is Cobb-Douglas:[3]

$$Y_t = A_t K_t^{1-\rho}, \tag{1}$$

[3] The model is based on Krugman (1998) and Frenkel and Razin (1996, Chapter 7).

where A_t, $1-\rho$, and K_t denote the productivity level, the distributive share of capital, and the capital stock, respectively. We assume that productivity levels follow a first-order autoregressive stochastic process:

$$\ln(A_{t+1}) = \gamma \ln(A_t) + \varepsilon_{t+1} \tag{2}$$

where ε_{t+1} follows a uniform distribution over the region $[-1, 1]$. Using small letters to denote logs of cap letters, we get

$$a_{t+1} = \gamma a_t + \varepsilon_{t+1}. \tag{3}$$

Firms maximize the expected value of the discounted sum of profits subject to the available production technology and to a cost-of-adjustment investment technology. According to the latter, gross investment (Z_t) is specified as

$$Z_t = I_t \left(1 + \frac{1}{2}\frac{1}{v}\frac{I_t}{K_t}\right), \tag{4}$$

where $I_t = K_{t+1} - K_t$, and $\frac{1}{v}$ denote net capital formation (assuming zero depreciation) and a cost-of-adjustment coefficient, respectively. In the presence of costs of adjustment, gross investment typically exceeds net capital formation, because of the additional costs of the reorganization and retraining associated with the installation of new capital equipment.

Denote r as the world interest rate, a representative firm will maximize the following Lagrangian:

$$L = E\left[\Sigma_{t=0}^{\infty} \frac{1}{(1+r)^t} \left(A_t K_t^{1-\rho} - Z_t + q_t \left(K_t + I_t - K_{t+1}\right)\right)\right], \tag{5}$$

where the Lagrangian q_t could be interpreted as Tobin's q.

Maximizing the Lagrangian gives two first order conditions. The first one is with respect to I_t:

$$1 + \frac{1}{v}\frac{I_t}{K_t} = q_t. \tag{6}$$

Denoting $\ln(K_t)$ as k_t and linearizing $\ln(v(q_t - 1) + 1)$ gives

$$k_{t+1} = k_t + v(q_t - 1). \tag{7}$$

The second first-order condition with respect to K_t is:

$$q_t = \frac{1}{1+r}\left(E_t\left[R_{t+1}\right] - \frac{1}{2}\frac{1}{v}\left(\frac{I_t}{K_t}\right)^2 + E_t\left[q_{t+1}\right]\right), \tag{8}$$

where R_{t+1} is the capital rental rate. The optimal-investment rule in equation (8) implies that the cost of investing an additional unit of capital in the current period must be equal to the expected present value of the next period's marginal productivity of capital, plus the next period's induced fall in the adjustment cost of investment resulting from the enlarged stock of capital, plus the continuation value in the capital remaining for the entire future.

Note that from equation (1):

$$R_{t+1} = (1-\rho)\,A_{t+1}K_{t+1}^{-\rho}. \tag{9}$$

Linearizing $\ln\left(R_{t+1}\right)$, and denoting $\pi \equiv 1 + \ln(1-\rho)$, yields:

$$R_{t+1} = \pi - \rho k_{t+1} + a_{t+1}. \tag{10}$$

For simplification, assume that $\frac{1}{2v}\left(\frac{I_t}{K_t}\right)^2$ is relatively small compared with other two terms on the right hand side of equation (8). Then equation (8) becomes

$$(1+r)q_t = E_t\left[\pi - \rho k_{t+1} + a_{t+1}\right] + E_t\left[q_{t+1}\right]. \tag{11}$$

3.1.1 Free Market Valuation of Q

Combining equations (7) and (11), we get:

$$q_t = \frac{\left(\pi + \rho v - \rho k_t + \gamma a_t \ + E_t q_{t+1}\right)}{1 + r + \rho v}. \tag{12}$$

