The Impact of Creditor Protection on Stock Prices in the Presence of Credit Crunches

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Abstract

A Tobin q model of investment is used to show that stronger creditor protection increases the expected level and lowers the variance of stock prices in the presence of credit crunches. There are two main channels through which creditor protection enhances the performance of the stock market: (1) The credit-constrained stock price increases with better protection of creditors; (2) The probability of a credit crunch leading to a binding credit constraint falls with strong protection of creditors.

The paper tests the predictions of the model by using cross–country panel regressions of stock market returns in 40 countries over the period from 1984 to 2004 at an annual frequency. We find broad empirical support for the prediction of the model that creditor protection increases the expected level of the stock market price level and reduces its volatility, both directly and indirectly, by lowering the probability of credit crunches.

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1 Introduction

A central problem in the credit market is that lenders are reluctant to make loans because they cannot easily determine whether a prospective borrower has resources to repay the loan. If the loan is made, the lender is concerned whether the borrower will engage in risky behavior that could lower the probability that the loan will be repaid. Collateral reduces this information asymmetry problem because good collateral (that is, assets that are easily valued and easy to take control of) significantly decreases the losses to the lender if the borrower defaults on the loan. Good collateral also reduces the moral hazard problem because the borrower is reluctant to engage in excessively risky behavior since now he or she has something to lose. Creditor protection enhances the ability of the lender to take control of the collateral in case of default and thereby alleviate credit constraints. Thus, creditor rights regulation helps mitigate the problems of information asymmetry and moral hazard between creditors and borrowers. This mechanism is the focus of our paper.

Recent literature on law and finance has emphasized the role of strong institutions, such as those that enhance creditor protection, in fostering the development of financial markets. Accordingly, creditor rights' protection affects the credit cycle, and credit market breadth. For example, La Porta et al. (1997) find that countries with poor creditor protection have smaller debt markets. Their findings are confirmed by Levine (2004) as well as Djankov, McLiesh, and Shleifer (2006), with broader country coverage. Burger and Warnock (2006) also find that countries with stronger creditor rights have more developed local bond markets, and their economies rely less on foreign–currency bonds. Furthermore, Galindo and Micco (2005) find that strong creditor rights can reduce the volatility of the credit market. Creditor protection also lowers a firm's borrowing costs and increases the firm's value (e.g., La Porta et al. (2000) and Bae and Goyal (2003)); and it also reduces cash–flow risk, operating income variability, and operating leverage (e.g., Claessens, Djankov, and Nenova (2001)). This literature focuses mainly on the credit market itself, but not on the effect of creditor protection on the stock market.

In this paper, we attempt to fill a gap in the literature by addressing the issue of how the protection of creditor rights affect the level and volatility of stock prices.[1] We develop a Tobin q model of stock prices, and confront the predictions of the model with panel data of 40 developed and developing countries over the years 1984 to 2004. Our analysis is motivated by the empirical regularity that better creditor protection is associated with higher stock price and lower volatility, which we present in the next Section.

In the empirical part of the paper, we analyze data of the aggregate stock prices in 40 countries over the years 1984-2004. Liquidity crises are measured, alternatively, as either big decline in bank credit to the private sector, or a large rise in the real interest rate. We first look at how creditor protection affects the probability of a liquidity crisis. We find that better creditor protection reduces the probability of the liquidity crunch, as our model predicts.

Next we examine whether the liquidity crisis indicator has an effect on the stock market prices. Controlling for country fixed effects and using instrumental variables to control for potential endogeneity of the crisis indicator, we find that liquidity crises indeed lower the stock price, and raises the volatility of the stock returns for countries with low level of creditor rights protection. We find some evidence that this effect is mitigated in countries with high level of creditor right protection, although this finding is not very robust.

The remainder of the paper proceeds as follows. Section 2 contains a discussion of an empirical regularity. Section 3 develops the model of investment and stock prices, in the presence of liquidity shocks. Section 4 contains the empirical analysis, and Section 5 concludes.

[1]Some studies have examined how corporate control affects the dispersion of stock prices within 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.

2 Empirical Regularity

In this section we present an empirical regularity which serves to motivate the analysis in the following sections.

Data on 40 developed and developing countries over the period 1984-2004 show a strong positive link between the creditor protection and the level of stock market prices, and a negative link between the creditor protection and the volatility of the stock market.[2] The regularity is obtained from regressions of the log of deflated stock market index (P), and stock return volatility (σ), on the indicator of a high level of credit rights protection (CRH), developed country dummy (DEV), and the interaction of the two. The regression results are:

$$Log(P) = -0.06 + 4.49 * DEV + 3.58 * CRH - 2.82 * DEV * CRH + \varepsilon_p, \tag{1}$$

$$Log(\sigma) = 2.33 - 0.59 * DEV - 0.42 * CRH + 0.29 * DEV * CRH + \varepsilon_\sigma, \tag{2}$$

where ε_p, ε_σ are error terms. All coefficients are statistically significant at 1–percent confidence level. The total effect of CRH for developed countries is significantly positive at the 4-percent level in the stock price level regression and is significantly negative at the 3–percent confidence level in the volatility regression. Adjusted R^2's are equal to 0.25 and 0.21, respectively, and 774 observations were used.

The magnitude of the effect of creditor right on the level of the stock market index is substantial for developing countries (for an average developing country an improvement in creditor protection from low to high would increase the level of the stock market index by 1.5 standard deviations), but is quite small for developed countries.[3].

[2]See Section 4 for description of the panel data and the indicators of creditor protection. In the regressions we group the values of the creditor rights protection index (CR) into high (3,4) and low (0,1,2) so that our results are not influenced by individual countries.. We repeat all the results below with both the raw index and the full set of five indicators for each value of the index.

[3]This result is consistent with Mendoza (2006b).

In the next section, we develop a model to explain the empirical regularity.

3 A Tobin q Model of Stock Prices

This section derives the analytical expression for the stock price by using the standard Tobin q model. We consider two regimes: a frictionless credit regime, and a credit constrained regime.

