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Romain Ranciere
Aaron Tornell
Frank Westermann

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ABSTRACT

In this paper, we document the fact that countries that have experienced occasional financial crises have, on average, grown faster than countries with stable financial conditions. We measure the incidence of crisis with the skewness of credit growth, and find that it has a robust negative effect on GDP growth. This link coexists with the negative link between variance and growth typically found in the literature. To explain the link between crises and growth we present a model where contract enforce-ability problems generate borrowing constraints and impede growth. In the set of financially liberalized countries with a moderate degree of contract enforceability, systemic risk-taking relaxes borrowing constraints and increases investment. This leads to higher mean growth, but also to greater incidence of crises. We find that the negative link between skewness and growth is indeed strongest in this set of countries, validating the restrictions imposed by the model's equilibrium.

Romain Ranciere
International Monetary Fund
Research Department, 9-612
700 19th Street NW
Washington, DC 20431
rranciere@imf.org

Frank Westermann
Department of Economics
Rolandstr. 8
49069 Osnabrueck, Germany
Frank.Westermann@uni-osnabrueck.de

Aaron Tornell
Department of Economics
UCLA
405 Hilgard Ave, Bunche Hall #8283
Los Angeles, CA 90095-1477
tornell@econ.ucla.edu

1 Introduction

In this paper we show that over the last four decades countries that have experienced financial crises have, on average, grown faster than countries with stable financial conditions. To explain this fact we present a theoretical mechanism in which systemic risk taking mitigates financial bottlenecks and increases growth in countries with weak institutions. Systemic risk, however, also leads to occasional crises. We then show that the set of countries to which our mechanism applies in theory is closely identified with the countries that have experienced fast growth and crises in the data.

We use the *skewness* of real credit growth as a de facto measure of systemic-risk. During a systemic crisis there is a large and abrupt downward jump in credit growth. Since crises only happen *occasionally,* these negative outliers tilt the distribution to the left. Thus, in a large enough sample, crisis-prone economies tend to exhibit lower skewness than economies with stable financial conditions. We provide evidence of a strong correspondence between skewness and several crisis indexes. In particular, we show that crises are the principal source of negative skewness once we have controlled for large exogenous shocks such as war and large scale deterioration in the terms of trade.

We choose not to use *variance* to capture the uneven progress associated with financial fragility because high variance captures not only rare, large and abrupt contractions, but also frequent and symmetric shocks. In contrast, skewness specifically captures asymmetric and abnormal patterns in the distribution of credit growth and thus can identify the risky paths that exhibit *rare, large and abrupt* credit busts.[1]

We estimate a set of regressions that adds the three moments of credit growth to standard growth equations. We find a negative link between per-capita GDP growth and the skewness of real credit growth. This link is robust across alternative specifications and sample periods and is independent of the negative effect on growth due to variance that is typically found in the literature. The positive link between systemic crises and growth is confirmed when systemic banking crisis indicators are used instead of skewness.

Thailand and India illustrate the choices available to countries with weak institutions. While India followed a path of slow but steady growth, Thailand experienced high growth, lending booms and crisis (see Figure 1). GDP per capita grew by only 114% between 1980 and 2002 in India, whereas Thailand's GDP per capita grew by 162%, despite the effects of a major crisis.

The link between skewness and growth is economically important. Our benchmark estimates indicate that about a third of the difference in growth between India and Thailand can be attributed to systemic risk taking. Needless to say this finding *does not* imply that financial crises are good for growth. It suggests, however, that high growth paths are associated with the undertaking of

[1] In the finance literature, skewness is used to characterize the presence of abnormal downside risk. The literature review section provides references.

systemic risk and with the occurrence of *occasional* crises.

To interpret the link between skewness and growth we present a model in which high growth and a greater incidence of crises are part of an internally consistent mechanism. In the model, contract enforceability problems imply that growth is stymied by borrowing constraints. In a financially liberalized economy, systemic risk taking reduces the effective cost of capital and relaxes borrowing constraints. This allows for greater investment and growth as long as a crash does not occur. Of course, when a crash does occur the short-term effects of the sudden collapse in financial intermediation are severe. Since a crash is inevitable in a risky economy, whether systemic risk taking is growth enhancing or not is open to question. The key contribution of our model is to show that whenever systemic risk arises, it increases mean growth even if crises have arbitrarily large output and financial distress costs.

Our theoretical mechanism implies that the link between systemic risk and growth is strongest in the set of financially liberalized economies with a moderate degree of contract enforceability. In the second part of our empirical analysis, we test this identification restriction and find strong support for it.

This paper is structured as follows. Section 2 presents the model. Section 3 presents the empirical analysis. Sections 4 and 5 present a literature review and our conclusions. The appendix contains some extensions of the model and the description of the data used in the regression analysis. Finally, an extended appendix contains the proofs and presents some additional empirical results.

2 Model

Here, we present a stochastic Ak growth model where high growth depends on the nature of the financial system. Fast growth takes place either when contracts are easily enforced or when contracts are only moderately enforceable, but systemic risk taking supports high levels of investment. In the appendix we present a decreasing returns version of the model. Because our model generates a positive link between systemic risk and growth when financial institutions are moderately strong, the identifying restrictions considered in the empirical section select out countries with this characteristic.

We consider an economy where *imperfect contract enforceability* generates borrowing constraints as agents cannot commit to repay debt. This financial bottleneck leads to low growth because investment is constrained by firms' internal funds. When the government promises –either explicitly or implicitly– to bail out lenders in case of a systemic crisis, financial liberalization may induce agents to coordinate in undertaking insolvency risk. Since taxpayers will repay lenders in the eventuality of a systemic crisis, risk taking reduces the effective cost of capital and allows borrowers to attain greater leverage. Greater leverage allows for greater investment, which leads to greater future internal funds, which in turn will lead to more investment and so on. This is the *leverage effect* through which systemic risk increases investment and growth along the no-crisis path. Systemic risk taking, however, also leads to aggregate financial fragility and to occasional crises.

Crises are costly. Widespread bankruptcies entail severe deadweight losses. Furthermore, the resultant collapse in internal funds depresses new credit and investment, hampering growth. Can systemic risk taking increase long-run growth by compensating for the effects of enforceability problems? Yes. If contract enforceability problems are severe –so that borrowing constraints arise– but not too severe –so that the leverage effect is strong, then a risky economy will, on average, grow faster than a safe economy even if crisis costs are arbitrarily large.

Setup

During each period the economy can be either in a good state ($\Omega_t = 1$), with probability u, or in a bad state ($\Omega_t = 0$). To allow for the endogeneity of systemic risk, we assume that there are two production technologies: a safe one and a risky one. Under the safe technology, production is *perfectly uncorrelated* with the state, while under the risky one the correlation is perfect. For concreteness, we assume that the risky technology has a return $\Omega_{t+1}\theta$, and the safe return is σ

$$q_{t+1}^{safe} = \sigma I_t^s, \qquad q_{t+1}^{risky} = \begin{cases} \theta I_t^r & \text{prob } u, \quad u \in (0,1) \\ 0 & \text{prob } 1-u \end{cases} \tag{1}$$

where I_t^s is the investment in the safe technology and I_t^r is the investment in the risky one.[2] Production is carried out by a continuum of firms with measure one. The investable funds of a firm consist of its internal funds w_t plus the one-period debt it issues b_t. Thus, the firm's budget constraint is

$$w_t + b_t = I_t^s + I_t^r \tag{2}$$

The debt issued by firms promises to repay $L_{t+1} := b_t[1+\rho_t]$ in the next period. It is acquired by international investors who are competitive risk-neutral agents with an opportunity cost of funds equal to the international interest rate r.

In order to generate both borrowing constraints and systemic risk, we follow Schneider and Tornell (2004) and assume that firm financing is subject to two credit market imperfections: contract enforceability problems and systemic bailout guarantees. We model these imperfections by assuming that firms are run by overlapping generations of managers who live for two periods and cannot commit to repay debt. In the first period of her life, for example t, a manager chooses investment and whether to set up a diversion scheme. At $t+1$ the firm is solvent if revenue is

[2] Since we will focus on symmetric equilibria, we will not distinguish individual from aggregate variables.

greater than the promised debt repayment:

$$\pi_{t+1} = q_{t+1} - L_{t+1} > 0 \tag{3}$$

If the firm is solvent at $t+1$ and there is no diversion, the now old manager receives $[d-\tau]\pi_{t+1}$ and consumes it, the government is paid taxes of $\tau\pi_{t+1}$, the young manager receives $[1-d]\pi_{t+1}$ and lenders get their promised repayment. If the firm is insolvent at $t+1$, all output is lost in bankruptcy procedures. In this case, old managers get nothing, no tax is paid, and lenders receive the bailout if any is granted. If the firm is solvent and there is diversion, the firm defaults strategically, the old manager takes $[d-\tau]q_{t+1}$, and the rest of the output is lost in bankruptcy procedures. Lenders receive the bailout if any is granted. Finally, if the firm defaults, the young manager receives an aid payment from the government (a_{t+1}) that can be arbitrarily small.[3] Thus, a firm's internal funds evolve according to

$$w_{t+1} = \begin{cases} [1-d]\pi_{t+1} & \text{if } \; q_{t+1} > L_{t+1} \text{ and no diversion} \\ a_{t+1} & \text{otherwise} \end{cases} \tag{4}$$

In the initial period internal funds are $w_0 = [1-d]w_{-1}$ and the tax is τw_{-1}.

For concreteness, we make the following two assumptions.

Contract Enforceability Problems. If at time t the manager incurs a non-pecuniary cost $h \cdot [w_t + b_t][d-\tau]$, then at $t+1$ she will be able to divert provided the firm is solvent.

Systemic Bailout Guarantees. If a majority of firms becomes insolvent, the government pays lenders the outstanding debts of all defaulting firms. Otherwise, no bailout is granted.

Since guarantees are systemic, the decisions of managers are interdependent and are determined in the following credit market game. During each period, every young manager proposes a plan $P_t = (I_t^r, I_t^s, b_t, \rho_t)$ that satisfies the budget constraint (2). Lenders then decide whether to fund these plans. Finally, every young manager makes a diversion decision η_t, where $\eta_t = 1$ if the manager sets up a diversion scheme, and zero otherwise. The problem of a young manager is thus to choose an investment plan P_t and a diversion strategy η_t to maximize her expected payoff:

$$\max_{P_t, \eta_t} \; E_t \xi_{t+1} \left([1-\eta_t][q_{t+1} - L_{t+1}] \; + \; \eta_t [q_{t+1} - h[w_t + b_t]] \right) (d - \tau) \quad \text{s.t. (2)}, \tag{5}$$

where $\xi_{t+1} = 1$ if $q_{t+1} > L_{t+1}$, and zero otherwise.

Bailouts are financed by taxing solvent firms' profits at a rate $\tau < d$. The tax rate is set such that the expected present value of taxes equals the expected present value of bailout plus aid payments.

[3] The aid payment is necessary to restart the economy in the wake of a systemic crisis.

To ensure that the bailout scheme does not involve a net transfer from abroad we impose the following fiscal solvency condition

$$E_t \sum_{j=0}^{\infty} \delta^{j-t} \left\{ \xi_{t+j+1}\pi_{t+j+1}\tau \ - \ [1-\xi_{t+j+1}][a_{t+j+1} + L_{t+j+1}] \right\} |_{\tau<d} = 0, \quad \delta \equiv \frac{1}{1+r} \tag{6}$$

Finally, we define *financial liberalization* as a policy environment that does not constrain risk taking by firms and thus allows firms to finance any type of investment plan that is acceptable to international investors.

2.1 Discussion of the Setup

To make it clear that the positive link between growth and systemic risk in our mechanism does *not* derive from the assumption that risky projects have a greater mean return than safe ones, we restrict the risky technology to have an expected return ($u\theta$) that is *lower* than the safe one (σ)

$$\delta^{-1} \equiv 1 + r \leq u\theta < \sigma < \theta \tag{7}$$

The condition $u\theta < \sigma$ implies that the moral hazard induced by the guarantees supports lending to inefficient projects. Nevertheless, because an equilibrium with risky projects is also an equilibrium with high leverage and high investment, the risky equilibrium can exhibit greater mean growth–as shown by Proposition 2.2.[4] The condition $1+r \leq u\theta$ guarantees that both projects have a positive net present value.

The mechanism linking growth with the propensity to crisis requires that both borrowing constraints and systemic risk arise simultaneously in equilibrium in a financially liberalized economy. In most of the literature, there are models with either borrowing constraints or systemic risk, but not both. In our setup, in order to have both it is necessary that enforceability problems interact with systemic bailout guarantees. If only enforceability problems were present, lenders would be cautious and the equilibrium would feature borrowing constraints, but lenders would not allow firms to risk insolvency. If only systemic guarantees were present, there would be no borrowing constraints, so risk taking would not be growth enhancing.

It is necessary that guarantees be systemic. If bailouts were granted whenever there was an idiosyncratic default, borrowing constraints would not arise because lenders would always be repaid –by the government.

The government's only role is to transfer fiscal resources from no-crisis states to crisis states. The fiscal solvency condition (6) implies that in crisis times the government can borrow at the

[4] In other words, because higher average growth derives from an increase in borrowing ability due to the undertaking of systemic risk, the mechanism does not depend on the existence of a 'mean-variance' channel. That is, the mechanism does not require that *high* variance technologies have a *higher* expected return than *low* variance technologies.

world interest rate –or that it has access to an international lender of last resort– to bail out foreign lenders, and that it repays this debt in no-crisis times by taxing solvent domestic firms. In the extended appendix, we present evidence on bailouts that supports these assumptions.

Managers receive an exogenous share d of profits. The advantage of this assumption and of the overlapping generations structure is that we can analyze financial decisions period-by-period. Among other things, we do not have to take into account the effect of the firm's value –i.e. the future discounted profits of the firm– on a manager's decision to default strategically. This is especially useful in our setting, where financial decisions are interdependent across agents due to the systemic nature of bailout guarantees.