We then solve q_t by a "guess":

$$q_t = B_0 + B_1 a_t + B_2 k_t. \tag{13}$$

From equations (7) and (13), we get

$$E_t q_{t+1} = B_0 + B_1 (\gamma a_t) + B_2 (k_t + v (q_t - 1)) . \tag{14}$$

Substituting equations (13) and (14) into equation (12), we solve B_0, B_1, B_2 by comparing coefficients for a_t and k_t:[4]

$$\begin{aligned} B_0 &= \tfrac{-\pi-\rho v+vB_2}{-r-\rho v+vB_2} \\ B_1 &= \tfrac{\gamma}{1+r+\rho v-vB_2-\gamma} \\ B_2 &= \tfrac{r+\rho v-\sqrt{(r+\rho v)^2+4\rho v}}{2v}. \end{aligned} \tag{15}$$

3.1.2 Credit Guarantees

Now suppose that the government guarantees the investment if $a_{t+1} < g$. That is, if $a_{t+1} < g$, the net payoff to the firm will be

$$\text{Net Payoff} = 0. \tag{16}$$

However, if $a_t > g$, the net payoff to the firm will be

$$E_t R_{t+1} + E_t q_{t+1} - (1 + r)q_t. \tag{17}$$

Then equation (11) becomes

$$\begin{aligned} & (1 + r)q_t \\ = \quad & (1 + r)q_t * \Pr (a_{t+1} < g) + E_t [\pi - \rho k_{t+1} + a_{t+1} + q_{t+1} \,|\, a_{t+1} > g] * \Pr (a_{t+1} > g) , \end{aligned} \tag{18}$$

where $E_t [.|a_{t+1} > g]$ is the expectation conditioned on $a_{t+1} > g$. Combining equations (7) and (18) generates

$$q_t = \frac{\pi + \rho v - \rho k_t + E_t [a_{t+1} + q_{t+1}|a_{t+1} > g]}{1 + r + \rho v}. \tag{19}$$

Suppose that government guarantee is proportional to the highest value of productivity level, i.e., $g_{t+1} \equiv$

[4] Note that the jumping variable q_t is negatively related to the state variable k_t.

sa^H_{t+1}, where $s \in [0,1]$. Then,[5]

$$E\left[a_{t+1}|a_{t+1} > g_{t+1}\right] = \frac{(1+s)(\gamma a_t + 1)}{2}. \tag{20}$$

Again we apply the guessing method to solve q_t:

$$q'_t = B'_0 + B'_1 a_t + B'_2 k_t. \tag{21}$$

Then

$$E\left[q'_{t+1}|a_{t+1} > g_{t+1}\right] = B'_0 + B'_1 \frac{(1+s)(\gamma a_t + 1)}{2} + B'_2 k_{t+1}. \tag{22}$$

Substituting equations (7), (20), (21) and (22) into equation (19),we solve B'_0, B'_1, B'_2 by comparing coefficients for a_t and k_t:

$$\begin{array}{r} B'_0 = \frac{s+sB'_1+B'_1+2v\rho-2vB'_2+2\pi+1}{2r+2v\rho-2vB^{*\prime}_2} \\ B'_1 = \frac{\gamma(1+s)}{2r+2v\rho-2vB'_2+2-\gamma(1+s)} \\ B'_2 = \frac{r+\rho v-\sqrt{(r+\rho v)^2+4\rho v}}{2v}. \end{array} \tag{23}$$

Note that with more government guarantees s is larger, and B'_0 is also larger. Thus as expected government guarantees raise the stock price q_t.

The stock return volatility, conditioned on information available at time t (i.e., a_t, k_t, q'_t), is:

$$\begin{aligned} Var_t\left[q'_{t+1} - q'_t\right] &= Var_t\left[B'_1 a_{t+1} + B'_2 k_{t+1} - B'_1 a_t - B'_2 k_t\right] \\ &= Var_t\left[B'_1 \varepsilon_{t+1}\right] \end{aligned} \tag{24}$$

A rise in s increases B'_1 and therefore causes larger stock return volatility for any given realization of a_{t+1}. Since countries with better creditor protection tend to have smaller social demand for government guarantees, better creditor protection could then lower stock return volatility.