3.1 The Friction-Free Regime

Consider a small open economy facing a fixed world interest rate r. The production function of a single tradable goods is Cobb-Douglas:[4]

$$Y_t = A_t K_t^{1-\rho}, \tag{3}$$

where A_t, $1-\rho$, and K_t denote respectively the productivity shock parameter, the distributive share of capital, and the stock of capital. The productivity shock follows a first-order auto-regressive stochastic process:

$$\ln(A_{t+1}) = \gamma \ln(A_t) + \varepsilon_{t+1}, \tag{4}$$

where ε_{t+1} has a uniform distribution over $[-1, 1]$.

The cost-of-adjustment investment technology for gross investment (Z_t) is quadratic:

$$Z_t = I_t \left(1 + \frac{1}{2}\frac{1}{v}\frac{I_t}{K_t}\right), \tag{5}$$

where $I_t = K_{t+1} - K_t$ denotes net capital formation and $\frac{1}{v}$ is the cost-of-adjustment coefficient (depreciation rate is assumed to be equal to zero). As usual, gross investment exceeds net capital formation because of some additional reorganization and retraining costs associated with the installation of new capital.

[4]For a similar model of stock prices, see Krugman (1998) and Frenkel and Razin (1996, Chapter 7).

Producers maximize the expected value of the discounted sum of profits subject to the available production technology and cost-of-adjustment investment technology. The Lagrangian of the optimization problem is:

$$L_t = E_t \left[\Sigma_{s=1}^{\infty} \frac{1}{(1+r)^s} \left(A_t K_{t+s}^{1-\rho} - Z_{t+s} + Q_{t+s} \left(K_{t+s} + I_{t+s} - K_{t+s+1} \right) \right) \right]. \tag{6}$$

The Lagrangian multiplier, Q_t, is interpreted as the marginal Tobin Q.

The first-order condition, derived from the maximization of the Lagrangian with respect to I_t, is given by:

$$1 + \frac{1}{v} \frac{I_t}{K_t} = Q_t. \tag{7}$$

The first-order condition, associated with the derivative of the Lagrangian with respect to K_{t+1}, is given by:

$$Q_t = \frac{1}{1+r} \left(E_t \left[R_{t+1} \right] + \frac{1}{2} \frac{1}{v} \left(\frac{I_{t+1}}{K_{t+1}} \right)^2 + E_t \left[Q_{t+1} \right] \right), \tag{8}$$

where R_{t+1} denotes period $t+1$ capital rental rate.

Competitive factor markets imply that

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

The investment rule in equation (8) states that the cost of investing an additional unit of capital in the current period must equal to the expected present value of the next period marginal productivity of capital, plus the next period decline in adjustment costs (resulting from the next period enlargement of the stock of capital due to present period investment), plus the continuation marginal value of units of capital which will remain in the future.

Let $\tilde{L}_t$ be the maximized value of L_t. The stock price is defined as

$$P_t = \frac{\tilde{L}_t}{K_{t+1}} \tag{10}$$

With a quadratic cost-of-adjustment function, the stock price, P_t, is equal to the marginal Tobin q, Q_t. That is, $P_t = Q_t$.[5]

The deterministic steady state is given by

$$\bar{A} = 1,\ \bar{K} = \left(\frac{1-\rho}{r}\right)^{1/\rho},\ \text{and}\ \bar{Q} = \bar{P} = 1. \tag{11}$$

Log-linearizing the set of equations (7) and (9) around the deterministic steady state yields an approximated expression for Q_t, as follows[6].

$$P_t = Q_t = \frac{(1-\rho)\left(1+\rho\ln\bar{K}+\gamma a_t+\rho\left(v-k_t\right)\right)\bar{K}+E_t\left[Q_{t+1}\right]}{\left(1+r+v\rho\left(1-\rho\right)\bar{K}\right)}\ , \tag{12}$$

where $a_t = \ln(A_t)$ and $k_t = \ln(K_t)$.

The equilibrium level of P_t is a linear combination of the state variables, a_t and k_t, as follows:

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

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

$$\begin{aligned} B_0 &= \frac{(1-\rho)\left(1+v\rho+\rho\ln\bar{K}\right)\bar{K}-vB_2}{r+v\rho(1-\rho)\bar{K}-vB_2} \\ B_1 &= \frac{\gamma(1-\rho)\bar{K}}{1+r-\gamma-vB_2+v(1-\rho)\rho\bar{K}} \\ B_2 &= \frac{\left(Kv\rho-Kv\rho^2+r\right)-\sqrt{\left(Kv\rho-Kv\rho^2+r\right)^2+4v\left(K\rho-K\rho^2\right)}}{2v} \end{aligned} \tag{14}$$

Based on equations (7) and (14), the non credit-constrained equilibrium investment level is given by:

$$I_{t0} = vK_t\left(B_0 + B_1 a_t + B_2 k_t - 1\right). \tag{15}$$

[5]See Hayashi (1982) for the equality between average Q (the price) and the marginal Q.

[6]See Appendix 1.

Equation (15) implies that the non-credit-constrained investment increases if productivity rises (that is, $B_1 > 0$) ; and that the investment falls if the stock of capital increases (that is, $B_2 > 0$), as expected.

3.2 The Credit-Constrained Regime

We assume that the collateral required by the creditors in the credit market is a fraction, ω, of the existing capital stock, K_t, minus liquidation expenses induced by the liquidity shock, W_t.[7] That is, the credit constraint is given by:

$$I_t \ \leq \omega K_t - W_t, \tag{16}$$

The fraction ω is the creditor protection parameter (that is, better credit protection is associated with a larger ω).[8] The collateral insures the lender from any default on the firm's debt.

For simplicity, we assume that the aggregate liquidity shock, W_t, is permanent. We also assume that after the realization of W_t, no future shocks are anticipated. That is, upon the realization in period t of the liquidity shock, W_t, the investment constraint is a binding constraint in all present and future periods: $t, t+1, ..., \infty$. Thus, we assume that

$$I_s \ = \omega K_s - W_s \text{ for all } s \geq t. \tag{17}$$

[7]See the related literature of Bernanke and Gertler (1989), Hart and Moore (1994), Kiyotaki and Moore (1997), and Mendoza (2006a,b).