Our model is designed to be simple enough to make transparent the link between growth and systemic risk. Next, we discuss three extensions of the model that clarify how the mechanism works in more complicated situations. In the current setup, there are two states of nature, and the agents' choice of production technology determines whether or not systemic risk arises. This is a simple way to represent the basic mechanism underlying more realistic situations like currency mismatch, where insolvency risk arises endogenously because firms that produce for the domestic market issue debt denominated in foreign currency. Modelling currency mismatch makes the analysis more complicated because one needs to consider two sectors and characterize the behavior of their relative price. In the appendix, we describe how a mechanism analogous to ours emerges in a two-sector economy where systemic risk is generated by currency mismatch.

Our simple Ak set-up allows us to simplify the presentation dramatically, but it has implausible implications for the world income distribution and the world interest rate in the very long run. In the appendix we present a version of the model with decreasing returns technologies. We show that systemic risk accelerates growth if the level of income is sufficiently low, but does not increase growth indefinitely. When the economy becomes rich, it must switch to a safe path.

Finally, taxes in our current setup do not distort the incentives to divert income. In the proof of Proposition 2.1, we also consider an extension with a distortionary setup where old managers of solvent non-diverting firms are taxed, but those of diverting firms are not taxed. We find the same equilibria without diversion as those we describe in Proposition 2.1 below. However, more stringent conditions must be imposed on u and the tax rate on old managers must lie below a threshold.

2.2 Equilibrium Risk Taking

In this subsection, we characterize the conditions under which borrowing constraints and systemic risk can arise simultaneously in a symmetric equilibrium. Define a *systemic crisis* as a situation where a majority of firms goes bust, and denote the probability at date t that this event occurs in the next period by $1 - \zeta_{t+1}$, where ζ_{t+1} equals either u or 1. Then, a plan $(I_t^r, I_t^s, b_t, \rho_t)$ is part of a symmetric equilibrium if it solves the representative manager's problem, taking ζ_{t+1} and w_t as given.

The next proposition characterizes symmetric equilibria at a point in time. It makes three key points. First, binding borrowing constraints arise in equilibrium, and investment is constrained by internal funds only if contract enforceability problems are severe:

$$0 \leq h < [1+r]\zeta_{t+1} \equiv \bar{h}_{t+1}, \qquad \zeta_{t+1} \in \{1, u\} \tag{8}$$

Lenders are willing to lend up to the point where borrowers do not find it optimal to divert. When (8) does not hold, the expected debt repayment is lower than the diversion cost $h[w_t + b_t]$ for all levels of b_t, and no diversion takes place. Thus, when (8) does not hold, lenders are willing to lend any amount. Secondly, systemic risk taking eases, but does not eliminate, borrowing constraints and allows firms to invest more than under a safe plan. This is because systemic risk taking allows agents to exploit the subsidy implicit in the guarantees and thus they face a lower expected cost of capital. Thirdly, systemic risk may arise endogenously in a liberalized economy only if bailout guarantees are present. Guarantees, however, are not enough. It is also necessary that a majority of agents coordinates in taking on insolvency risk, that crises be rare, and that contract enforceability problems are not 'too severe' ($h > \underline{h}$):

$$\underline{h} := \frac{\sigma - \theta u^2}{2(1-u)} - \frac{\left[(\sigma - \theta u^2)^2 - 4u\delta^{-1}(1-u)(\sigma - \theta u)\right]^{1/2}}{2(1-u)} \tag{9}$$

When h is too small, taking on risk does not pay because the increase in leverage is too small to compensate for the risk of insolvency.

Proposition 2.1 (Symmetric Credit Market Equilibria (CME)) *Borrowing constraints arise in equilibrium only if the degree of contract enforceability is not too high: $h < \bar{h}_{t+1}$. If this condition holds, then:*

1. *There always exists a 'safe' CME in which all firms only invest in the safe technology and a systemic crisis in the next period cannot occur ($\zeta_{t+1} = 1$).*
2. *Under financial liberalization there also exists a 'risky' CME in which $\zeta_{t+1} = u$ and all firms invest in the risky technology if and only if crises are rare events ($u > 0.5$) and $h > \underline{h}$.*
3. *In both safe and risky CMEs, credit and investment are constrained by internal funds:*

$$b_t = [m_t - 1]w_t, \qquad I_t = m_t w_t, \qquad \text{with} \;\; m_t = \frac{1}{1 - (\zeta_{t+1})^{-1}h\delta}. \tag{10}$$

The intuition underlying the safe equilibrium is the following.[5] Given that all other managers

[5] We show in the proof that if taxes are imposed only on old managers of solvent non-diverting firms (as described in subsection 2.1), the equilibria of Proposition 2.1 exist provided $\tau^{old} < dh/u\theta$ and u is large enough.

choose a *safe plan*, a manager knows that no bailout will be granted next period. Since lenders must break-even, the manager must internalize the insolvency risk. Thus, she will choose a safe technology, which has a greater expected return than the risky technology (i.e., $\sigma > u\theta$). Since the firm will not go bankrupt in any state, the interest rate that the manager has to offer satisfies $1+\rho_t = 1+r$. It follows that lenders will be willing to lend up to an amount that makes the no diversion constraint binding: $(1+r)b_t \leq h(w_t + b_t)$. By substituting this borrowing constraint in the budget constraint we can see that there is a financial bottleneck: investment equals internal funds times a multiplier ($I_t^s = w_t m^s$, where $m^s = (1-h\delta)^{-1}$).[6]

Consider now the risky equilibrium. Given that all other managers choose a *risky plan*, a young manager expects a bailout in the bad state, but not in the good state. The key point is that since lenders will get repaid in full in both states, the interest rate allowing lenders to break even is again $1+\rho_t = 1+r$. It follows that the benefits of a risky no-diversion plan derive from the fact that, from the firm's perspective, expected debt repayments are reduced from $1+r$ to $[1+r]u$, as the government will repay debt in the bad state. A lower cost of capital eases the borrowing constraint as lenders will lend up to an amount that equates $u[1+r]b_t$ to $h[w_t+b_t]$. Thus, investment is higher than in a safe plan. The downside of a risky plan is that it entails a probability $1-u$ of insolvency. Will the two benefits of a risky plan –more and cheaper funding– be large enough to compensate for the cost of bankruptcy in the bad state? If h is sufficiently high, the leverage effect ensures that expected profits under a risky plan exceed those under a safe plan: $u\pi_{t+1}^r > \pi_{t+1}^s$. Note that the requirement that crises be rare events (i.e. that u be large) is necessary in order to prevent diversion. A high u rules out scams where the manager offers a very large repayment in the bad state and diverts all funds in the good state. Since the firm must be solvent in order for diversion to occur, when u is large enough the manager will not find it optimal to offer a diversion plan.

Finally, there is no CME in which both $I^r > 0$ and $I^s > 0$. The restrictions on returns and the existence of bankruptcy costs rule out such an equilibrium. Since in a safe equilibrium no bailout is expected, a firm has no incentive to invest any amount in the risky technology as its expected return, $u\theta$, is lower than the safe return, σ. In a risky equilibrium, firms have no incentive to invest any amount in the safe technology as in the bad state all output is lost in bankruptcy procedures, and in the good state the risky return is greater than the safe ($\sigma < \theta$).

2.3 Economic Growth

We have loaded the dice against finding a positive link between growth and systemic risk. First, we have restricted the expected return on the risky technology to be lower than the safe return ($\theta u < \sigma$). Secondly, we have allowed crises to have large financial distress costs as internal funds

[6] This is a standard result in the macroeconomics literature on credit market imperfections, e.g. Bernanke et. al. (2000) and Kiyotaki and Moore (1997).

collapse in the wake of crisis, i.e., the aid payment (a_{t+1}) can be arbitrarily small.

Here we investigate whether systemic risk is growth-enhancing in the presence of borrowing constraints by comparing two symmetric equilibria, safe and risky. In a safe (risky) equilibrium in every period agents choose the safe (risky) plan characterized in Proposition 2.1. We ask whether average growth in a risky equilibrium is higher than in a safe equilibrium.

The answer to this question is not straightforward because an increase in the probability of crisis, $1-u$, has opposing effects on growth. One the one hand, when $1-u$ increases, so does the subsidy implicit in the bailout guarantee. This in turn raises the leverage ratio of firms and the level of investment and growth along the lucky no-crisis path. On the other hand, an increase in $1-u$ also makes crises more frequent, which reduces average growth. In what follows we assume that the aid payment is a share α of the internal funds that the firm would have received had no crisis occurred

$$a_{t+1} = \alpha[1-d]\pi^r_{t+1}|_{(\Omega_{t+1}=1)}, \qquad \alpha \in (0,1) \tag{11}$$

The smaller α, the greater the financial distress costs of crises. Assumption (11) implies that although a richer economy experiences a greater absolute loss than a poor economy, in the aftermath of crisis the richer economy remains richer than the poor economy. Below, we discuss the implications of assuming instead that a_{t+1} is a constant.

In a safe symmetric equilibrium, crises never occur, i.e. $\zeta_{t+1} = 1$ in every period. Thus, internal funds evolve according to $w^s_{t+1} = [1-d]\pi^s_{t+1}$, where profits are $\pi^s_{t+1} = [\sigma - h]m^s w_t$. It follows that the growth rate, g^s, is given by

$$1 + g^s = [1-d][\sigma - h]m^s \equiv \gamma^s, \qquad m^s = \frac{1}{1-h\delta} \tag{12}$$

Since $\sigma > 1 + r$, the lower h, the lower the growth rate.

Consider now a risky symmetric equilibrium. Since firms use the risky technology, $\zeta_{t+1} = u$ every period. Thus, there is a probability u that firms will be solvent at $t+1$ and their internal funds will be $w_{t+1} = [1-d]\pi^r_{t+1}$, where $\pi^r_{t+1} = [\theta - u^{-1}h]m^r w_t$. However, with probability $1-u$ firms will be insolvent at $t+1$ and their internal funds will equal the aid payment: $w_{t+1} = a_{t+1}$. Since crises can occur in consecutive periods, growth rates are independent and identically distributed over time. Thus, the mean growth rate is

$$E(1+g^r) = [u + \alpha(1-u)]\gamma^n, \quad \gamma^n = [1-d][\theta - u^{-1}h]m^r, \qquad m^r = \frac{1}{1-u^{-1}h\delta} \tag{13}$$

The following proposition compares the mean growth rates in (12) and (13) and establishes conditions for systemic risk to be growth enhancing.[7]

[7] Although expected profits are greater in the risky than in the safe equilibrium, it does not follow that the risky equilibrium must be played every period. Proposition 2.2 simply compares situations where a safe equilibrium is

Proposition 2.2 (Growth and Systemic Risk) *Given the proportional aid payment (11), for any financial distress costs of crisis (i.e., for any $\alpha \in (0,1)$) :*

1. *A financially liberalized economy that follows a risky path experiences higher average growth than one that follows a safe path.*

2. *The greater the degree of contract enforceability, within the bounds $(\underline{h}, \overline{h})$, the greater the growth enhancing effects of systemic risk.*

3. *Guarantees are fundable via domestic taxation.*

The Leverage Effect

A shift from a safe to a risky equilibrium increases the likelihood of crisis from 0 to $1-u$. This shift results in greater leverage ($\frac{b_t^r}{w_t} - \frac{b_t^s}{w_t} = m^r - m^s$), which increases investment and growth in periods without crisis. We call this the leverage effect. However, this shift also increases the frequency of crises and the resultant collapse in internal funds and investment, which reduces growth. Proposition 2.2 states that the leverage effect dominates the crisis effect if the degree of contract enforceability is high, but not too high. If h is sufficiently high, the undertaking of systemic risk translates into a large increase in leverage, which compensates for the potential losses caused by crises. Of course, if h were excessively high, there would be no borrowing constraints to begin with and risk taking would not enhance growth.

An increase in the degree of contract enforceability –a greater h within the range $(\underline{h}, \bar{h})$– leads to higher profits and growth in both risky and safe economies. An increase in h can be seen as a relaxation of financial bottlenecks allowing greater leverage in both economies. However, such an institutional improvement benefits the risky economy to a greater extent as the subsidy implicit in the guarantee amplifies the effect of better contract enforceability.[8]

Notice that whenever systemic risk arises, it is growth enhancing. This is because the thresholds $\underline{h}$ and $\bar{h}$ in Propositions 2.1 and 2.2 are the same. Managers choose the risky technology when the expected return of the risky plan is greater than that of the safe plan. The resulting systemic risk is associated with higher mean growth because in an Ak world with an exogenous savings rate, the expected growth rate of the economy equals the expected rate of return times the savings rate. The tiny aid payment after a crash does not undermine this result because it does not affect the return expected ex-ante by managers.

Figure 2 illustrates the limit distribution of growth rates by plotting different paths of w_t corresponding to different realizations of the risky growth process. This figure makes it clear that

played every period with situations where a risky equilibrium is played every period.

[8] Needless to say, the first best is to improve financial institutions dramatically, so that h exceeds $\bar{h}$ and borrowing constraints are no longer binding. However, we are considering economies where such institutional changes may not be possible in the medium-run.

greater long-run growth comes at the cost of occasional busts. We can see that over the long run the risky paths generally outperform the safe path, with the exception of a few unlucky risky paths. If we increased the number of paths, the cross section distribution would converge to the limit distribution.[9]

The choice of parameters used in the simulation depicted in Figure 2 is detailed in the appendix. The probability of crisis (4.13%) corresponds to the historical probability of falling into a systemic banking crisis in our sample of countries over 1981-2000.[10] The financial distress costs are set to 50%, which is a third more severe than our empirical estimate derived from the growth differential between tranquil times and a systemic banking crisis. The degree of contract enforceability is set just above the level necessary for risk taking to be optimal ($h = 0.5$). Finally, the mean return on the risky technology is 2% below the safe return. Nevertheless, growth in the risky equilibrium is on average 3% higher than in the safe equilibrium.