[5]Note that conditioned on a_t, a_{t+1} has a uniform distribution over $[\gamma a_t - 1, \gamma a_t + 1]$.

3.2 Creditor Protection and Credit-Constrained Investment

We now analyze an alternative Tobin Q mechanism that evolves around credit constraints.[6]

Assume that the firm has to borrow from the creditor a durable input W_t, where $W_t \in [0, 1]$. At the end of the period t, the firm needs to return W_t. For simplicity, assume that the interest rate paid on the durable input is zero. Then the firm will borrow up to 1. However, there are some chances that the firm is not willing, or able, to return W_t, and the creditor has to go to a costly court procedure to claim back the durable good W_t. Therefore, the creditor imposes an ex ante constraint on how much the firm can borrow. More specifically,

$$W_t \leq \min[\omega A_t, 1]. \tag{25}$$

The borrowed input is constrained by the firm's productivity level A_t: as A_t decreases, the firm will have to borrow less. Finally, higher ω is associated with better creditor protection.[7]

Assume that production function is:

$$Y_t = A_t W_t K_t^{1-\rho}. \tag{26}$$

Therefore, if $W_t = \omega A_t$, then $Y = A_t \omega A_t K_t^{1-\rho}$. However, if $W_t = 1$, $Y = A_t K_t^{1-\rho}$.

A representative firm will maximize the following Lagrangian:

$$L = E\left[\Sigma_{t=0}^{\infty} \frac{1}{(1+r)^t} \left(A_t W_t K_t^{1-\rho} - Z_t + q_t \left(K_t + I_t - K_{t+1}\right)\right)\right]. \tag{27}$$

where the Lagrangian multiplier, q_t, is interpreted again as Tobin Q.

Maximizing this Lagrangian will again gives us equations (7) and (8), although now the form for $E_t\left[R_{t+1}\right]$ is different. At time t, the firm needs to take into account whether the constraint will be binding or not at

[6] See Bernanke and Gertler (1989), Hart and Moore (1994), Kiyotaki and Moore (1997), and Mendoza (2005).

[7] In the literature on credit constraint and financial accelerator, the constraint tends to be based on a firm's market value $q_t k_t$. However, if both q_t and k_t are endogenous as in Mendoza (2005), then no tractable solution is available. By using A_t rather than q_t, we are able to provide tractable closed-form solutions.

time $t+1$. Equation (10) therefore becomes

$$\begin{aligned} E_t\left[R''_{t+1}\right] &= E_t\left[\pi - \rho k_{t+1} + a_{t+1} + \ln\left(W_{t+1}\right)\right] \\ &= E_t\left[\pi - \rho k_{t+1} + 2a_{t+1} + \ln\omega \,|\, W_{t+1} < 1\right] * \Pr\left(W_{t+1} < 1\right) \\ &\quad + E_t\left[\pi - \rho k_{t+1} + a_{t+1} | W_{t+1} = 1\right] * \Pr\left(W_{t+1} = 1\right) \\ &= \pi - \rho k_{t+1} + \gamma a_t - \frac{1}{4}\left(\ln\omega + \left(\gamma a_t - 1\right)\right)^2 . \end{aligned} \tag{28}$$

Note that $E_t\left[\pi - \rho k_{t+1} + 2a_{t+1} + \ln\omega \,|\, W_t < 1\right]$ is the expected R_{t+1} when the constraint is binding, while $E_t\left[\pi - \rho k_{t+1} + a_{t+1} | W_t = 1\right]$ is the expected R_{t+1} when the constraint is not binding. Combining equations (7), (8) and (28) generates

$$q''_t = \frac{\pi + \rho v - \rho k_t + \gamma a_t - \frac{1}{4}\left(\ln\omega + \left(\gamma a_t - 1\right)\right)^2 + E_t q_{t+1}}{1 + r + \rho v}. \tag{29}$$