[8]In the literature on credit constraint and financial accelerator, the constraint tends to be based on a firm's market value $\omega q_t K_t$. However, if both q_t and K_t are endogenous as in Mendoza (2006b), then no tractable solution is available for q_t. By using ωK_t rather than $\omega q_t K_t$, we are able to provide tractable closed-form solutions for q_t and its volatility.

3.2.1 Derivation of the credit-constrained stock price

The maximum value of the firm at the end of period t, L_t, is given by:

$$\hat{L}_t = \max E_t \left[\Sigma_{s=1}^{\infty} \frac{1}{(1+r)^s} \left(A_{t+s} K_{t+s}^{1-\rho} - Z_{t+s} \right) \right]. \tag{18}$$

The ex-dividend stock price P_t, at the end of period t, is:

$$\begin{aligned} P_t &= \frac{\hat{L}_t}{K_{t+1}} \\ &= \frac{1}{1+r} E_t \left(A_{t+1} K_{t+1}^{-\rho} - \frac{Z_{t+1}}{K_{t+1}} + \frac{K_{t+2}}{(1+r) K_{t+1}} P_{t+1} \right). \end{aligned} \tag{19}$$

Because the credit constraint is binding, we also have

$$K_{t+s+1} = (1+\omega) K_{t+s} - W_t, \text{ for all } s = 0, 1, 2, ... \tag{20}$$

Using equations (18), (19) and (20), we write the stock price equation (expressed as a difference equation) as follows:[9]

$$\hat{P}_t = \frac{1}{1+r} E_t \left(A_{t+1} K_{t+1}^{-\rho} - \omega \left(1 + \frac{\omega}{2v} \right) + \frac{1+\omega}{1+r} \hat{P}_{t+1} \right). \tag{21}$$

Log-linearizing equation (21) around the deterministic steady state (see equation (11)), we get:

$$\hat{P}_t = \frac{1}{1+r} E_t \left(\bar{K} \left(1 + \rho \ln \left(\bar{K} \right) + a_{t+1} - \rho k_{t+1} \right) - \omega \left(1 + \frac{\omega}{2v} \right) + \frac{1+\omega}{1+r} \hat{P}_{t+1} \right). \tag{22}$$

We can now solve for the stock price $\hat{P}_t$, by "guessing" the linear equilibrium relationship

[9] To simplify the exposition, we assume that the realized value of W_t (which triggers the credit constraint to be binding) is equal to zero.

between $\hat{P}_t$ and the state variables, a_t and k_t:

$$\hat{P}_t = C_0 + C_1 a_t + C_2 k_t. \tag{23}$$

The "guess" is verified by the substitution of equation (23) into (22), to get:

$$\begin{aligned} C_0 &= \frac{(1+r)\left(\bar{K}\left(\rho \ln \bar{K} - \rho \ln(\omega+1)+1\right) - \omega\left(\frac{1}{2v}\omega+1\right) - \bar{K}\rho(\ln(\omega+1))\frac{\omega+1}{r^2+2r-\omega}\right)}{r^2+2r-\omega} \\ C_1 &= \frac{\gamma(1+r)\bar{K}}{1-\gamma-\gamma\omega+2r+r^2} \\ C_2 &= -\frac{\rho(1+r)\bar{K}}{r^2+2r-\omega}. \end{aligned} \tag{24}$$

3.3 The Effect of Liquidity Crises on the Stock Price

We are now in a position to derive the expression for the expected returns in the stock market as a function of the probability of the credit crunch. Let U_t be a dummy indicator for the credit-constrained binding regime. That is, $U_t = 1$ when the credit constraint binds and $U_t = 0$ when the credit constraint does not bind. The expected value of the stock price is:

$$E\left[P_t; a_t, k_t, \omega\right] = \Pr\left(U_t = 0\right) P_{t,unconstrained} + \Pr\left(U_t = 1\right) \ P_{t,constrained} \tag{25}$$

The probability of a credit crunch, $\Pr\left(U_t = 1\right)$, is given by

$$\Pr\left(U_t = 1\right) = \Pr\left(I_{t0} > \omega K_t - W_t\right). \tag{26}$$

Note that

$$\begin{aligned} \frac{\partial E\left[P_t; a_t, k_t, \omega\right]}{\partial \omega} &= \frac{\partial \Pr\left(U_t = 0\right)}{\partial \omega}\left[P_{t,unconstrained} - \ P_{t,constrained}\right] \\ &\quad + \frac{\partial (P_{t,constrained})}{\partial \omega}(1 - \Pr\left(U_t = 0\right)). \end{aligned} \tag{27}$$

We can now state the following proposition:

Proposition 1: If the creditor protection becomes stronger, the expected stock price rises through two channels: (1) The probability of credit crunches diminishes; (2) The market value of the firm rises in the credit-constrained regime.

The proposition is proved by noting that:

i)

$$\frac{\partial \Pr(U_t = 0)}{\partial \omega} > 0,$$

because the expression $\Pr(I_{t0} > \omega K_t - W_t)$ depends negatively on ω.

ii) Lifting the constraint must raise the value function if the credit constraint binds. Therefore,

$$\frac{\partial(P_{t,constrained})}{\partial \omega} > 0.$$

iii) In general, the value function in the constrained regime cannot exceed the value function in the unconstrained regime. This implies that

$$P_{t,unconstrained} - P_{t,constrained} > 0.$$

3.4 The Effect of Liquidity Crises on Variance of the Stock Returns

By the variance decomposition rule, we have:

$$Var[P_t] = E[Var[P_t|U_t]] + Var[E[P_t|U_t]], \tag{28}$$

where $Var[P_t]$ is variance of P_t.