Figure 3 plots the difference in log w_t between a risky and a safe economy for varying degrees of contract enforceability. As we can see, an increase in the degree of contract enforceability increases the growth benefits from risk taking. Figure 4 plots the difference in log w_t for different financial distress costs. Recall that if risk taking is optimal, it is also growth-enhancing for any arbitrarily large financial distress cost. Less severe distress costs evidently improve the average long-run growth in the risky equilibrium. Notice that the upper curve is computed with the value of financial distress costs estimated from our sample of countries ($\alpha = 0.8$).

Net Expected Value of Managers' Income: Risky vs. Safe Equilibria

Proposition (2.2) shows that because of the *leverage effect* bailouts can be funded domestically by taxing non-defaulting firms. There is in fact a stronger result that we prove in the extended appendix: if the leverage effect is strong enough, the increase in the expected profits generated by systemic risk is greater than the associated expected bailout cost. That is, the expected present value of managers' income *net* of taxes –denoted by Y– is greater in a risky than in a safe equilibrium. This result holds even for an arbitrarily large financial distress cost of crisis ($\alpha \rightarrow 0$). To see this consider the value of Y in a risky and in a safe equilibrium:

$$\begin{aligned} Y^r &= w + \delta(1-d)(\theta u - (1+r))m^r \frac{w}{1-\delta\gamma^r} \\ Y^s &= w + \delta(1-d)(\sigma - (1+r))m^s \frac{w}{1-\delta\gamma^s} \end{aligned} \tag{14}$$

[9] If instead of (11) the aid payment were a constant, the result in Proposition 2.2 illustrated in Figure 2 would have to be qualified. This is because over time it would become more and more unlikely that the level of output along the risky path overtakes the safe one as along a safe path w grows without bound, while along a risky path crises would reset w to a constant with probability $1-u$.

[10] Notice that this is the probability to shift from a non-crisis state to a crisis state, which is different from the share of years spent in a crisis state. The probability of falling into a crisis is given by $\frac{\pi_1}{1-\pi_2}$, where π_1 is the unconditional probability that a crisis starts in a given year, and π_2 is the unconditional probability of being in a crisis in given year.

The net expected present value of income depends on three factors: the expected excess return on investment ($\theta u - (1+r)$, $\sigma - (1+r)$), the leverage (m^r, m^s), and the mean growth rate of the economy (γ^r, γ^s). Since we have imposed the condition $u\theta < \sigma$, the following trade-off arises. Projects have a higher expected rate of return in a safe equilibrium than in a risky one, but leverage and scale are smaller ($m^s < m^r$). In a risky economy, the subsidy implicit in the guarantees attracts projects with a lower expected excess return but permits greater scale by relaxing borrowing constraints. This relaxation of the financial bottleneck is dynamically propagated at a higher growth rate ($\gamma^r > \gamma^s$). If h is high enough, greater leverage and growth compensate for the costs of crises and generate a higher net expected present value of income in a risky than in a safe equilibrium.

2.4 From Model to Data

The equilibria of the model indicate that a positive link between systemic risk and growth may be present in countries with particular characteristics. In the empirical section we will use these characteristics in our identification strategy through country groupings. First, we discuss the relationship between skewnes and growth.

Skewness and Growth. In a risky equilibrium, firms face endogenous borrowing constraints, and so credit is constrained by internal funds. As long as a crisis does not occur, internal funds accumulate gradually. Thus, credit grows fast but only *gradually.* In contrast, when a crisis erupts there are widespread bankruptcies, internal funds collapse and credit falls abruptly. The upshot is that in a risky equilibrium the growth rate can take on two values: low in the crisis state (g^c), or high in the lucky no crisis state (g^n).

A risky equilibrium exists only if crises are rare events. In particular, the probability of crisis $1-u$ must be less than half (by Proposition 2.1). Since $1-u < 1/2$, the low growth rate realizations (g^c) are farther away from the mean than the high realizations (g^n). Thus, in a large enough sample, the distribution of growth rates in a risky equilibrium is characterized by negative outliers and must be negatively skewed. In contrast, in the safe equilibrium there is no skewness as the growth process is smooth. Since systemic risk arises in equilibrium only when it is growth enhancing (by Proposition 2.2), our model predicts that there is a negative link between skewness and mean growth.

Identifying Restrictions. In the model, systemic guarantees are equally available to all countries. However, countries differ crucially in their ability to exploit these guarantees by taking on systemic risk. An equilibrium with systemic risk exists and is growth enhancing only in the set of financially liberalized countries with a 'medium' degree of contract enforceability h. On the one hand, borrowing constraints arise in equilibrium only if contract enforceability problems are 'severe': $h < \bar{h}$ so borrowers may find it profitable to divert funds. On the other hand, risk taking is individually optimal and systemic risk is growth enhancing only if $h > \underline{h}$. Only if h is large enough can risk taking induce enough of an increase in leverage to compensate for the distress costs of crises. A central part of our empirical strategy is, therefore, to exploit cross-country differences in financial liberalization and contract enforceability to test the identifying restriction described above.

3 Systemic Risk and Growth: The Empirical Link

The empirical analysis of the link between systemic risk and growth faces several challenges. The first challenge is *measurement.* In subsection 3.1, we discuss why skewness of credit growth is a good de facto measure of systemic risk and how skewness is linked to financial crisis indexes. The second challenge is the *identification* of a channel linking systemic risk and growth. In subsection 3.2, after having established a robust and stable partial correlation between the skewness of credit growth and GDP growth, we test an identifying restriction derived from our theoretical mechanism: the link between skewness and growth is strongest in the set of financially liberalized countries with moderately weak institutions. The third challenge is *robustness.* In subsection 3.2.3, we revisit our results using a GMM system estimator. In subsection 3.3, we present an alternative analysis of the link between systemic risk and growth based on several indexes of financial crises. In subsection 3.4, we test a further implication of our theoretical mechanism which is that skewness increases growth via its effect on investment. Finally, subsection 3.5 presents a set of additional robustness tests.

3.1 Measuring Systemic Risk

We use the *skewness of real credit growth* as a de facto indicator of financial systemic risk. The theoretical mechanism that links systemic risk and growth implies that financial crises are associated with higher mean growth only if they are *rare* and *systemic*. If the likelihood of crisis were high, there would be no incentives to take on risk. If crises were not systemic, borrowers could not exploit the subsidy implicit in the guarantees and increase leverage. These restrictions –*rare* and *systemic* crises– are the conditions under which negative skewness arises. During a crisis there is a large and abrupt downward jump in credit growth. If crises are rare, such negative outliers tend to create a long left tail in the distribution and reduce skewness.[11] When there are no other major shocks, rare crisis countries exhibit strictly negative skewness.[12]

[11] Skewness is a measure of *asymmetry of the distribution* of a series around its mean and is computed as $S = \frac{1}{n}\sum_{i=1}^{n}\frac{(y_i-\overline{y})^3}{\nu^{3/2}}$, where $\bar{y}$ is the mean and ν is the variance. The skewness of a symmetric distribution, such as the normal distribution, is zero. Positive skewness means that the distribution has a long right tail and negative skewness implies that the distribution has a long left tail.

[12] We use the skewness of real credit rather than GDP growth because the former reflects more accurately the effects of crisis on credit constrained firms. In middle-income countries, there is a pronounced sectoral asymmetry in the response to crisis: while large export oriented firms expand due to the real depreciation, small nontradables firms contract. Since the former have access to world financial markets, while the latter are bank-dependent, this asymmetry dampens GDP fluctuations more than credit fluctuations.

To illustrate how skewness is linked to systemic risk, the kernel distributions of credit growth rates for India and Thailand are given in Figure 5.[13] India, the safe country, has a lower mean and is quite tightly distributed around the mean, with skewness close to zero. Meanwhile, Thailand, the risky fast-growing country, has a very asymmetric distribution with large negative skewness.

Negative skewness can also be caused by forces other than financial systemic risk. We control explicitly for the two exogenous events that we would expect to lead to a large fall in credit: severe wars and large deteriorations in the terms of trade. Our data set consists of all countries for which data is available in the World Development Indicators and International Financial Statistics for the period 1960-2000. Out this set of eighty-three countries we identify twenty five as having a severe war or a large deterioration in the terms of trade.[14]

Crises are typically preceded by lending booms. However, the typical boom-bust cycle generates negative, not positive, skewness. Even though during a lending boom credit growth rates are large and positive, the boom typically takes place for several years and in any given year is not as large in magnitude as the typical bust.[15]

3.1.1 Skewness versus Variance

Rare crises are associated not only with negative skewness but also with high *variance*, the typical measure of volatility in the literature. For the purpose of identifying systemic risk there is, however, a key difference between variance and skewness. Variance may also reflect other shocks, that could either be symmetric or happen more frequently. In contrast, skewness captures specifically asymmetric and abnormal patterns in the distribution and can thus identify the risky paths that lead to *rare, large and abrupt* busts. If crises were not rare but the usual state of affairs, unusually high variance, not large negative skewness, would arise. Brazil is a good example. Here, hyperinflation, unsustainable government debt, and pro-cyclical fiscal policy have led to frequent falls and rebounds, so clear negative outliers are not identifiable. Over 1981-2000, the crisis indexes we consider below indicate that for more than half of the sample years Brazil was in a crisis.[16]

As we shall show below, our regression results do not contradict the negative link between variance and growth found by Ramey and Ramey (1995).

[13] The kernel distributions are smoothed histograms. They are estimated using an Epanechnikov kernel. For comparability we choose the same bandwidth for both graphs.

[14] The severe war cases are: Algeria, Congo Rep., Congo Dem. Rep, El Salvador, Guatemala, Iran, Nicaragua, Peru, Philippines, Sierra Leone, South Africa and Uganda. The large terms of trade deterioration cases are: Algeria, Congo, Rep., Congo, Dem. Rep., Cote d'Ivoire, Ecuador, Egypt, Ghana, Haiti, Iran, Pakistan, Sri Lanka, Nicaragua, Nigeria, Sierra Leone, Syria, Togo, Trinidad and Tobago, Uganda, Venezuela and Zambia. A detailed description of how these countries were identified is given in the extended appendix.

[15] See Tornell and Westermann (2002) for a description of boom-bust cycles in middle income countries.

[16] This case is not the standard in our sample, as in most countries crises are rare. Across the financially liberalized countries in our sample only 9% of country-years are coded as having a consensus crisis by the ten indexes we consider.

3.1.2 Correspondence Between Skewness and Crisis Indexes

In principle, the sample measure of skewness can miss cases of risk taking that have not yet led to crisis. This omission, however, makes it more difficult to find a negative relationship between growth and realized skewness. Thus, it does not invalidate our empirical strategy. What is important, however, is that skewness captures mostly financial crises once we control for wars and large terms of trade deteriorations. To investigate this correspondence, we consider ten standard indexes: three of banking crises, four of currency crises and two of sudden stops.[17] We then identify two types of crises: coded crises, which are classified as a crisis by any one of the indexes, and consensus crises. The latter are meant to capture truly severe crises and are defined as follows: First, the epsiode is identified by at least two banking crises indexes or two currency crises indexes or two sudden stop indexes. Second, it has not been going on for more than ten years, and, third, it does not exhibit credit growth of more than 10%.[18]

First, we find that our skewness measure captures mostly coded crises as: (i) the elimination of 2 (or 3) extreme negative credit growth observations suppresses most of the negative skewness; and (ii) at least 80% of these extreme observations correspond to coded crises. Table 1, panel A shows that among the countries with negative skewness, 90% (79%) of the of the 2 (3) extreme negative observations are coded as a crisis. Moreover, if we eliminate the 2 (3) extreme observations, skewness increases on average from -0.7 to +0.16 (0.36), and in 80 % (90%) of the cases, skewness increases to more than -0.2, which is close to a symmetric distribution. These are particularly high numbers given the fact that we forced each country to have 2 (3) outliers. It remains, in theory, a possibility that skewness is affected by non-extreme observations. To consider this possibility, for each country we eliminate the three observations whose omission results in the highest increase in skewness. Panel B in Table 1 shows that this procedure eliminates virtually all negative skewness. Moreover, 79% of the omitted observations correspond to coded crises.[19]

Second, there is significantly less negative skewness once we exclude consensus crises. Table 1, panel C, shows that if we eliminate the observations with a consensus crisis, skewness increases in 32 out of the 35 crisis countries.[20] On average, skewness increases from -0.41 to 0.32 and the percentage of crisis countries with skewness below -0.2 shrinks from 63% to 11%.[21]

In sum, there is a fairly close correspondence between both measures. There are, however,

[17] These indexes are described in the extended appendix.

[18] This last criterion ensures that the beginning of the crisis is the year in which it actually starts having macroeconomic consequences. For example DD and CK report 1997 as the start of the crisis in Thailand when credit growth was still strong (+12%) before contracting abruptly in 1998 (−12%). The application of this criterion adjusts the start date in nine cases (all banking crises): Argentina (1981,1989), Brazil (1994,1998), Mexico (1994), Korea (1997), Thailand (1982-1983,1997), and Norway (1987).

[19] Table EA4 in the extended appendix details for each country the list of extreme observations, the associated coded or consensus crises and the effect on skewness of eliminating 2 (3) observations.

[20] This procedure eliminates on average 2.9 observations for each country.

[21] Table EA5 in the extended appendix presents for each country the list of consensus crises and skewness with and without consensus crises.

advantages and disadvantages to the use of both skewness and crisis indexes as proxies for systemic risk. On the one hand, skewness simply looks for abnormal patterns in a macro variable and does not use direct information about the state of the financial system. On the other hand, it is objective and can be readily computed for large panels of countries over long time periods. Furthermore, it signals in a parsimonious way the occurrence of rare and systemic falls in credit growth. In contrast, de jure banking crisis indexes are based on more direct information. Unfortunately, they are also subjective, limited in their coverage over countries and time, and do not provide information on the relative severity of crises.[22] In addition, they are sometimes vague about the timing of a crisis and their samples are often not unconditional as in many instances they only include crisis countries. These shortcomings limit their usefulness for regression analysis over large panels.