Again we solve q''_t by guess:

$$q''_t = B''_0 + B''_1 a_t + B''_2 k_t + B''_3 a_t^2 \tag{30}$$

and

$$q''_{t+1} = B''_0 + B''_1 a_{t+1} + B''_2 k_{t+1} + B''_3 a_{t+1}^2. \tag{31}$$

Then

$$E_t q_{t+1} = B''_0 + B''_1\left(\gamma a_t\right) + B''_2\left(k_t + v\left(q''_t - 1\right)\right) + B''_3\left(\gamma^2 a_t^2 + \frac{1}{3}\right). \tag{32}$$

Note that since a_{t+1} has a conditional uniform distribution over $[\gamma a_t - 1, \gamma a_t + 1]$, $E\left(a_{t+1}^2\right) = \gamma^2 a_t^2 + \frac{1}{3}$.

Plugging equations (30) and (32) into equation (29), we solve B''_0, B''_1, B''_2 and B''_3 by comparing coefficients for a_t and k_t:

$$\begin{aligned} B''_0 &= \frac{-\frac{1}{4}(1-\ln\omega)^2 - vB''_2 + \frac{1}{3}B''_3 + v\rho + \pi}{r + v\rho - vB''_2} \\ B''_1 &= \frac{(3-\ln\omega)\gamma}{2\left(r - \gamma + v\rho - vB''_2 + 1\right)} \\ B''_2 &= \frac{r + \rho v - \sqrt{(r+\rho v)^2 + 4\rho v}}{2v} \\ B''_3 &= -\frac{1}{4}\frac{\gamma^2}{r + v\rho - \gamma^2 - vB''_2 + 1} \end{aligned} \tag{33}$$

Note that as credit-constraint laxity coefficient, ω, rises, so does the market value of the firm, q_t; because B_0'' is increasing in ω.[8]

Conditional on information available at time t,

$$\begin{aligned} Var_t\left[q_{t+1}'' - q_t''\right] &= Var_t\left[B_0'' + B_1'' a_{t+1} + B_2'' k_{t+1} + B_3'' a_{t+1}^2\right] \\ &= Var_t\left[B_1'' a_{t+1} + B_3'' a_{t+1}^2\right]. \end{aligned}$$

As ω increases, B_1'' decreases, which lowers $Var_t\left[q_{t+1}'' - q_t''\right]$. Therefore, better creditor protection reduces the price volatility. Note that as ω increases, B_0'' increases, so Tobin q_t'' increases rather than decreases.

Having established two channels that connect institutional features to asset price volatility, we proceed with empirical analysis of these channels.

4 Evidence

We now attempt to determine which of the two channels presented in the model (government guarantees or credit constraints), if any, is responsible for the transmission of the creditor protection to the stock market volatility. To do so, we first estimate a benchmark model of the stock price volatility to which we add, one at a time (and also together), our proxies for the degree of government guarantees and tightness of credit constraints.

4.1 Empirical Approach

In recent literature, financial crises are triggered not only by fundamental shocks, but also by the degree to which market expectations about these fundamentals are coordinated. In the absence of common knowledge, an individual market participant receives only an independent and noisy signal about the fundamentals but also must have some uncertainty about the other market participants' expectations. Morris and Shin (2000) show how the market participants' knowledge about the statistical distributions of the signals and the market fundamentals (but not the actual realization of the fundamental and its idiosyncratic signals) helps to coordinate the behavior of market participants. The coordination of expectations induces a unique

[8] Note that $(1 - \ln \varpi)$ is positive in the model. Therefore, as ϖ increases, $(1 - \ln \varpi)^2$ decreases.

equilibrium in such a set up, in which there exists a unique threshold level of the fundamental.[9]