The first term on the right hand side of equation (28) is given by:

$$
\begin{aligned}
& E\left[Var\left[P_t|U_t\right]\right] \qquad (29)\\
= \; & \Pr\left(U_t=0\right)Var\left[P_{t,unconstrained}|U_t=0\right]+\Pr\left(U_t=1\right)Var\left[P_{t,constrained}|U_t=1\right].
\end{aligned}
$$

Combining equations (13) and (23), we get:

$$
E\left[Var\left[P_t|U_t\right]\right]=\left(\Pr\left(U_t=0\right)B_1^2+\Pr\left(U_t=1\right)C_1^2\right)Var\left[\varepsilon_t\right]. \qquad (30)
$$

and

$$
Var\left[E\left[P_t|U_t\right]\right]=\Pr\left(U_t=1\right)\left(1-\Pr\left(U_t=1\right)\right)\left(P_{t,unconstrained}-P_{t,constrained}\right)^2, \qquad (31)
$$

where $Var\left[\varepsilon_t\right]$ denotes the variance of the productivity shock.

The effect of ω on $Var\left[P_t\right]$ is, however, not easily tractable in the presence of productivity shocks. To focus on the effect of liquidity shocks, it is useful to shut off the productivity shock(i.e., $Var\left[\varepsilon_t\right]=0$). In this case,

$$
\begin{aligned}
Var\left[P_t\right] &= Var\left[E\left[P_t|U_t\right]\right]\\
&= \Pr\left(U_t=1\right)\left(1-\Pr\left(U_t=1\right)\right)\left(P_{t,unconstrained}-P_{t,constrained}\right)^2. \qquad (32)
\end{aligned}
$$

The effect of ω on the variance is:

$$
\begin{aligned}
\frac{\partial Var\left[P_t\right]}{\partial\omega} &= \left(1-2\Pr\left(U_t=1\right)\right)\left(P_{t,unconstrained}-P_{t,constrained}\right)^2\frac{\partial\Pr\left(U_t=1\right)}{\partial\omega}\\
&\quad+\Pr\left(U_t=1\right)\left(1-\Pr\left(U_t=1\right)\right)\frac{\partial\left(P_{t,unconstrained}-P_{t,constrained}\right)^2}{\partial\omega}. \qquad (33)
\end{aligned}
$$

From the preceding subsection, we recall that

$$\frac{\partial \Pr\left(U_t = 1\right)}{\partial \omega} < 0. \tag{34}$$

Also, as shown above, we have:

$$\frac{\partial \left(P_{t,unconstrained} - P_{t,constrained}\right)^2}{\partial \omega} < 0 \tag{35}$$

Therefore,[10]

$$\frac{\partial Var\left[q_t\right]}{\partial \omega} < 0. \tag{36}$$

This result is stated as a proposition.

Proposition 2: If the creditor protection becomes stronger, the variance of stock returns declines through two channels: (1) The difference between the stock prices in the constrained regime and the unconstrained regime decreases with better protection of creditors; and (2) The probability of credit crunches declines with stronger protection.

We turn now to confront the main predictions of the model, in Propositions 1 and 2, with cross–country panel data.

4 Empirical Analysis

In our theoretical model, the credit constraint mechanism works through a random situation where the constraint moves between binding and nonbinding. That is, the mechanism is based on a probability that the credit constraint is binding. In the empirical model, we use the indicator of a liquidity crisis to proxy for the situation when the constraint is binding. Hence, our empirical mea-

[10] If $Var\left[\varepsilon_t\right]$ is not equal to 0, then we can see that as ω rises, C_1 will increase, and hence the volatility of P_t will also increase in reaction to a shock to the technology, a_t. That is, when the constraint always binds, weak creditor protection will reduce the stock price volatility. The intuition is that a binding credit constraint would reduce the upside potential of good productivity shocks by constraining the firm growth.

sure of the liquidity crisis is directly related to the theoretical counterpart of the credit constraint. To proxy for the productivity shock which also affects q in the model, we include the growth rate of GDP per capita among our control variables.[11]

4.1 Measures of Liquidity Crises, Creditor Protection, and Stock Price

We define a liquidity crisis in two ways: First, as a sharp decline in bank credit to the private sector (quantity approach); second, as a sharp increase in the real interest rate (price approach). In both cases we define observations in the top 10 or 5 percent tail of annual changes in the underlying variable as crises, listed in Table 1. We refer to these definitions as weak and strong, respectively. This corresponds to the annual decline of credit to the private sector by 5.1 percent and 10 percent, respectively, and to an increase in real interest rate of over 4.3 or 8.4 percentage points in one year, respectively.[12] Thus, our liquidity crisis variable measures domestic liquidity crises and proxies for periods when credit constraints are likely to be binding.[13] By construction, the frequency of crises in the full sample is 10 percent and 5 percent with weaker and stricter measures, respectively, while it might vary slightly in the regressions as some observations drop out due to missing data.

Our creditor protection index comes from La Porta, et al. (1998).[14] The creditor rights index ranges from 0 to 4 with a higher number associated with better protection for creditors. The index is formed by adding one for each of the following four institutions: when the country imposes restrictions, such as requiring a firm to obtain creditor consent or pay minimum dividends to file for reorganization; when secured creditors are able to gain possession of their security as soon as the reorganization petition has been approved (with no automatic stay); when secured creditors

[11] We realize that this measure also includes demand shocks. Unfortunately, employment data is not available for many countries in our sample.

[12] We obtain the data on interest rates from IMF International Financial Statistics. We use line 22d for the bank credit to private sector and divide it by the CPI index. For the interest rate, in most cases we use the money market rate. When the money market rate is not available, we use the discount rate. We calculate the real interest rate by subtracting the CPI inflation rate from the nominal interest rate. We then calculate annual percentage changes in these variables to identify liquidity crisis episodes.

[13] Note that because we are interested not only in the on–set of the crisis, but in the crisis *situation*, we keep our indicator to be equal to 1 in all the years that our procedure determines as crises, and not only in the first crisis year.