To illustrate the difficulty of measuring banking crises, consider the well-known indexes of Caprio and Klingbiel (CK) and Detragiache and Demirguc-Kunt (DD). They report 35 and 42 crises, respectively, over 1981-2000 in our sample of 58 countries. Although DD is in part built on CK, there is a striking mismatch between the two: out of a total of 46 crisis episodes reported by at least one index, there are 16 episodes in which they do not agree at all on the existence of a crisis episode. Out of the remaining 30 crisis episodes, there are only 17 cases where the the timing of crisis is the same.

Other financial crisis indexes –e.g., currency crisis and sudden stops– are, like skewness, de facto indexes**.** However, the rules followed to construct these indexes are subjective and differ from one author to another.[23] As a result, it is not unusual for these crisis indexes to identify different episodes. In contrast, skewness is a standard and objective way to detect abnormal patterns in aggregate financial variables.

Finally, consider Thailand as an example to compare the two procedures. Figure 6, panel A exhibits Thailand's credit growth rates. We see two severe busts with negative growth rates (1980 and 1998-2000), and a slowdown with small positive growth rates (1985-86). Figure 6, panel B displays the same information using histograms and kernel distributions, which are smoothed histograms. The first panel covers the entire sample, in which skewness is -0.90. The second panel eliminates the consensus crisis years: 1998-2000 and 1985-87. We see that one important outlier (1980) has not been eliminated and therefore skewness remains almost unchanged at -0.99. If instead we eliminate the major negative outliers (1998-2000 and 1980), the third panel shows that skewness shrinks abruptly to -0.19. If we also eliminate 1986, the year with the next smallest growth rate, skewness becomes virtually zero (+0.04).

The Thai case shows that crisis indexes capture well-known crises (1998-2000). However, they

[22] As Caprio and Klingbiel acknowledge: "Some judgement has gone into the compilation of this list, not only for the countries in which data are absent on the size of the losses but also in that in many cases the official estimates understate the size of the problem."

[23] The extended appendix describes the crisis indexes and, in particular, illustrates the different rules used to construct them.

can make two types of errors: (i) failure to report some severe episodes (1980);[24] and (ii) the placement of a mild episode (1985-1986) on an equal footing with a severe crisis episode (1998-2000). In contrast, the procedure that selects the observations that drive negative skewness –which are the largest negative credit growth observations– correctly identifies both the 1998-2000 and the 1980 crises.

3.2 Skewness and Growth

We start by presenting baseline evidence of the link between skewness and growth based on cross-section regressions estimated by OLS, and panel regressions estimated by GLS using ten-year non-overlapping windows. We then test the identifying restriction of our theoretical mechanism by introducing interaction term effects in the growth regressions. Finally, we revisit our results using a GMM system estimator. The sample used in the regressions consists of the 58 countries that have experienced neither a severe war nor a large deterioration in the terms of trade.

3.2.1 Baseline Estimation

In the first set of equations we estimate, we include the three moments of credit growth in a standard growth equation.[25]

$$\Delta y_{it} = \gamma' X_{it} + \beta_1 \mu_{\Delta B,it} + \beta_2 \sigma_{\Delta B,it} + \beta_3 S_{\Delta B,it} + \eta_t + \varepsilon_{it}, \tag{15}$$

where Δy_{it} is the average growth rate of per-capita GDP; $\mu_{\Delta B,it}$, $\sigma_{\Delta B,it}$ and $S_{\Delta B,it}$ are the mean, standard deviation, and skewness of the growth rate of real bank credit to the private sector, respectively; X_{it} is a vector of control variables; η_t is a period dummy and ε_{it} is the error term.[26] Here, we consider a *simple control set* that includes initial per-capita GDP and the initial ratio of secondary schooling. In section 3.5 we show that similar results are obtained with an *extended control set* that includes the simple set plus the inflation rate, the ratio of government consumption to GDP, a measure of trade openness and life expectancy at birth.[27] We do not include investment in (15) as we expect the three moments of credit growth, our variables of interest, to affect GDP growth through investment.[28]

[24]Kaminsky and Reinhart (1999) in their well-known study on twin banking and currency crises do record a crisis in 1979. Moreover, the 1980 IMF Article IV Mission in Thailand reports a credit crunch, a rapid deterioration of the financial position of financial institutions and the collapse of a major finance company. It also mentions that the Central Bank reacted aggressively by providing emergency lending to the financial sector and by injecting liquidity through the newly created repurchase market.

[25]The complete description of the variables used in the regression analysis is presented in the appendix.

[26]In cross-section regressions, η_t is a constant, and in panel regressions it corresponds to time effects.

[27]These control variables are standard in the empirical growth literature, e.g. Levine, Loayza and Beck (2000).

[28]In section 3.4, we analyze the link between investment and the three moments of credit growth.

We consider three sample periods: 1961-2000, 1971-2000 and 1981-2000.[29] In the cross-sections, the moments of credit growth are computed over the sample period and initial variables are measured in 1960, 1970 or 1980. In the panels, the moments of credit growth are computed over each decade and the initial variables are measured in the first year of each decade.[30] All panel regressions are estimated with time effects.[31]

Table 2 reports the estimation results. The novel finding is the negative partial correlation between the skewness of real credit growth and real GDP growth. Skewness always enters with a negative point estimate that ranges between -0.244 and -0.334. These estimates are significant at the 5% level in the cross-section regressions and at the 1% level in the panel regressions. The positive partial correlation between the mean of credit growth and GDP growth is standard in the literature (e.g., Levine and Renelt (1992)). The negative partial correlation between the standard deviation and GDP growth is consistent with the finding of Ramey and Ramey (1995) on the negative link between growth and variance.

Are these estimates economically meaningful? To address this question consider India and Thailand over the period 1981-2000. India has near zero skewness, and Thailand a skewness of about minus one.[32] The cross-sectional estimate of -0.32 for 1981-2000 implies that a one unit decline in skewness (from 0 to -1) is associated with a 0.32% increase in annual real per capita growth. This figure corresponds to a little less than a third of the per-capita growth differential between India and Thailand over the same period.

Figure 7 depicts the partial linear effect of each moment of credit growth on per-capita GDP growth. The plots reveal that higher per-capita GDP growth is associated with (a) higher mean growth rate in credit, (b) lower variance and (c) lower skewness.

3.2.2 Identification of the Mechanism

Here, we test an identification restriction implied by the equilibria of our model. Namely, whether the negative link between skewness and growth is stronger in the set of financially liberalized countries with a medium degree of contract enforceability than in other countries.[33]

[29] By using three sample periods, we make the baseline estimation results presented in this section comparable to the results of all the regressions presented in this paper.

[30] For example, if the sample period is 1981-2000, two sets of moments of credit growth are computed (over 1981-1990 and 1991-2000) and the initial variables are measured in 1980 and 1990. To compute the moments of credit growth, we impose a minimum of 8 annual observations over each non-overlapping ten-year window.

[31] We do not include fixed-effect in our baseline regressions. The GMM estimation presented below is the standard method to deal with the presence of country fixed effects in a dynamic equation. Moreover, Hauk and Wacziarg (2004) have shown, using Monte-Carlo simulations, that in the presence of measurement error, the typical growth regression can be better estimated with the simple pooled estimators used in this section. When within group estimators are used, they exacerbate measurement error problems.

[32] A one unit increase in skewness also corresponds to the average change resulting from eliminating, for each country, the three lowest observations in the set of countries with negative skewness. See Table 1.

[33] A similar empirical strategy is followed by Rajan and Zingales (1998) to analyze the effect of financial development on growth.

In the theory section we show that in economies where financing constraints are an important obstacle to growth, systemic risk taking allows agents to attain greater leverage, increasing investment and growth. Risk taking, however, also generates financial fragility and implies that crises will occur occasionally. Therefore, high mean growth is associated with negative skewness. The theory indicates that the negative link between skewness and growth will be observed in only a restricted set of countries. First, our mechanism is present only in countries with a medium degree of contract enforceability (MEC), so financial markets function, but borrowing constraints are an important barrier to growth. By contrast, in countries with high enforceability (HEC) agents have easy access to external finance, so that growth is determined by investment opportunities, not by borrowing constraints. In the other extreme, in countries with low enforceability (LEC) borrowing constraints are too severe. In these countries the increase in leverage induced by risk taking is so small that it does not compensate for the effects of crises. Secondly, the mechanism requires not only weak institutions but also policy measures that are conducive to the emergence of systemic risk. Financial liberalization can be viewed as such a policy measure. In non-liberalized economies, regulations do not permit agents to take on systemic risk.

We use the law and order index of the Political Risk Service Group in 1984 to construct the MEC set.[34] We classify as MECs the countries with an index in 1984 ranging between 2 and 5.[35] We use three alternative indexes of financial liberalization: First, a de facto binary index based on the identification of trend breaks in capital flows, which is equal to one if a country is liberalized in a given year and zero otherwise. By averaging this index over 10 years, we obtain the share of liberalized years in a given decade. Second, the de jure index of Quinn (2001) that reports on a zero to one scale the intensity of capital account liberalization based on the IMF report on capital account restrictions. Third, the de jure index of Abiad and Mody (2004). The de facto index is computed for the full sample of 58 countries for the period 1981-2000. The two other indexes cover fewer countries, but are available for a longer time period.[36]

We generate a *composite index* by combining an MEC dummy –that equals one for MEC countries and zero otherwise– with one of the liberalization indexes. For each country i and each of our non-overlapping ten-year windows $(t, t+9)$ the index equals

$$MEC_i\_FL_{i,t} = MEC_i \bullet \frac{1}{10}\sum_{j=0}^{9} fl_{i,t+j} \qquad t \in \{1961, 1971, 1981, 1991\} \tag{16}$$

For each liberalization index, we interact the MEC_FL index with the three moments of credit

[34] This index rates countries on a 1 to 6 scale according to the quality of enforceability of the legal system. We use the index in 1984 as it is the earliest available date. For a small number of countries for which the index is not available in 1984, we use 1985 instead.

[35] Table 9 shows that our estimation results are robust to alternative definitions of the MEC set.

[36] See the extended appendix for a detailed description of the three financial liberalization indexes.

growth and add them to regression equation (15).[37] Table 3 shows that, consistent with the restrictions imposed by the model, the effect of skewness on growth is strongest among MEC_FL countries. The interaction term $skewness * MEC\_FL$ enters negatively and significantly at the 1% level in the three regressions. Its point estimate ranges between -1.00 and -0.75. By contrast, the coefficient of *skewness* is not significantly different from zero. It ranges between -0.08 and -0.01. The difference between the two estimates indicates that the negative link between skewness and growth is not only stronger in the MEC_FL set, but that it also only exists within this set.

By adding up the interacted and non-interacted skewness coefficients, we obtain the effect of skewness on growth for a fully liberalized MEC country. The point estimates of this effect –reported at the bottom of Table 3– range between -1.00 and -0.81 and are significant at the 1% level. An estimate of -0.81 means that a one unit increase in skewness for a fully liberalized MEC country is associated with a 0.81 percentage point increase in annual GDP growth. This effect is three times larger than the homogenous effect estimated in Table 2.

We have shown that the negative relationship between skewness and growth emerges only in the set of financially liberalized countries with a medium level of contract enforceability. By validating the identifying restrictions of our theoretical mechanism, this finding supports our hypothesis that the negative link between skewness and growth results from a systemic risk taking mechanism.

3.2.3 Generalized Method of Moments System Estimation

Here, we use a GMM system estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998) that controls for unobserved time- and country-specific effects, and accounts for some endogeneity in the explanatory variables. The regression equation to be estimated is $y_{i,t} - y_{i,t-1} = (\alpha - 1)\, y_{i,t-1} + \beta' Z_{i,t} + \eta_i + \varepsilon_{i,t}$, where $y_{i,t}$ is the logarithm of real per-capita GDP, Z_{it} is the set of explanatory variables excluding initial income and a time dummy, η_i is the country-specific effect, and $\varepsilon_{i,t}$ is the error term. In order to eliminate the country-specific effect, we take first-differences and get

$$y_{i,t} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(Z_{i,t} - Z_{i,t-1}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \tag{17}$$

We relax the assumption of exogeneity of the explanatory variables by allowing them to be correlated with current and previous realizations of the error term. However, we assume that future realizations of the error term do not affect current values of the explanatory variables.[38] The use of instruments deals with: (i) the likely endogeneity of the explanatory variables, and (ii) the problem that, by construction, the new error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$, is correlated with the lagged dependent variable,

[37] For each regression, the estimation period corresponds to the time coverage of the liberalization index.

[38] As Levine et al.(2000) point out, this assumption of *weak exogeneity* does not imply that expectations of future growth do not have an effect on current moments of credit expansion, but only that unanticipated future shocks to economic growth do not influence the current realizations of the explanatory variables.

$y_{i,t-1} - y_{i,t-2}$. Following Blundell and Bond (1998), we use the *GMM system estimator.*[39] This estimator combines the regression in differences (17) and the corresponding regression in levels together into a single system. The system estimator uses a set of moment conditions where lagged levels are used as instruments in the difference equations and lag differences in the level equation.[40] The consistency of the GMM estimates depends on whether lagged values of the explanatory variables are valid instruments in the growth regression. We address this issue by considering two specification tests. The first is a Sargan-Hansen test of over-identifying restrictions, which tests the overall validity of the instruments.[41] The second test examines whether the differenced error term is second-order serially correlated.