This recent theory of financial crises can guide us as to how to design our empirical approach. Financial crises are cast in terms of self-fulfilling expectation games. Self-fulfilling expectations games played by market participants have elements of a "beauty contest" (Allen, Morris and Shin, 2003). Market participants must care not just about acting in the way that conforms with current fundamentals, but also about acting similarly to the way other do. Institutional features determine the stochastic distribution of the fundamentals and the effect of the market fundamentals on the performance of institutions. Thus, for example, deposit insurance exerts not only a direct effect on stock return volatility, through the government guarantees mechanism, but it could also have an indirect effect on the volatility, through its impact on the probability of financial crises. That is, the deposit insurance can reduce the probability of bank runs (Diamond and Dybvig, 1983) and thereby reduce the probability of financial crises.

We define financial crisis as an event of a big increase in the real interest rate of over 3 percentage points in one year, which corresponds to highest 10% of annual changes in real interest rate in our sample. We also define an alternative measure, to be used for the robustness tests, where crisis is defined as an increase in the real interest rate of over 7.1 percentage points in one year, or top 5% of annual real interest rate changes. Table 5 presents a list of countries and years for which our financial crisis indicator is equal to 1 along with the value our more strict indicator takes and the changes in real interest rate.

Following the methodology in Razin and Rubinstein (2006), we use a financial crisis indicator to estimate the following model.

$$\mathrm{I(crisis)}_{it} = \begin{cases} 1 & \text{if } \; y_{it} > 0 \\ 0 & \text{if } \; y_{it} \leq 0 \end{cases} ,$$

where y is a latent variable and a function of our independent variables:

$$y_{it} = X_{it}'\beta + \varepsilon_{it},$$

and ε have either normal or logistic PDF. We also estimate linear probability model

$$\mathrm{I(crisis)}_{it} = X_{it}'\beta + \varepsilon_{it}.$$

[9] In a limiting case when the signal's residual approaches zero.

We then construct a measure of the probability of financial crisis as a predicted value from the above estimation, which we use in the analysis of stock market volatility. We first estimate a benchmark model

$$\ln(\sigma_{it}) = \alpha_i + \gamma * \Pr(\text{crisis})_{it} + Z'_{it}\delta + \omega_{it},$$

where $\ln(\sigma_{it})$ is our measure of the stock market volatility, for December of each year; α_i is a set of country fixed effects, Z_{it} is a set of control variables, errors ω_{it} are allowed to be serially correlated and heteroschedastic. We use GLS in order to estimate this regression.

Given high level of autocorrelation in errors, we are concerned about the specification of our model. We estimate, alternatively, the dynamic panel regression, using Arellano and Bond (1991) method:

$$\ln(\sigma_{it}) = \alpha_1 \ln(\sigma_{it-1}) + \alpha_2 \ln(\sigma_{it-2}) + \gamma * \Pr(\text{crisis})_{it} + Z'_{it}\delta + \upsilon_{it},$$

where we specify the size of the stock market as exogenous and the probability of the crisis as predetermined variables.

We then proceed by adding our proxies of government bailouts and credit constraints to see whether they have an effect on stock market volatility.

Actual government bailouts are highly endogenous and crisis dependent, we are therefore more interested in the *potential* government bailouts. To proxy for this we use an indicator of whether the country had an explicit deposit insurance, financed by either government or private funds. We include deposit insurance financed by private funds, because in most cases these funds would themselves expect to be bailed–out by the government. The data for the deposit insurance comes from the World Bank Deposit Insurance Database.

Credit constraints are notoriously difficult to measure. At the aggregate level, we assume that the availability of foreign financing for the country is highly correlated with aggregate availability of funds, since domestic resources are limited by aggregate savings, which are usually not very volatile. In the spirit of Klein, Peek and Rosengren (2002), we use country's sovereign rating from Standard & Poors as a proxy for the country's aggregate credit constraint.[10] When the sovereign rating is poor, government, banks and non–financial firms find it expensive to borrow abroad and therefore compete for domestic resources. In the countries with weak institutions, lending to the private sector would be squeezed first, leading to the credit

[10] We use numeric representation of the rating, with higher number corresponding to higher risk, i.e. worse rating.

constraints.