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

are ranked first in the distribution of the proceeds that result from the disposition of the assets of a bankrupt firm; and when the debtor does not retain the administration of its property pending the resolution of the reorganization. Figure 1 shows the countries in our sample that fall into different categories of the creditor rights index.

To proxy for stock price level and volatility, we use stock market indexes from Global Financial Data. We use monthly data calculated by central banks, national statistical agencies, or stock exchanges themselves as of the end–of–month closes. We scale down all stock market indexes by the local CPI at the end of the month. To measure stock market level (q), we average the scaled down index for each country for each calendar year. For regressions without fixed effects, we normalize all indexes to be equal to 1 in 1997.[15] We use the log of this variable in our regressions. To measure the stock return volatility (σ), we compute non–overlapping standard deviations for the monthly stock returns for each calendar year. As alternatives, we used range measure of volatility proposed by Alizadeh et. al. (2001) and found that our results are not sensitive to such alterations. We use logs of these measures in our regressions. Sources of these data as well as our control variables are listed in Appendix 2.

4.2 Empirical Approach

To test whether better creditor protection lowers the probability of a liquidity crisis, we begin by estimating probit regressions of each of the four liquidity crisis indicators on the indicator of high index of creditor rights protection and control variables, which include lagged dependent variable, ICRG political risk index, growth rate of GDP per capita and a *de jure* measure of capital controls.[16]

Next, we turn to the level and volatility of the stock market. We begin with a naive OLS estimation of the effect of crisis indicators and creditor protection on the level and the volatility of stock market index. Because the model predicts that good creditor protection affects stock market

[15] 1997 is chosen because in this year we have stock market data for all countries in our sample. The results are not sensitive to the normalization point.

[16] Logit and linear probability models produce similar results.

level and volatility in credit constrained regime, we include the interaction term of crisis indicator and the indicator of high level of creditor rights index. We control for growth rate of GDP per capita and a *de jure* measure of capital controls.

Evidently, one cannot possibly explain all the cross–country differences that would affect the stock market level volatility variation across countries by institutional variables. Thus, we employ country–specific fixed–effects regression analysis. Note that since our measure of creditor rights protection does not vary over time, it drops out from these regressions. Alternatively, we include region fixed effects instead of country fixed effects, which allows us to keep the creditor protection measure in the regressions.

The problem with the above approach is that liquidity crises and stock market level and volatility are likely to be simultaneously determined. To address this, problem we follow Razin and Rubinstein (2006), and estimate an instrumental variable regression.[17]

We use as instruments the indicator of liquidity crisis lagged by one year and the ICRG indicator of political risk. Because stock market prices tend to be forward–looking and efficient in processing information, past liquidity crises are unlikely to have a *direct* effect on the volatility of the stock market, although they are likely to affect the probability of future crises.[18] While there are many theoretical reasons to believe that the indicator of political risk does have a direct effect on stock market level and volatility, informal tests of this exclusion restriction confirm that it is a valid instrument.[19]

4.3 Empirical Findings

Table 2 reports the results of four probit regressions. The first two columns use the quantity–based definition of the liquidity crisis (decline in bank credit to the private sector), the second two — the

[17]For technical reasons, we use linear probability model in the first stage and estimate the system jointly using limited information maximum likelihood.

[18]See Fama (1991) for empirical evidences of the weak-form efficient market hypothesis.

[19]The results of these tests are not reported but are available upon request.

price–based definition (increase in the real interest rate). The first and the third regressions use the weak definition of the crisis (10% tail), while the second and the fourth use the strict definition (5% tail). While we experimented with a number of explanatory variables, here we use parsimonious specifications in which only the variables that have significant effects are included.

We find that crises are persistent when quantity definition is used, but not persistent if they are defined according to the price definition. As model predicts, better creditor protection lowers the probability of a liquidity crisis. In addition, higher rate of per capita GDP growth and a more stable political situation lower the probability of a liquidity crisis, regardless of the crisis definition used, although the effect of per capita GDP growth is only significant if quantity definition is used.[20] Finally, when crises are defined as a rise in the real interest rate, a more open financial account lowers the probability of a domestic liquidity crisis. In terms of magnitude of the effects, an increase in the creditor rights index from a low level of 0, 1, or 2 to a high level of 3 or 4 lowers the probability of a liquidity crisis by 5.5 percentage points if the weak quantity definition of crises is used, and by 7.8 percentage points if the weak price definition is used. These effects are quite large given that the share of crises in the sample is 10 percent by construction when the weak definition is used.

Table 3 reports the results of our OLS regression with country fixed effects. Because the index of creditor rights protection does not vary over time, it drops out of the estimation. We can see, however, the effects of liquidity crises and how they differ in countries with high level of creditor rights protection, using the interaction term.

We find, as model predicts, that liquidity crises tend to lower the level of stock market index and to increase its variance in countries with low level of creditor rights protection. These effects are found regardless of the liquidity crisis indicator used, although statistical significance of the effect depends on the definition used. The model predicts that better creditor protection would

[20]We did not lag the GDP growth variable because we believe it to be predetermined and only affected by the liquidity crisis with a lag.

mitigate the effect of the crisis. We do find this effect, although it is statistically significant only in one of the four cases (weak quantity definition in the level regression and weak price definition in the quantity regression).

Table 4 reports the results of a similar regression, but with only region fixed effects, which allows us to estimate the effect of creditor rights protection indicator directly. Because of the interaction term, the coefficient on the creditor rights protection itself should be interpreted as the effect of creditor rights protection during the unconstrained regime (when crisis indicator is zero). The model predicts that in unconstrained case creditor protection does not play a role because borrowing constraint is not binding. With the exception of column (1) in the level regression, where we find a significant negative effect, this prediction is supported by the data. During the crisis, however, creditor protection does seam to mitigate the crisis effect on both level and the volatility of the stock market, as the model predicts. Note that the effects in these regressions are stronger than those reported in Table 3.