The use of lagged variables as instruments and the requirement of three consecutive time units to perform the two specification tests restrict the available periods of estimation to 1970-2000. Table 4 shows the estimation results. In the first column all regressors are treated as endogenous and moment conditions are computed using appropriate lagged values of the levels and differences of the explanatory and dependent variables. In the second column, all the regressors are treated as endogenous with the exception of skewness. We can see that skewness enters with very similar coefficients in both regressions (-0.60 and -0.59) and that both are significant at the 5% level. Thus, relaxing the exogeneity assumption for skewness seems to have little effect on the estimates. Notice that the coefficients on the skewness and mean of credit growth are noticeably higher with the GMM estimation than with the GLS estimation. In contrast, the standard deviation is not significant in the GMM specification. The Sargan-Hansen test shows that, in both regressions, the validity of the instruments cannot be rejected.[42]

Table 5 is the counterpart of Table 3. It shows that the interaction effects presented in subsection 3.2.2 are also significant in the GMM specification. In sum, these results confirm that when we correct for biases resulting from unobserved country fixed effects and control for some of the endogeneity in the explanatory variables, the link between skewness and growth established in subsection 3.2.1 remains robust and in fact appears even stronger.

3.3 Crisis Indexes and Growth

In subsection 3.1 we showed that our skewness measure coincides closely with several financial crisis indexes, and we discussed why skewness is better suited to establish the link between systemic risk

[39] The GMM system estimator has two advantages: (i) it reduces the potential biases and imprecision associated with the usual GMM difference estimator; and (ii) it allows us to exploit simultanously the between and within country variations to estimate the effects of the moments of credit growth on GDP growth.

[40] We compute robust two-step standard errors by following the methodology proposed by Windmeijer (2005) that corrects the small sample downward bias in the two-step standard errors and therefore allows us to rely on the asymptotically efficient two-step estimates of the coefficients.

[41] Since the validity of the moment conditions using internal instruments depends on the weak exogeneity of the explanatory variables, the Sargan-Hansen test is also, by construction, a test of this assumption.

[42] The second order serial correlation tests indicate that second order correlation can be safely rejected.

and growth in large panels. Here we show that, for the subsamples covered by crisis indexes, the same link is also evident when we replace skewness with crisis indexes in our growth regressions.

We consider three banking crisis indexes (Caprio-Klingebiel, Demirguc-Detragiache and a consensus index), a sudden stop consensus index and a currency crisis consensus index.[43] For each crisis index we set a dummy equal to one if the country has experienced a crisis during the decade and zero otherwise. Using a crisis dummy computed over ten years allows us to capture the average medium-run growth impact of crises rather than just the growth shortfall experienced during a crisis.[44]

The empirical specification is the same as in the panel analysis of Table 2, substituting the crisis dummies for skewness. Table 6 shows that the three banking crisis dummies enter positively (with point estimates ranging from +0.22 to +0.26) and significantly at the 5% level. Thus, we find that countries that experienced a systemic banking crisis in a given decade also experience on average a 0.24% annual increase in per-capita GDP growth. Interestingly, this effect is similar in magnitude to that of a one unit change in skewness (see Table 2). Turning to the other crisis indexes, we find a similar positive growth effect of sudden stops, but we do not find any significant growth effect of currency crises.[45] Finally, in Table EA1, in the extended appendix we show that the results of Table 6 persist when the estimation is done with the full set of control variables.

3.4 Skewness and Investment

In our mechanism, systemic risk taking leads to higher mean growth because it helps relax borrowing constraints and thus allows firms to invest more. Although the link between investment and growth has been extensively analyzed in the literature, the link between systemic risk and investment has not. Here we analyze this link by adding the skewness of credit growth to a panel investment regression. Following Barro (2001), we regress the investment-to-GDP ratio on our controls and the lagged investment rate, which captures the high degree of serial correlation in the investment rate. We calculate investment rates in two ways: using real PPP-converted prices and using domestic prices.

Table 7, panel A presents the results of the GLS and GMM panel estimations performed over the period 1970-2000 for the two investment rates using the simple set of control variables.[46] The estimation yields very similar results for the two investment rates. Skewness enters negatively and is significant at the 1% level in the GLS estimations and at the 5% level in the GMM estimation.

[43] As described before, consensus indexes are designed to capture systemic crisis events. For each crisis type, they record episodes that are confirmed by at least two indexes.

[44] Using panel regression with five-year windows, Barro (2001) finds that a negative contemporaneous link between crisis and growth can coexist with a positive link when the same crisis dummy is lagged by one five-year interval.

[45] Aghion, Bachetta, Rogoff and Ranciere (2006) also find that, on average, there is no significant growth effect associated with exchange rate regime collapses.

[46] The specification with lagged investment prevents us from estimating the investment regression over 1960-2000. In Table EA2 in the extended appendix, we present similar results obtained with the extended set of control variables.

Furthermore, investment is positively correlated with the mean of credit growth and negatively with the standard deviation. The effect of skewness on investment is slightly larger in the GMM estimation. In the GMM (GLS) estimation, a one unit increase in skewness is associated with a 1.1 (0.77) percentage point direct effect on the investment rate at domestic prices.[47]

In order to relate the investment effects to growth outcomes, we present in Table 7, panel B, a set of growth regressions in which the investment rate replaces the moments of credit growth. Investment enters significantly at the 1% level with point estimates close to 0.2, a standard value in the growth literature (e.g., Levine and Renelt (1992)). By combining the effect of skewness on investment (0.77) with the corresponding effect of investment on growth (0.22), one obtains −0.17. This figure is of the same order of magnitude as the direct effect of skewness on growth in the panel regression presented in Table 2 for the same sample period (− 0.24), although it is slightly lower.[48]

The identification of a negative link between skewness and investment and a positive link between investment and growth reinforces the support we have found for our theoretical mechanism where systemic-risk taking affects growth through an investment channel.

3.5 Robustness Tests

Here, we examine whether the negative link between skewness and growth is robust to an alternative set of control variables, alternative samples, alternative country groupings and the elimination of outliers.

Extended Set of Control Variables. Table 8 presents the panel estimates obtained with the extended control set for the three estimation periods. The coefficients of the moments of credit growth are very similar across all the panel regressions. In particular, skewness enters significantly at the 1% level with point estimates that range between -0.26 and -0.20. The average point estimate of - 0.24 is close to the average panel estimate of -0.28 in Table 2. Notice also that in most of the regressions, the control variables enter with the expected sign and their point estimates are significant.[49]

Alternative MEC Sets. We have shown that the negative link between skewness and growth is significantly stronger in the set of financially liberalized countries with a medium degree of contract enforceability. Now we show that this is robust to alternative definitions of the MEC set. The baseline MEC set includes all countries with a law and order index ranging between 2 and

[47] This number amounts to a long run effect of 2.9 (2.7) percentage points, given the dynamic nature of the investment regression. This long run effect is computed as $\frac{\alpha}{1-\beta}$ with α the skewness coefficient and β the coefficient of the lagged investment rate.

[48] Note that by combining the two coefficients, we only consider the direct effect of skewness on investment and ignore the additional dynamic effect stemming from the persistence in the investment rate. More importantly, this figure (−0.17) is not an *estimate* of the indirect effect of skewness on growth through an investment channel. Such an estimation would require us to estimate *jointly* a growth and an investment equation in a dynamic set-up and goes beyond the purpose of this section.

[49] An exception is initial secondary schooling that is only significant with the simple set of controls.

5. In the three regressions presented in Table 9, we exclude successively from the MEC set: (i) countries with an index of 2, (ii) countries with an index of 2 or 3, and (iii) countries with an index equal to either 2 or 5. In the first regression, the negative link between skewness and growth is only present in the MEC_FL set, while in the two other regressions, this negative link is at least three time larger in this set.[50] This robustness test supports the empirical validity of the identifying restrictions imposed by our theoretical mechanism.

The Full Sample of Countries. In order to interpret the link between skewness and growth as the result of endogenous systemic risk taking, in our benchmark estimation we have controlled for two other main sources of skewness: war and large terms-of-trade shocks. These shocks are exogenous and we do not expect them to reflect the relaxation of financial bottlenecks induced by systemic risk taking. Nevertheless, to investigate whether the effect of negative skewness on growth is observed in an unconditional sample, we re-estimate the panel regression presented in Table 2 including the *full sample of 83 countries* for which we have available data. Table 10 shows that skewness still enters negatively and remains statistically significant at the 1% level, although the magnitude of the average point estimate is reduced from -0.28 to -0.21.

Outliers. To test whether the link between skewness and growth may be driven by outliers, we consider the GLS panel regression performed with the simple control set over 1961-2000 (regression 4, Table 2). There are 13 country-decades whose residuals deviate by more than two standard deviations from the mean.[51] As Table 11 shows, the exclusion of outliers does not change our results. In particular, the coefficient on skewness ranges between -0.30 and -0.35, excluding individual outliers, and is -0.24 when all outliers are excluded. These estimates are significant at the one percent confidence level and are quite similar to our average benchmark estimate of -0.33.

4 Related Literature

A novelty of this paper is to use skewness to analyze economic growth. In the finance literature, skewness has been used to capture asymmetry in risk in order to explain the cross-sectional variation of excess returns. If, holding mean and variance constant, investors prefer positively skewed to negatively skewed portfolios, the latter should exhibit higher expected returns. Kraus and Litzenberger (1976) show that adding skewness to the CAPM model improves its empirical fit. Harvey and Siddique (2000) find that coskewness has a robust and economically important impact on equity risk-premia even when factors based on size and book-to-market are controlled for.[52] Veldkamp

[50] The significant link between skewness and growth outside the MEC_FL set is the consequence of having a more restrictive definition of the MEC set: it excludes some countries for which the systemic risk-taking mechanism may be at play.

[51] The 13 outliers are: Bolivia (60s), Niger (70s and 80s), Senegal (70s), Jordan (80s), Papua New Guinea (80s), Brazil (70s), Indonesia (70s), Singapore (70s), Bostwana (80s), Korea (80s), Japan (60s) and China (90s).

[52] Coskewness is the component of an asset's skewness that is related to the skewness of the market portfolio.

(2005) rationalizes the existence of skewness in assets markets in a model with endogenous flows of informations. In the macroeconomic literature, Barro (2006) measures the frequency and size of large GDP drops over the twentieth century and shows that these negatively skewed patterns can explain the equity premium puzzle.

In our empirical analysis, the negative link between skewness and growth coexists with the negative link between variance and growth identified by Ramey and Ramey (1995). The contrasting growth effects of different sources of risk are also present in Imbs (2004), who finds that aggregate volatility is bad for growth, while sectorial volatility is good for growth.

Most of the empirical literature on financial liberalization and economic performance focuses either on growth or on financial fragility and excess volatility. On the one hand, Bekaert, Harvey and Lundblad (2005) find a robust and economically important link between stock market liberalization and growth; Henry (2002) finds similar evidence by focusing on private investment; while Klein (2005) finds that financial liberalization is growth enhancing only among middle-income countries. On the other hand, Kaminsky and Reinhart (1998) and Kaminsky and Schmukler (2002) show that the propensity to crisis and stock market volatility increase in the aftermath of financial liberalization. Our findings help to integrate these contrasting views.

Obstfeld (1994) demonstrates that financial openness increases growth if international risk-sharing allows agents to shift from safe to risky projects with a higher return. In our framework, risky projects have a lower expected return than safe ones. The growth gains are obtained because firms that take on more risk can attain greater leverage.

In our paper, liberalization policies that discourage hedging can induce higher growth because they help ease borrowing constraints. Tirole (2003) and Tirole and Pathak (2004) reach a similar conclusion in a different setup. In their framework, a country pegs the exchange rate as a means to signal a strong currency and attract foreign capital. Thus, it must discourage hedging and withstand speculative attacks in order for the signal to be credible.

By focusing on the growth consequences of imperfect contract enforceability, this paper is connected with the growth and institutions literature. For instance, Acemoglu et. al. (2003) show that better institutions lead to higher growth, lower variance and less frequent crises. In our model, better institutions also lead to higher growth, and it is never optimal for countries with strong institutions to undertake systemic risk. Our contribution is to show how systemic risk can enhance growth by counteracting the financial bottlenecks generated by weak institutions.

The cycles in this paper are different from schumpeterian cycles in which the adoption of new technologies and the cleansing effect of recessions play a key role, e.g. Aghion and Saint Paul (1998), Caballero and Hammour (1994) and Schumpeter (1934). Our cycles resemble Juglar's credit cycles in which financial bottlenecks play a dominant role. Juglar (1862) characterized asymmetric credit cycles along with the periodic occurrence of crises in France, England, and the United States during the nineteenth century.

5 Conclusions

Our finding that fast growing countries tend to experience occasional crises sheds light on two contrasting views of financial liberalization. In one view, financial liberalization induces excessive risk taking, increases macroeconomic volatility and leads to more frequent crises. In another view, liberalization strengthens financial development and contributes to higher long-run growth. Our findings indicate that, while liberalization does lead to systemic risk taking and occasional crises, it also raises growth rates, even when the costs of crises are taken into account.

In order to uncover the link between systemic risk and growth, it is essential to distinguish between booms punctuated by rare, abrupt busts and up-and-down patterns that are more frequent or more symmetric. While both of these patterns will increase variance, only the former causes a decline in skewness. This is why we use the skewness of credit growth, not variance, to capture the volatility generated by crises. An innovation in this paper is the use of skewness as a de facto indicator of financial systemic risk in order to study economic growth.

We analyze the relationship between systemic risk and growth by developing a theoretical mechanism based on the existence of financial bottlenecks. In countries with institutions that are weak –but not too weak, financial liberalization may give rise to systemic risk, enabling financially constrained firms to attain greater leverage and to increase investment and growth along a path without crises. This is the leverage effect. We show that in the set of financially liberalized countries with moderate institutional problems, the leverage effect is strong enough that the gains from larger investment will dominate the losses from occasional financial crises.