Evidently, one cannot possibly account by institutional variables for all the cross–country differences that would account for the variations in the stock market volatility between countries. Thus, we employ country specific fixed–effects regression analysis. Since our creditor rights measures do not vary over time, they drop out from some stages of our analysis.

4.2 Results

We now report the results of the two stage estimation procedure: probability of crises and stock price volatility.

4.2.1 Probability of Financial Crises

Table 6 shows our first stage estimation of the probability of financial crises. Since fixed effects Probit regressions are not identified due to incidental parameters problem, we use pooled specification which also allows us to include our measures of creditor rights protection. Since our proxies of government guarantees and credit constraints might also affect the probability of financial crises, we include them in the regression as well. Changes in banking system reserves and in commercial bank credit to the private sector (corrected for inflation) could also be indicative of the financial crisis. Finally, since the United States interest rates tend to be transmitted to credit conditions in other countries, we include US 3-year Treasury rate.

As we would expect, better shareholder and creditor rights protection lowers the probability of financial crisis, while sovereign credit risk increases the probability of crises. We expected deposit insurance to reduce the probability of the crisis (see Diamond and Dybvig, 1983), and indeed we find that it has a stabilizing effect. We also see that financial crises are more likely when domestic commercial banks decrease their lending to private sector and increase their reserves. But we interpret these as feedbacks rather than causes of financial crises, because we do not have available good instruments. Finally, as we would expect, financial crises are more likely when US Treasury rate is high.

Since column (4) seems to provide the best fit, we use it to predict the probability of financial crisis to be used in our second stage.

4.2.2 Stock Price Volatility

Benchmark results of the GLS estimation of our second stage regression are reported in column (1) of Table 7. We can see that higher probability of financial crises increases the stock price volatility, while higher GDP growth rate (which we lag by one year) lowers it.[11] We also control for the size of the domestic stock market, by including the (log of) number of firms listed on the market. As expected, larger markets are less volatile than thinner markets.

The predicted crisis probability is of course a function of our measures of deposit insurance and credit constraint proxies. In order to see whether the effect of the crisis probability on stock price volatility is due to either of these variables, we include them one at a time (columns (2) and (3)), and also together (column (4)). In columns (2) and (4) the coefficient on the credit rating is significant while the coefficient on the probability of the crisis is reduced, significantly. We therefore find that credit rating (our proxy for the severity of credit constraints) indeed accounts for some, although not all, of the effect. The deposit insurance, on the other hand, does not seem to have any effect. We temporarily conclude that the credit constraints seem to be a more likely channel affecting the volatility of the stock market than government guarantees.

The results of the dynamic panel regression (as in Arellano and Bond (1991)) are now reported in Table 8. We can see that credit rating still enters significantly, however, including it no longer reduces the effect of the predicted crisis probability. Interestingly, deposit insurance now enters significantly, when included by itself. However its presence does not have an effect on the crisis probability coefficient. Thus, we conclude that while credit constraints and government guarantees do indeed affect the stock price volatility, as predicted by the theory, these are not the only channels through which financial conditions and stock market volatility are linked.

5 A Concluding Remark

The paper may have an interesting implication for the literature on the "equity premium" puzzle. To the extent that institutional weaknesses raise the variance on stock returns, they may also contribute to the

[11] We do not find it necessary to lag other variables, since the dependent variable is measured for the end of the year (December), while the rest of the variables are either flows over the year or average for the year.

spread between the mean return and the safe return on bonds. We conjecture that the introducing of elements of risk aversion to the models on credit guarantees and credit constraints may explain part of the equity puzzle and the variations of the equity puzzle across economies of different institutional characteristics.