Because the crisis indicator is potentially endogenous, or is determined simultaneously with the stock market index, we repeat the regression analysis reported in Tables 3 and 4 using instrumental variables approach, in which we estimate the linear probability model for the crisis and its interaction with creditor protection index simultaneously with the linear regression for the level or volatility of the stock market, using limited information maximum likelihood. The results are reported in Tables 5 and 6 for regressions with country and region fixed effects, respectively.

We can see from Table 5 that not only our results with respect to the effect of liquidity crisis on the level and volatility of the stock market index survive the IV treatment, they in fact become stronger — we now find statistically significant effects in three out of four cases for both level and volatility regressions. The effects of the interaction term of crisis indicator and creditor protection indicator is more affected. For the level regression, high level of creditor rights protection appears to offset the effect of the crisis only in the regressions where quantity definition of the crisis is used, and the effect is only significant for the strong definition. For the volatility regression, none of the coefficients on the interaction term are statistically significant, and only one (in column (4)) is large enough to offset the crisis effect.

Turning to Table 6, we find that the high level of the creditor rights index does not have an effect on stock market volatility and lowers the level of the stock market index during non–crisis times. It does appear to offset the crisis effect on the stock market level in the regressions with quantity definition of the crisis and in three out of four volatility regressions, although in case of volatility the effect is not statistically significant. We continue to find that in countries with low level of creditor rights protection, liquidity crisis lowers the level of the stock market index (only if quantity definition is used) and increases stock market volatility.

To summarize, we find strong support for the model prediction that creditor rights protection lowers the probability of a liquidity crisis. The results of our stock market index regressions are more mixed, but are broadly consistent with model predictions. In fact, in almost all regressions reported in Tables 3 through 7 one cannot reject the hypothesis that liquidity crises have no effect on the level or volatility of the stock market index in countries with high level of creditor rights protection, while in many cases we can reject this hypothesis for countries with low level of creditor rights protection.

5 Conclusion

In this paper we examine the connection between creditor protection and the level and volatility of stock market prices. Tobin q model of stock prices predicts that the strengthening of the creditor protection results in higher expected returns and reduced volatility.

The paper tests these predictions of the model by using cross–country panel regressions of the stock market returns, in 40 countries, over the period from 1984 to 2004, at an annual frequency. We find broad empirical support for the prediction of the model that creditor protection increases the expected level of the stock market price level and reduces its volatility, both directly and indirectly, by lowering the probability of credit crunches.

Our paper thus demonstrates the importance of creditor protection for the development of a well–functioning stock market: strong creditor rights not only enhances stock market values, it also reduces the volatility of the stock returns. This finding is relevant for the recent credit crunch that is associated with significant increase in stock market volatility. For example, while Germany (with strong creditor-protection institutions) has been affected significantly by the liquidity crisis, the increase in German stock market volatility has been less pronounced than in countries with weaker creditor protection, such as France, Australia, or Japan.

Finally, there are other mechanisms through which creditor protection may affect the level and volatility of stock market prices. For instance, Hale, Razin, and Tong (2006) analyze the moral hazard channel.

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6 Appendix I. Derivation of Stock Price Under Friction-Free Regime

The first-order condition, derived from the maximization of the Lagrangian with respect to I_t, is given by

$$1 + \frac{1}{v}\frac{I_t}{K_t} = Q_t. \tag{A1}$$

Linearizing $\ln\left(1 + v\left(Q_t - 1\right)\right)$ at the steady state $\bar{Q} = 1$ yields:

$$k_{t+1} = k_t + v\left(Q_t - 1\right). \tag{A2}$$

Linearizing R_{t+1} at the steady state, $\bar{A}$ and $\bar{K}$, gives:

$$R_{t+1} = (1-\rho)\,\bar{K}\left(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}\right). \tag{A3}$$

Also,

$$\frac{1}{v}\left(\frac{I_{t+1}}{K_{t+1}}\right)^2 = v\left(Q_{t+1} - 1\right)^2, \tag{A4}$$

hence

$$Q_t = \frac{1}{1+r}E_t\left(\left((1-\rho)\,\bar{K}\left(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}\right)\right) + \frac{1}{2}v\left(Q_{t+1} - 1\right)^2 + Q_{t+1}\right), \tag{A5}$$

Around the steady state, $\left(Q_{t+1} - 1\right)^2$ is an order of magnitude smaller than the term $\left(Q_{t+1} - 1\right)$. Accordingly, we drop $\left(Q_{t+1} - 1\right)^2$ from the approximation equation (A5) , and get:

$$(1+r)Q_t = (1-\rho)\,\bar{K}\left(1 + a_{t+1} - \rho k_{t+1} + \rho \ln \bar{K}\right) + E_t\left[Q_{t+1}\right]. \tag{A6}$$

Note that

$$a_{t+1} = \gamma a_t + \varepsilon_{t+1}. \tag{A7}$$

Combining equations (A2), (A5), and (A7), we get

$$Q_t = \frac{(1-\rho)\left(1+\rho \ln \bar{K} + \gamma a_t + \rho (v - k_t)\right) \bar{K} + E_t [Q_{t+1}]}{\left(1 + r + v\rho (1-\rho) \bar{K}\right)} \tag{A8}$$

Appendix 2. Data sources

In the regressions that are reported we used the data series constructed from the variables listed below. In our robustness tests we used a host of additional control variables that were obtained mostly from the IFS and the Global Financial Data.