The data strongly supports the empirical hypotheses associated with these theoretical results: over the last four decades, the link between skewness and growth is strongest in financially liberalized countries with a moderate degree of contract enforceability. Furthermore, investment is the main channel through which skewness affects growth.

We would like to emphasize that the fact that systemic-risk can be good for growth does not mean that it is necessarily good for welfare. Furthermore, as the decreasing returns version of the model demonstrates, systemic risk taking is not a strategy for increasing growth that can be pursued in the very long-run. Once a country becomes rich enough, it must shift to a safe path.

Finally, within the model there are several policies that could increase investment without incurring crisis costs. A major improvement in the contract enforceability environment eliminates financial bottlenecks. However, it often takes a long time for this institutional reform to be achieved. An alternative policy is to grant failure-unrelated subsidies to firms. However, in the real world, such a policy might lead to cronyism and rampant corruption.

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A APPENDIX

A.1 Decreasing Returns Technologies

Here, we present a decreasing returns version of the model, and show that systemic risk may accelerate growth in a transition phase, but not indefinitely. At some point, an economy must switch to a safe path. Here, we show that there is a threshold for internal funds w^* such that for $w < w^*$, the economy is in a "fragile phase" where, as in the Ak model, there are two equilibria: safe and risky. Meanwhile, for $w > w^*$, the economy is in a "non-fragile phase" in which only the safe equilibrium exists. We then show that in the fragile phase, expected growth is greater in the risky equilibrium than in the safe one.[53]

The setup is like that in Section 2 where the safe and risky technologies are similar to those in (1) except that the linear production functions are replaced by concave ones: $q^r_{t+1} = \Omega_{t+1} f(I_t)$ and $q^s_{t+1} = g(I_t)$. To capture the parameter restrictions, in (7) we assume that the safe production function is proportional to the risky one $g(I) \equiv \chi \cdot f(I)$ and use the following parametrization.

$$f(I) = I^{\lambda}, \qquad g(I) = \chi \cdot I^{\lambda}, \quad \lambda \in (0, 1), \quad 0 < u < \chi < 1 \tag{18}$$

Since $u < \chi$, the risky technology yields more than the safe technology in the good state but has a lower expected return. This captures the same idea as $u\theta < \sigma < \theta$. Meanwhile, the condition analogous to $1 + r < u\theta$ only holds for low levels of capital because $f(I)$ is concave.

We assume that at any point in time, either the risky or the safe technology can be used but that both cannot be used simultaneously, and that when a majority of firms is insolvent a bailout is granted to the lenders of insolvent firms that did not divert funds. The rest of the model is as in Section 2. Under these assumptions one can derive the following proposition, which is the analogue of Proposition 1.2 (the proof is in the extended appendix).

[53] The model we present here follows Schneider and Tornell (2005), who consider a decreasing returns setup to explain why rich countries do not experience severe financial crises.

Proposition A.1 (Symmetric Credit Market Equilibria (CME)) *Borrowing constraints arise in equilibrium only if the degree of contract enforceability is not too high ($h < \zeta_{t+1}\delta^{-1}$). If this condition holds, then:*

- *For all levels of w there exists a 'safe' CME in which all firms only invest in the safe technology and a systemic crisis in the next period cannot occur: $\zeta_{t+1} = 1$.*
- *There is a unique threshold for internal funds $w^* \in (\tilde{I}/m^r, \tilde{I})$, such that there also exists a risky CME in which $\zeta_{t+1} = u$ if and only if $w < w^*$ and $h \in (\underline{h}, \bar{h})$, where $\underline{h}$ is given by (31).*
- *In the safe and risky CME borrowing constraints bind for internal funds lower than $\hat{I}/m^s$ and $\tilde{I}/m^r$, respectively. Investment is given by*

$$I^s = \begin{cases} m^s w & \text{if } w < \frac{\hat{I}}{m^s} \\ \hat{I} & \text{if } w \geq \frac{\hat{I}}{m^s} \end{cases} \qquad I^r = \begin{cases} m^r w & \text{if } w < \frac{\tilde{I}}{m^r} \\ \tilde{I} & \text{if } w \geq \frac{\tilde{I}}{m^r} \end{cases} \qquad \text{where} \quad \begin{matrix} g'(\hat{I}) = 1 + r \\ f'(\tilde{I}) = 1 + r \end{matrix}.$$

This proposition identifies two levels of capital: the 'efficient level' $\hat{I}$ which is the one that would be attained in a standard neoclassical economy, and the 'Pangloss level' $\tilde{I}$, which equalizes the marginal return of the risky technology in the good state to $1 + r$. Clearly, $\tilde{I}$ is larger than $\hat{I}$.

In a risky (safe) CME, borrowing constraints bind up to $w = \tilde{I}/m^r(\hat{I}/m^s)$. As long as borrowing constraints bind, investment is equal to the one in the Ak setup: $I^j = wm^j$. However, when borrowing constraints cease to bind, investment remains unchanged as w increases.

The key point made by Proposition A.1 is that while a safe CME always exists, a risky CME exists only for levels of internal funds lower than w^*. This threshold, however, is high enough so that whenever borrowing constraints bind, a risky CME exists. This is because w^* is larger than $\tilde{I}/m^r$. The intuition is the following. As in the Ak setup, there is a leverage effect and an efficiency effect. At low levels of w the increase in leverage more than compensates for the lower expected productivity of the risky technology. This advantage, however, weakens as w increases because there are decreasing returns in production. Thus, at some point, w^*, the advantage disappears and the risky CME ceases to exist.

Proposition A.1 implies that an economy cannot be on a risky path forever. A switch to a safe phase must happen before w reaches the Pangloss level $\tilde{I}$. This result contrasts with that in the Ak setup.

Next, we derive a result analogous to Proposition 2.2 by comparing the expected growth rate of an economy that travels from a risky to a safe phase –a "risky economy"– with an economy that is always on the safe path –a "safe economy." We assume that a risky CME is played whenever it exists –i.e., for all $w < w^*$. Thus, in a risky economy internal funds evolve as follows:

$$w^r_{t+1} = \begin{cases} a_{t+1} & \text{if } w_t < w^* \text{ and } \Omega_{t+1} = 0 \\ [1-d-\tau][f(w_t m^r) - u^{-1} h m^r w_t] & \text{if } w_t < \tilde{I}/m^r \text{ and } \Omega_{t+1} = 1 \\ [1-d-\tau][f(\tilde{I}) - \delta^{-1}[\tilde{I} - w_t]] & \text{if } w_t \in [\tilde{I}/m^r, w^*) \text{ and } \Omega_{t+1} = 1 \\ [1-d-\tau][g(w_t m^s) - h m^s w_t] & \text{if } w_t \geq w^* \text{ and } w^* < \hat{I}/m^s \\ [1-d-\tau][g(\hat{I}) - \delta^{-1}(\hat{I} - w_t)] & \text{if } w_t \geq w^* \text{ and } w^* \geq \hat{I}/m^s \end{cases} \tag{19}$$

The crisis aid payment a_{t+1} is given by (11). In a safe economy internal funds are given by the fourth row of (19) for $w_t < \hat{I}/m^s$ and by the fifth row for $w_t \geq \hat{I}/m^s$.

Notice that a poor economy behaves like an Ak economy. If $w_t < \tilde{I}/m^r$, borrowing constraints bind and firms have incentives to take on risk as a way to increase leverage. In fact, if we replace the production function $f(I)$ by θI, we can see that internal funds evolve identically as in Section 2.

The following proposition compares the expected growth rates in safe and risky symmetric equilibria $\gamma^j_{t+1} = E_t(w^j_{t+1}/w_t)$, $j = \{risky,\ safe\}$.

Proposition A.2 *Under the proportional aid assumption (11), there exists a threshold for the degree of contract enforceability $\underline{h}$, given in (31) in the extended appendix, such that for any generosity of aid granted in the case of systemic insolvency, i.e., for any $\alpha \in (0,1)$:*

1. *Systemic risk arises in equilibrium* only if $w_t < w^*$ *and* $h \in (\underline{h}, \bar{h})$.
2. *Whenever systemic risk arises, it increases the expected growth rate.*
3. *If w_t reaches w^*, there is a shift to a safe path. Furthermore, if $d \leq 1-\delta$, output converges to the efficient level $q_{t+1} = g(\hat{I})$.*

This proposition makes two points. First, whenever systemic risk arises, it accelerates expected growth. Second, systemic risk and the increase in expected growth cannot last forever, but only during a transition phase. As the economy becomes richer, there must be a shift to a safe path. The first point follows because the thresholds for w_t and h are the same as those in Proposition A.1. The intuition is the same as in Section 2. The second point follows because as the risky economy becomes sufficiently rich, borrowing constraints cease to bind, so the leverage benefits due to risk taking go away. Recall that on a risky path, borrowing constraints are binding up to $w = \tilde{I}/m^r$, which is less than w^*. Finally, under condition $d \leq 1-\delta$, the transition curve is always above the 45-degree line in the (w_t, w_{t+1}) space. Thus, the economy will not cycle between the safe and the risky phases. Once it reaches the safe phase, it stays there forever. In this case, output converges to $g(\hat{I})$, and the excess of w over $\hat{I}$ is saved and thus earns the world interest rate.

A.2 Currency Mismatch

In most middle income countries risky strategies have been undertaken via currency mismatch. This occurs when firms that sell to the domestic market borrow in foreign currency. If there is sufficient real exchange rate variability, currency mismatch generates insolvency risk as a sharp depreciation can bankrupt firms through a balance sheet effect. This variability, in turn, may arise if there is enough dollar debt in the books. The risky technology in the model captures this phenomenon by hardwiring insolvency risk in the model.

In order to explicitly model currency mismatch, we need to consider nontradables (N-) and tradables (T-) sectors and endogenize their relative price: the real exchange rate. The derivation and the intuition, however, is significantly more involved because the source of insolvency risk – sufficient real exchange variability– must be endogenously derived. This more complicated setup has been worked out by Ranciere et.al. (2003). A mechanism similar to ours is at work in this two-sector model. In particular, systemic risk arises and is growth enhancing when crises are rare and there is a medium degree of contract enforceability.

A.3 Simulations

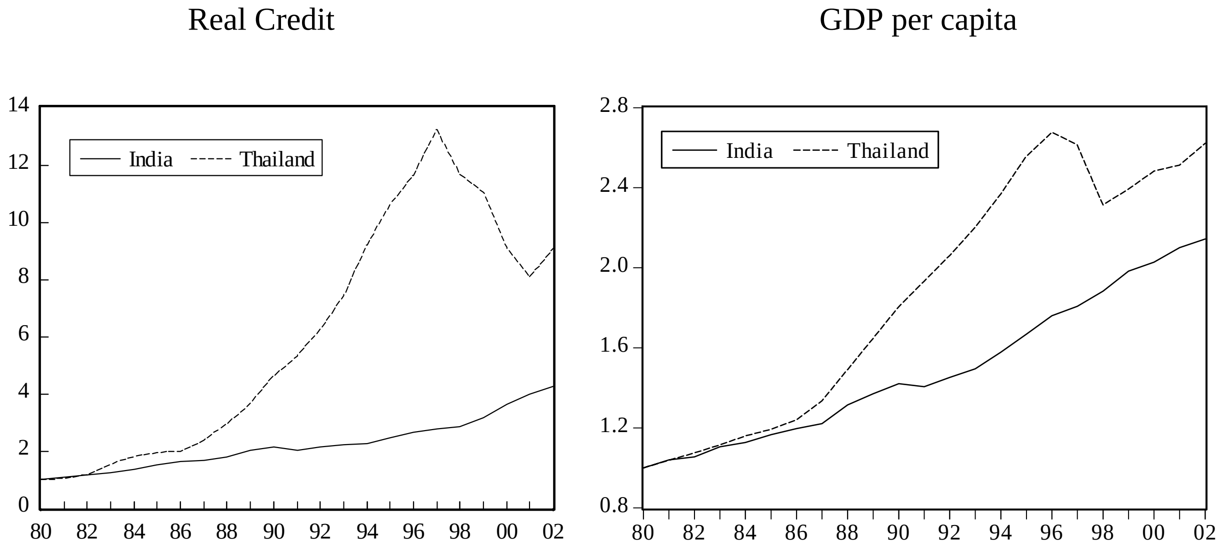
The behavior of the model economy is determined by seven parameters: $\theta, \sigma, d, r, u, \alpha, h$. We set the probability of crisis $(1-u)$ equal to the historical probability of a systemic banking crisis. Using the crisis index of Caprio and Klingebiel (2003) we find that $1-u = 4.13\%$ across our sample of 83 countries over the period 1981-2000.[54] Since in our model $\alpha = \frac{\text{1+growth lucky times}}{\text{1+growth crisis times}}$, we estimate α using the following algorithm. First, we find the minimum annual growth rate during each systemic banking crisis in our sample and then we average these growth rates: we obtain $g_c = -7.23\%$ with a standard deviation of $\sigma_{g_c} = 5.83\%$. Second, we compute the average growth rate in non-crisis years: $g_n = 1.43\%$ with a standard deviation $\sigma_{g_n} = 4.11$. Third, we consider a drop from a boom $(g_n + 2\sigma_{g_n})$ to a severe bust $(g_c - 2\sigma_{g_c})$ and obtain $\alpha = 0.79$. In our benchmark simulation, we set α even more conservatively at $\alpha = 0.5$. The interest rate r, is set to the average Fed funds rate during the nineties: 5.13%.

Given the values of r and u, we determine the range for the degree of contract enforceability h over which risky and safe equilibria exist: $h \in (\underline{h} = 0.48,\ u\delta^{-1} = 1.006)$. In our benchmark simulation, we set $h = 0.5$. Finally, the technological parameters (θ,σ) and the payout rate d do not have an empirical counterpart and are irrelevant for the existence of equilibria. We set $d = 10\%$ and the return to the safe technology to 10% ($\sigma = 1.1$). We then set $\theta = 1.12$ so as to satisfy the restriction $1 + r < \theta u < \sigma < \theta$. The following table summarizes the parameters used in our benchmark simulation presented in Figures 2-4.