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Table 1: Corporate Governance Indicators

country	Law and order	Creditor protection	Shareholder rights
Argentina	5.4	1	4
Australia	10	1	4
Brazil	6.3	1	3
Canada	10	1	5
Chile	7.0	2	5
Denmark	10	3	2
Finland	10	1	3
France	9	0	3
Hong Kong	8.2	4	5
Italy	8	2	1
Japan	9	2	4
Korea	5	3	2
Malaysia	7	4	4
New Zealand	10	3	4
Singapore	9	4	4
Sweden	10	2	3
Switzerland	10	1	2
Thailand	6	3	2
United Kingdom	9	4	5
United States	10	1	5

Table 2: Stock market volatility and creditor rights

	Coef.	Std. Err.	t
Law	-0.23	0.02	-10.70
Creditor Protection	-0.06	0.03	-1.82
Constant	3.95	0.20	20.11
R^2	0.33		
Observations	220		

Dependent variable is private credit growth volatility
Time fixed effects are included

Table 3: Private credit growth volatility

	Coef.	Std. Err.	t
Creditor Protection	-0.003	0.001	-3.01
Law	-0.005	0.001	-7.11
Constant	0.101	0.007	14.56
Observations	200		
R^2	0.23		

Dependent variable is private credit growth volatility
Time fixed effects are included

Table 4: Stock return volatility

	Coef.	Std. Err.	t
Law	-0.18	0.02	-7.3
Creditor Protection	-0.03	0.03	-0.97
Volatility of Credit Growth (log)	0.73	0.12	6.02
Constant	5.60	0.33	17.01
R^2	0.41		
Observations	220		

Dependent variable is stock return volatility
Time fixed effects are included

Table 5: Countries and years of financial crises

country	year	Alt. definition	Δ Real Interest rate
Argentina	1983	1	59.70617
Argentina	1984	0	5.532223
Argentina	1985	1	139.0005
Argentina	1989	1	42963.53
Argentina	1990	1	358475.8
Argentina	1992	1	29.09467
Argentina	1993	0	3.948962
Argentina	1994	1	7.228606
Argentina	2001	1	17.07706
Australia	1984	1	7.183205
Australia	1989	0	4.190388
Brazil	1982	1	10.75856
Brazil	1983	1	7.105807
Brazil	1988	0	6.53093
Brazil	1989	1	194.1218
Brazil	1990	1	608.8476
Brazil	1994	1	352.7721
Brazil	1998	1	7.15094
Brazil	2003	0	7.019809
Czech Republic	1997	0	4.689676
Czech Republic	1999	0	3.858152
Denmark	1982	0	3.474774
Denmark	1990	0	3.446622
Finland	1983	0	3.899578
Hong Kong	1998	0	3.779408
Hong Kong	1999	1	7.541826
Korea	1982	1	9.151735
Korea	1989	0	4.859002
Malaysia	1982	0	3.731038
Mexico	1984	1	12.51175
Mexico	1985	1	12.27889
Mexico	1989	1	43.93285
Mexico	1993	0	4.050268
Mexico	1995	1	10.32351
Mexico	1998	1	8.395061
New Zealand	1988	0	3.542305
Poland	1992	0	4.26256
Poland	1995	0	5.699811
Poland	1997	0	5.706461
Sweden	1992	1	13.51082
Switzerland	1983	0	3.00679
Thailand	1982	0	5.137234
Thailand	1984	0	4.482033
Thailand	1997	0	5.300499