Variable	Units	Frequency	Source
Creditor rights index	Index 0-4	cross-section	La Porta, et al. (1998)
Composite stock market close	Index	monthly (eop)	Global Financial Data
Exchange rate against U.S. dollar	n.c./U.S.dollar	monthly (eop)	Global Financial Data
U.S. CPI	Index	monthly (eop)	Global Financial Data
Bank credit to private sector	millions of n.c.	annual	IFS, line 22d
Deposit rate	percent	annual/monthly (eop)	IFS, line 60l
Money market rate	percent	annual/monthly (eop)	IFS, line 60b
Inflation rate	percent	annual/monthly	IFS, line 64..x
GDP in U.S. dollars	millions of USD	annual	Global Financial Data
Population	thousands of people	annual	Global Financial Data
De jure financial account openness	Index 0-100	annual	Edwards (2006)
Index of political stability	Index 0-100	annual	ICRG
Index of *de jure* capital controls	Index	annual	Edwards (2006)
Systemic sudden stop	Binary	annual	Calvo et al. (2006)
Companies listed on stock markets	units	annual	Global Financial Data

Figure 1: The distribution of countries over creditor rights index (CR)

	Developing	Developed
CR=0	Colombia, Mexico, Peru, Philippines	France
CR=1	Argentina, Brazil	Australia, Canada, Finland, Greece, Ireland, Portugal, Switzerland
CR=2	Chile, Turkey	Belgium, Italy, Japan, Netherlands, Norway, Spain, Sweden
CR=3	Korea, South Africa, Thailand	Austria, Denmark, Germany, New Zealand
CR=4	China, Egypt, Hong Kong, India, Indonesia, Israel, Malaysia, Pakistan, Singapore	United Kingdom

Table 1: List of liquidity crises in the sample

Country	Years of financial crisis	
	Quantity definition	Price definition
Argentina	1988[a], 1990, 2001-2003	1984, 1987-1990, 1992, 1993-1994[a], 2001, 2004[a]
Brazil	1989, 1990, 1998	1987-1990, 1992-1994, 1996, 1997-1998[a]
Chile	1985[a], 1990[a]	1984[a], 1987[a], 1989
China	1988[a]	1990[a], 1995[a], 1996[a]
Colombia	1998[a], 1999, 2000	1998
Denmark	1991, 1993, 1994[a]	
Egypt	1989[a], 1991	1985[a], 1990[a], 1992[a], 1996[a]
Finland	1992[a], 1993, 1994	
France	1993[a]	
Greece	1987[a], 1990[a], 1993[a]	1987[a], 1988[a]
Hong Kong	1991, 1999[a]	1999[a]
India	1991[a]	1984[a], 1989[a], 1995[a]
Indonesia	1998, 1999	1984[a], 1997
Ireland	1991[a]	
Japan	2001, 2002[a]	
Malaysia	1990, 1998[a]	
Mexico	1985[a], 1986, 1987[a], 1995-1996, 1998-1999[a], 2001	1984, 1985, 1989, 1995, 1998
Pakistan	1990[a]	
Peru	1989, 2000[a], 2003[a]	1991, 1992, 1993, 1995[a], 1999[a]
Philippines	1984-1986, 1991[a], 1998, 1999[a], 2001[a]	1985, 1986, 1992, 1997[a]
Singapore	2002[a]	
South Africa	1986[a], 2002	1984[a], 1988[a]
Spain	1984[a]	1987[a]
Sweden	1991[a], 1993, 1994[a]	1992
Thailand	1998-2000, 2001[a]	1997[a]
Turkey	1988, 1994, 1998[a], 1999, 2001	1990, 1991, 1994, 1996, 1998[a], 1999, 2001, 2003[a]

[a] No liquidity crisis by on a more strict definition.
Countries that did not have crises: Australia, Austria, Belgium, Canada, Germany, Italy, Israel, Korea, Netherlands, New Zealand, Norway, Switzerland, United Kingdom.

Table 2: Marginal effects of the probit regressions

Dependent variable: I(liquidity crisis)	Quantity definition		Price definition	
	weak	strong	weak	strong
	(1)	(2)	(3)	(4)
I(Creditor rights index = 3 or 4)	-0.055***	-0.017	-0.078***	-0.044***
	(0.020)	(0.013)	(0.023)	(0.014)
ICRG political risk index	-0.002***	-0.001	-0.003***	-0.001**
	(0.001)	(0.001)	(0.001)	(0.000)
Lagged dependent variable	0.121***	0.207***	0.050	0.055
	(0.047)	(0.076)	(0.042)	(0.038)
Growth rate of GDP per capita	-0.337***	-0.181***	-0.022	-0.031
	(0.105)	(0.055)	(0.054)	(0.022)
Capital controls (de jure)	0.000	-0.000	-0.001***	-0.001***
	(0.001)	(0.000)	(0.001)	(0.000)

Probit regressions' marginal effects. Standard errors in parentheses. 692 observations.
* significant at 10%; ** significant at 5%; ***significant at 1%.

Table 3: OLS regressions. Country fixed effects

Crisis definition	Quantity definition		Price definition	
	weak	strong	weak	strong
	(1)	(2)	(3)	(4)
Dependent variable: stock market level				
I(Crisis)	-0.868**	-1.361*	-0.0592	-0.651
	(0.346)	(0.711)	(0.171)	(0.526)
I(CRED=3 or 4)*I(Crisis)	0.548*	0.980	-0.177	0.253
	(0.313)	(0.660)	(0.215)	(0.640)
Growth rate of GDP per capita	-0.0941	-0.151	0.235	0.170
	(0.414)	(0.468)	(0.333)	(0.341)
Capital controls (de jure)	0.0271***	0.0271***	0.0275***	0.0261***
	(0.00678)	(0.00667)	(0.00756)	(0.00683)
Adjusted R^2	0.848	0.849	0.846	0.847
Dependent variable: stock market volatility				
I(Crisis)	0.158	0.119	0.205***	0.318**
	(0.0963)	(0.133)	(0.0749)	(0.154)
I(CRED=3 or 4)*I(Crisis)	0.0485	0.100	-0.346**	-0.236
	(0.179)	(0.224)	(0.128)	(0.220)
Growth rate of GDP per capita	-0.228	-0.260	-0.302*	-0.275*
	(0.185)	(0.185)	(0.172)	(0.161)
Capital controls (de jure)	-0.00500	-0.00508	-0.00472	-0.00433
	(0.00358)	(0.00354)	(0.00351)	(0.00328)
Adjusted R^2	0.346	0.343	0.347	0.350

Standard errors in parentheses. 716 observations.
* significant at 10%; ** significant at 5%; ***significant at 1%.