[54] If we use the banking crisis index of Detriagache and Demirguc-Kunt, we find $1 - u = 3.94\%$.

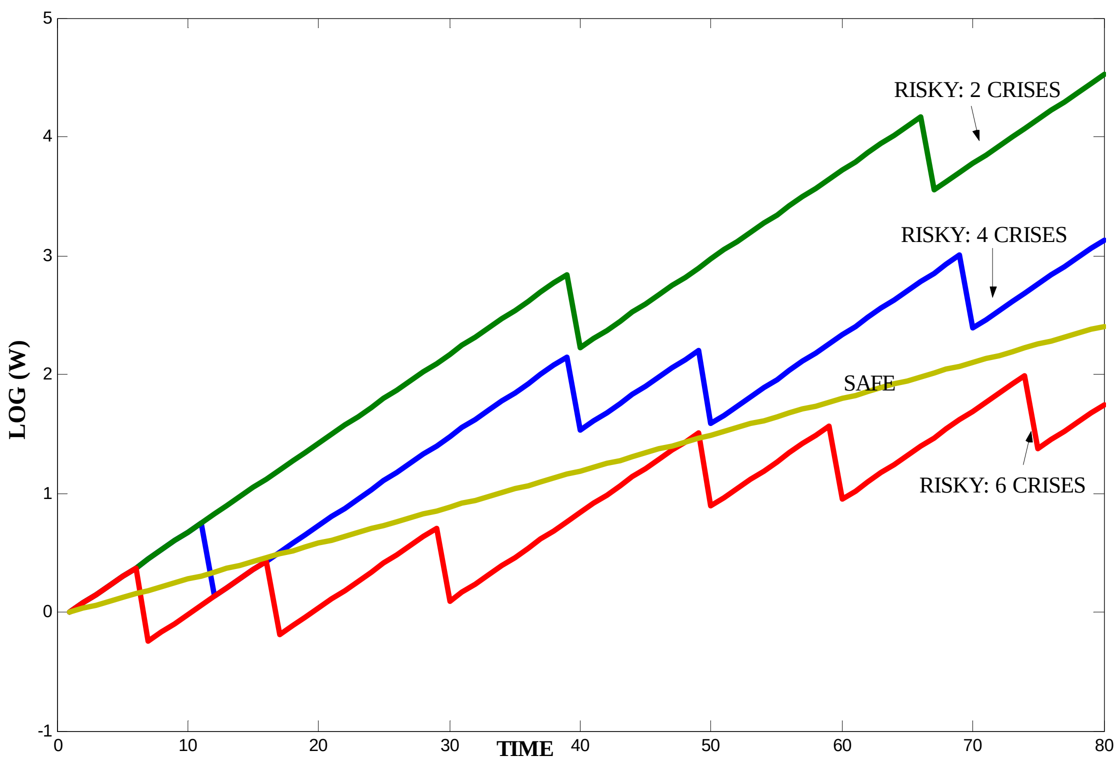
Parameters	baseline value
Safe Return	$\sigma = 1.10$
Risky High Return	$\theta = 1.12$
World Interest Rate	$r = 0.0513$
Dividend Rate	$d = 0.10$
Financial Distress Costs	$\alpha = 0.50$
Probability of crisis	$1 - u = 0.0418$
Degree of Contract Enforceability	$h = 0.50$

Figure 1: Safe vs. Risky Growth Path: A Comparison of India and Thailand, 1980–2002



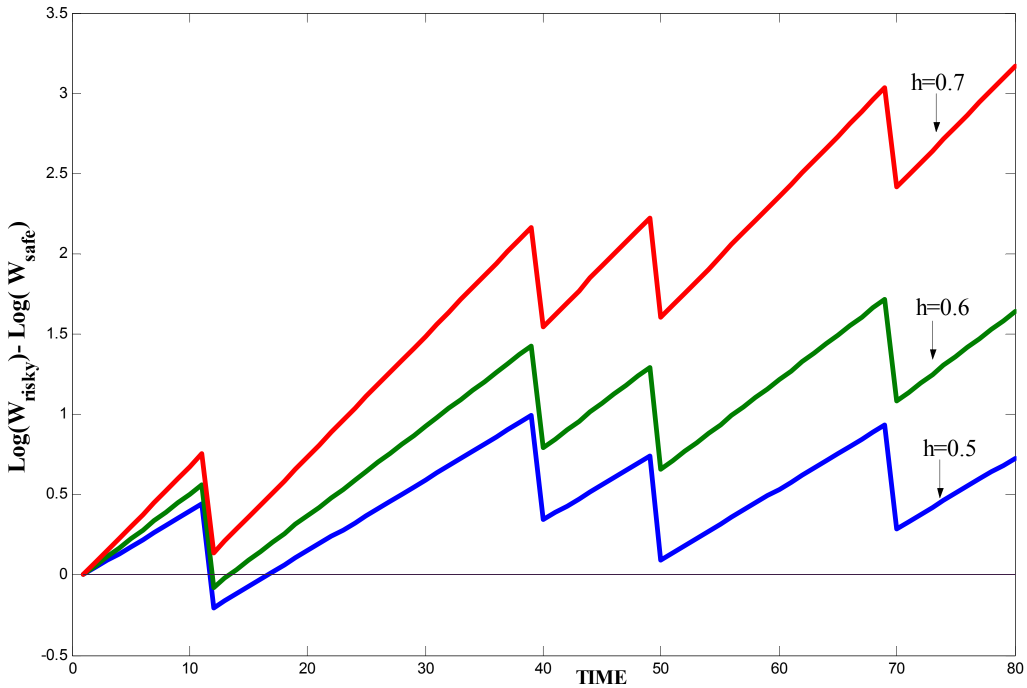
Note: The values for 1980 are normalized to one. The figures display annual credit and per-capita GDP series.

Figure 2: Model Economy: Growth and Crises



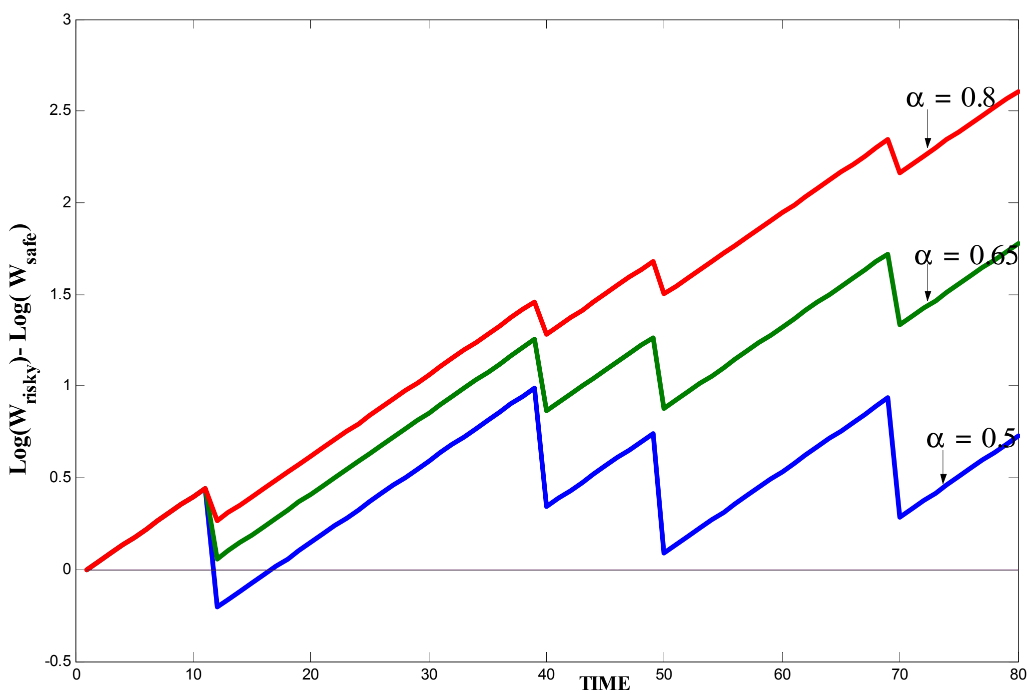
$parameters: \sigma = 1.10 \quad \theta = 1.12 \quad r = 0.051 \quad d = 0.10 \quad \alpha = 0.5 \quad 1 - u = 0.0418 \quad h = 0.5$

Figure 3: Risky vs. Safe: The Role of Contract Enforceability



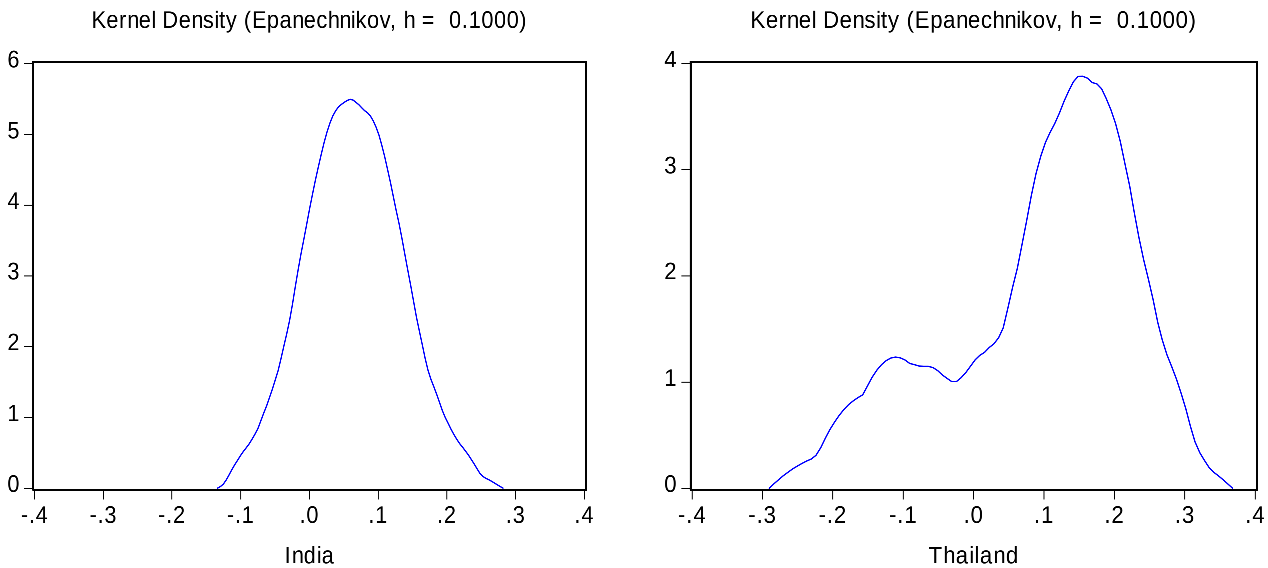
parameters : $\sigma = 1.10 \quad \theta = 1.12 \quad r = 0.051 \quad d = 0.10 \quad \alpha = 0.5 \quad 1-u = 0.0418$

Figure 4: Risky vs. Safe: Financial Distress Costs



parameters : $\sigma = 1.10 \quad \theta = 1.12 \quad r = 0.051 \quad d = 0.10 \quad h = 0.5 \quad 1-u = 0.0418$

Figure 5: Kernel Distributions of Real Credit Growth 1980-2002

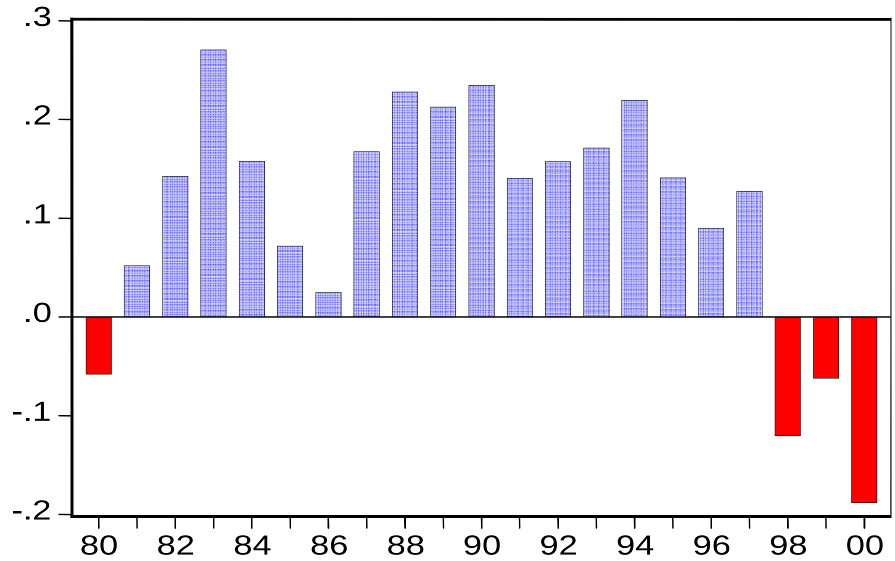


Moments of real credit growth (1980-2002)

	India	Thailand
Mean	0.064	0.094
Standard Deviation	0.055	0.126
Skewness	0.132	-0.824

Figure 6: Measuring Systemic Risk: Skewness and Crisis Indexes

Panel A: Real credit growth rates in Thailand (1980-2000)