Table 6: Estimating probability of financial crisis

	probit (1)	logit (2)	linear (3)	probit (4)	logit (5)	linear (6)
Shareholder rights	-0.345***	-0.655**	-0.012	-0.324***	-0.612***	-0.012
	(0.125)	(0.255)	(0.010)	(0.103)	(0.211)	(0.009)
Creditor Protection	-0.216**	-0.438**	-0.019	-0.181*	-0.363	-0.015
	(0.099)	(0.202)	(0.011)	(0.105)	(0.224)	(0.011)
Credit risk	0.084***	0.166***	0.010***	0.105***	0.206***	0.011***
	(0.018)	(0.037)	(0.003)	(0.017)	(0.036)	(0.003)
Deposit insurance	-0.808***	-1.645***	-0.057**	-0.716**	-1.454**	-0.048*
	(0.284)	(0.621)	(0.023)	(0.312)	(0.708)	(0.025)
Change in real bank	-0.005***	-0.010***	-0.000	-0.005***	-0.010***	-0.000*
credit to private sector	(0.001)	(0.002)	(0.000)	(0.001)	(0.001)	(0.000)
Change in real bank	0.025***	0.048***	0.000**	0.024***	0.045***	0.000
reserves	(0.007)	(0.011)	(0.000)	(0.004)	(0.006)	(0.000)
US 3-year Treasury rate				0.120**	0.234**	0.010
				(0.056)	(0.105)	(0.006)
Constant	-0.173	-0.136	0.115**	-1.416*	-2.586	0.022
	(0.574)	(1.180)	(0.051)	(0.806)	(1.612)	(0.060)
Observations	285	285	285	285	285	285
Adjusted R^2			0.05			0.05
McFadden's R^2	0.19	0.19		0.22	0.22	

Dependent variable is crisis indicator
Robust standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7: Determinants of stock market volatility

	(1)	(2)	(3)	(4)
Pr(fincris2)	2.202***	1.116**	2.608***	1.041*
	(0.569)	(0.530)	(0.603)	(0.611)
Growth rate of GDP L1	-0.247	-0.303*	-0.226	-0.308*
	(0.185)	(0.172)	(0.184)	(0.172)
Log of number of firms listed	-0.058**	-0.048*	-0.064**	-0.047*
	(0.029)	(0.025)	(0.028)	(0.025)
Credit rating		0.051***		0.051***
		(0.008)		(0.009)
Explicit deposit insurance			0.104	-0.015
			(0.071)	(0.067)
Constant	1.986***	1.767***	1.936***	1.773***
	(0.183)	(0.161)	(0.189)	(0.165)
Observations	273	273	273	273
Number of group(country)	19	19	19	19
AR(1)	0.40	0.33	0.40	0.32
Log likelihood	-109.7	-100.3	-109.0	-100.3

Dependent variable is log of stock market volatility. Estimated by GLS.
Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8: Determinants of stock market volatility

	(1)	(2)	(3)	(4)
Stock market volatility L1	0.198***	0.141***	0.173***	0.141***
	(0.050)	(0.050)	(0.050)	(0.050)
Stock market volatility L2	-0.040	-0.076	-0.060	-0.078
	(0.048)	(0.047)	(0.048)	(0.048)
Pr(fincris2)	3.477***	3.642***	4.746***	4.121***
	(0.726)	(0.705)	(0.823)	(0.832)
Growth rate of GDP L1	-0.385**	-0.221	-0.298	-0.212
	(0.188)	(0.186)	(0.188)	(0.186)
Log of number of firms listed	-0.005	-0.005	-0.004	-0.004
	(0.004)	(0.004)	(0.004)	(0.004)
Credit rating		0.060***		0.051***
		(0.014)		(0.017)
Explicit deposit insurance			0.347***	0.138
			(0.109)	(0.126)
Constant	0.034	0.028	0.026	0.026
	(0.024)	(0.024)	(0.024)	(0.024)
Observations	256	256	256	256
Number of group(country)	19	19	19	19
Sargan χ^2	273.0	273.9	268.2	271.6
H0: no autocorrelation of 2nd order	cannot reject	cannot reject	cannot reject	cannot reject
Pr > z	0.15	0.41	0.25	0.43

Dependent variable is log of stock market volatility. Estimated by Arellano–Bond method.
Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%