Table 4: OLS regressions. Region fixed effects

Crisis definition	Quantity definition		Price definition	
	weak	strong	weak	strong
	(1)	(2)	(3)	(4)
Dependent variable: stock market level				
I(Creditor rights index = 3 or 4)	-1.469*	-1.306	-1.075	-1.154
	(0.791)	(0.797)	(0.827)	(0.817)
I(Crisis)	-2.220**	-1.893*	0.886	0.138
	(0.926)	(1.080)	(0.962)	(1.071)
I(CRED=3 or 4)*I(Crisis)	2.020**	1.296	-0.706	-0.964
	(0.970)	(1.212)	(1.223)	(1.441)
Growth rate of GDP per capita	-1.347	-1.145	-0.522	-0.560
	(0.876)	(0.791)	(0.603)	(0.622)
Capital controls (de jure)	0.00786	0.00852	0.0101	0.00897
	(0.0156)	(0.0157)	(0.0159)	(0.0161)
Adjusted R^2	0.316	0.305	0.301	0.299
Dependent variable: stock market volatility				
I(Creditor rights index = 3 or 4)	-0.169	-0.177	-0.139	-0.152
	(0.128)	(0.128)	(0.109)	(0.113)
I(Crisis)	0.252**	0.321*	0.441***	0.594***
	(0.108)	(0.174)	(0.117)	(0.174)
I(CRED=3 or 4)*I(Crisis)	-0.0896	-0.117	-0.554***	-0.476*
	(0.184)	(0.250)	(0.163)	(0.241)
Growth rate of GDP per capita	-0.171	-0.173	-0.261	-0.226
	(0.204)	(0.207)	(0.191)	(0.190)
Capital controls (de jure)	-0.00506**	-0.00511**	-0.00478**	-0.00456**
	(0.00214)	(0.00212)	(0.00207)	(0.00194)
Adjusted R^2	0.216	0.215	0.236	0.242

Standard errors in parentheses. 716 observations.
* significant at 10%; ** significant at 5%; ***significant at 1%.

Table 5: IV regressions. Country fixed effects

Crisis definition	Quantity definition		Price definition	
	weak	strong	weak	strong
	(1)	(2)	(3)	(4)
Dependent variable: stock market level				
I(Crisis)	-4.234*	-5.578***	-1.469	-6.363**
	(2.160)	(1.804)	(3.379)	(2.609)
I(CRED=3 or 4)*I(Crisis)	4.657	5.198*	17.29	-8.195
	(3.340)	(2.896)	(12.61)	(10.79)
Growth rate of GDP per capita	-1.179	-1.375*	0.242	-0.338
	(0.897)	(0.724)	(0.840)	(0.674)
Capital controls (de jure)	0.0184***	0.0203***	0.0255*	0.00175
	(0.00474)	(0.00455)	(0.0145)	(0.00967)
Adjusted R^2	0.864	0.870	0.582	0.765
Dependent variable: stock market volatility				
I(Crisis)	0.547	1.254**	1.396*	1.895***
	(0.634)	(0.587)	(0.762)	(0.725)
I(CRED=3 or 4)*I(Crisis)	0.143	-0.449	0.602	-1.633
	(0.991)	(0.947)	(2.404)	(2.131)
Growth rate of GDP per capita	0.0341	0.177	-0.211	-0.0650
	(0.270)	(0.239)	(0.189)	(0.188)
Capital controls (de jure)	-0.00448***	-0.00478***	-0.000347	0.000382
	(0.00147)	(0.00152)	(0.00320)	(0.00266)
Adjusted R^2	0.341	0.266	.	0.0752

Estimated by LIML. Instrumented: I(Crisis) and I(CRED=3 or 4)*I(Crisis)
Instruments: ICRG political risk index, lagged I(Crisis)
Standard errors in parentheses. 680 observations.
* significant at 10%; ** significant at 5%; ***significant at 1%.

Table 6: IV regressions. Region fixed effects

Crisis definition	Quantity definition		Price definition	
	weak	strong	weak	strong
	(1)	(2)	(3)	(4)
Dependent variable: stock market level				
I(Creditor rights index = 3 or 4)	-2.575***	-1.529***	-2.755	-1.032**
	(0.697)	(0.457)	(3.774)	(0.450)
I(Crisis)	-10.96***	-6.583**	11.03	0.201
	(3.876)	(3.239)	(20.87)	(2.978)
I(CRED=3 or 4)*I(Crisis)	11.79**	4.662	87.74	-11.09
	(5.859)	(5.357)	(153.5)	(11.45)
Growth rate of GDP per capita	-4.302**	-2.604*	-1.155	-0.254
	(1.938)	(1.532)	(4.806)	(1.096)
Capital controls (de jure)	0.000577	0.00309	0.0604	0.00204
	(0.00867)	(0.00772)	(0.101)	(0.00865)
Adjusted R^2	0.0887	0.286	.	0.280
Dependent variable: stock market volatility				
I(Creditor rights index = 3 or 4)	-0.0399	-0.0902	0.0242	0.00567
	(0.102)	(0.0741)	(0.121)	(0.0811)
I(Crisis)	1.314**	1.801***	2.281***	2.522***
	(0.568)	(0.524)	(0.697)	(0.522)
I(CRED=3 or 4)*I(Crisis)	-1.112	-1.327	0.0193	-1.988
	(0.861)	(0.868)	(3.220)	(1.814)
Growth rate of GDP per capita	0.265	0.347	-0.252	-0.0638
	(0.281)	(0.249)	(0.232)	(0.202)
Capital controls (de jure)	-0.00479***	-0.00509***	-0.00236	-0.00252*
	(0.00125)	(0.00126)	(0.00228)	(0.00151)
Adjusted R^2	0.0603	0.0554	.	.

Estimated by LIML. Instrumented: I(Crisis) and I(CRED=3 or 4)*I(Crisis)
Instruments: ICRG political risk index, lagged I(Crisis)
Standard errors in parentheses. 680 observations.
* significant at 10%; ** significant at 5%; ***significant at 1%.