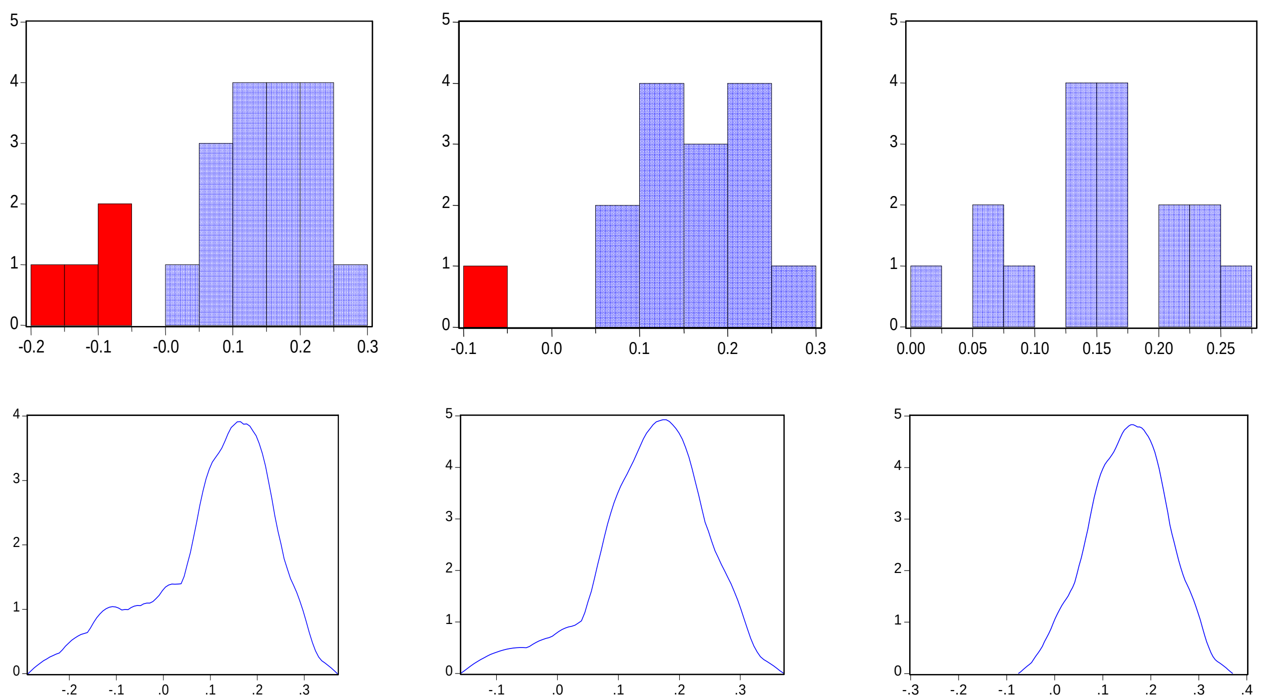


Panel B: Histograms and kernel distributions of credit growth rates in Thailand (1980-2000)

A) All years | B) Without de jure Crises | C) Without outliers

years excluded: 1985-1987; 1998-2000

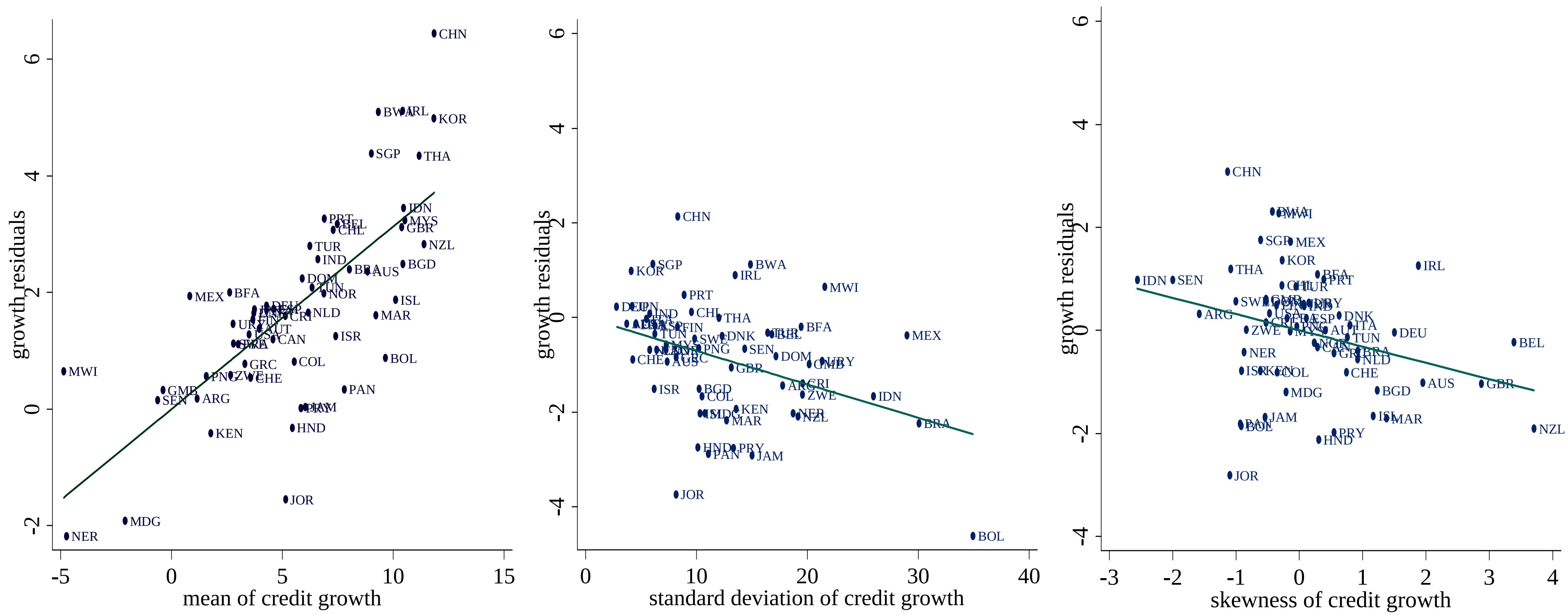
years excluded: 1980; 1998-2000



	A)	(B)	(C)
Mean	0.103	0.152	0.153
Std. Dev.	0.123	0.081	0.067
Skewness	-0.900	-0.994	-0.196

Note: The de jure crises are identified by the consensus banking crisis index described in subsection 3.1. The outliers are the four negative extreme observations.

Figure 7: Growth Residuals vs. Moments of Credit Growth



Note: The partial linear plots are based on the estimation results of regression 3, Table 2.

Table 1
Skewness, Crises, and Extreme Observations

Panel A: Extreme observations, coded crises and skewness
Sample: 29 countries with negative skewness (1981-2000)

Lowest extreme observations		Complete credit growth distributions	Credit growth distributions without extreme observations		
Observations eliminated	Percentage of crisis years	Average skewness	Average skewness	Share of countries with skewness >-0.2	Share of countries with skewness >0 or reduced by 80% in absolute value
2	90%	-0.70	0.16	79%	65%
3	79%	-0.70	0.36	90%	87%

Note: Panel A assesses whether extreme credit growth observations drive negative skewness. We consider the countries with negative skewness, and for each country we eliminate the 2 (or 3) lowest credit growth observations. We then compute the effect of these extreme observations on skewness and determine whether they are coded as a crisis by any of the ten crisis indexes we list in the extended appendix. Average skewness figures correspond to cross-country averages across the sample of 29 countries with negative skewness. The sample period is 1981-2000.
Source: Table EA4 in the extended appendix.

Panel B: Observations with highest impact on skewness, coded crises and skewness
Sample: 29 countries with negative skewness (1981-2000)

Observations with highest impact on skewness		Complete credit growth distribution	Credit growth distribution without observations with highest impact on skewness		
Observations eliminated	Percentage of crisis years	Average skewness	Average skewness	Share of countries with skewness >-0.2	Share of countries with skewness>0 or reduced by 80% in absolute value
2	75%	-0.70	0.22	86%	72%
3	79%	-0.70	0.45	97%	97%

Note: Panel B considers the possibility that negative skewness can also be affected by non-extreme credit growth observations. We look at the countries with negative skewness, and for each country we eliminate the 2 (3) observations whose omission results in the highest increase in skewness. The sample period is 1981-2000.

Panel C: Consensus crisis years and skewness
Sample: 35 countries with at least one consensus crisis (1981-2000)

Number of countries with increased skewness after elimination of crisis years	Average skewness	
	Complete distributions	Distribution without crisis years
32	-0.41	0.32

Note: Panel C assesses whether the exclusion of crises increases skewness. For each country we exclude consensus crises and compute the effect on skewness. Average skewness figures correspond to cross-country averages across the sample of 35 countries with at least one consensus crisis. Consensus crises are meant to capture truly severe crises. They are defined in subsection 3.1. The sample period is 1981-2000.
Source: Table EA5 in the extended appendix.

Table 2
Skewness and Growth: Baseline Estimations
Dependent variable: Real per capita GDP growth
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1961-2000	1971-2000	1981-2000	1961-2000	1971-2000	1981-2000
Estimation technique		OLS			FGLS	
Unit of observations		Cross-section			Non-overlapping 10 year windows	
	[1]	[2]	[3]	[4]	[5]	[6]
Moments of real credit growth:						
Real credit growth - mean	0.339 ***	0.348 ***	0.313 ***	0.156 ***	0.149 ***	0.159 ***
	0.05	*0.056*	*0.053*	*0.011*	*0.011*	*0.012*
Real credit growth - standard deviation	-0.032	-0.068 **	-0.071 **	-0.049 ***	-0.064 ***	-0.048 ***
	0.024	*0.03*	*0.029*	*0.01*	*0.009*	*0.009*
Real credit growth - skewness	-0.274 **	-0.334 **	-0.315 **	-0.333 ***	-0.244 ***	-0.268 ***
	0.129	*0.131*	*0.143*	*0.073*	*0.075*	*0.071*
Control variables:						
Initial secondary schooling	0.031 **	0.024 *	0.019	0.016 ***	0.021 ***	0.026 ***
	0.013	*0.013*	*0.018*	*0.004*	*0.004*	*0.003*
Initial income per capita	-0.222	-0.283	-0.344	-0.022	-0.182 *	-0.209 ***
(in logs)	*0.247*	*0.273*	*0.348*	*0.093*	*0.095*	*0.062*
No. countries / No. observations	58/58	58/58	58/58	58/209	58/166	58/114

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Regressions 1 to 3 are cross-section regressions estimated by Ordinary Least Squares (OLS). Heteroskedasticity robust standard errors are reported. Regressions 4 to 6 are panel regressions estimated by Feasible Generalized Least Squares (FGLS). All the FGLS specifications include time effects. Coefficients for period dummies are not reported.

Table 3
Skewness and Growth: Country Grouping Estimations

Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1981-2000	1961-2000	1971-2000
Unit of observations	Non-overlapping 10 year windows		
Financial liberalization indicator	De facto	De jure (Quinn)	De jure (Mody)
	[1]	[2]	[3]
Moment of credit growth:			
Real credit growth - mean	0.105 ***	0.091 ***	0.091 ***
	0.018	*0.025*	*0.033*
Real credit growth - standard deviation	-0.058 ***	-0.077 ***	-0.098 ***
	0.009	*0.014*	*0.016*
Real credit growth - skewness	-0.011	-0.081	-0.019
	0.085	*0.109*	*0.133*
Moment of credit growth interacted:			
Mean credit growth * MEC_FL	0.131 ***	0.170 ***	0.151 ***
	0.034	*0.044*	*0.055*
Standard deviation of credit growth * MEC_FL	0.047 **	0.020	0.043
	0.018	*0.028*	*0.030*
Skewness of credit growth * MEC_FL	-0.802 ***	-0.750 ***	-1.002 ***
	0.165	*0.244*	*0.275*
MEC_FL	-0.145	-0.026	-0.048
(Medium contract enforceability*financial liberalization)	*0.230*	*0.376*	*0.412*
Control variables:			
Initial secondary schooling	0.019 ***	0.013 ***	0.000
	0.006	*0.005*	*0.008*
Initial income per capita	-0.236 *	-0.164	-0.074
(in logs)	*0.140*	*0.123*	*0.152*
Skewness (fully liberalized MEC countries; FIN_MEC=1):			
Coefficient	-0.810	-1.020	-0.850
Standard error	0.120	0.040	0.210
F-test Ho: Coefficient=0 (P-value)	0.000	0.000	0.000
No. countries / No. observations	58/114	32/96	49/163

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: See Section 3.2 for the construction of the composite index of medium enforceability of contracts and financial liberalization (MEC_FL). Coefficients for period dummies are not reported.

Table 4
Skewness and Growth: GMM System Estimations
Dependent variable: Real per capita GDP growth
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1971-2000	
Unit of observations	Non-overlapping 10 year windows	
	[1]	[2]
Moment of credit growth:		
Real credit growth - mean	0.26 ***	0.24 ***
	0.039	*0.044*
Real credit growth - standard deviation	-0.109	-0.15
	0.089	*0.104*
Real credit growth - skewness	-0.601 ***	-0.589 **
	0.163	*0.222*
Set of control variables	Simple set	Simple set
No. countries / No. observations	58/166	58/166
SPECIFICATION TESTS (*p* -values)		
(a) Sargan-Hansen Test:	0.13	0.18
(b) Second-order serial correlation:	0.29	0.3

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: 2-step system GMM estimates are reported. Robust standard errors are computed using Windmeijer's (2005) small sample correction. In regression 1, all regressors are treated as endogenous. In regression 2, all regressors are treated as endogenous with the exception of skewness. Appropriate lagged levels (differences) are used as instruments to estimate the difference (level) equation. All GMM system regressions include time effects and country fixed effects. The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Table 5

Skewness and Growth: Country Groupings GMM System Estimations

Dependent variable: Real per capita GDP growth

(Standard errors are presented below the corresponding coefficient.)

Financial liberalization indicator	De jure (Quinn)		De jure (Mody)	
Estimation period	1971-2000			
Unit of observations	Non-overlapping 10 year windows			
	[1]		[2]	
Moment of credit growth:				
Real credit growth - mean	0.042		0.129	
	0.063		*0.082*	
Real credit growth - standard deviation	-0.135	***	-0.126	**
	0.026		*0.05*	
Real credit growth - skewness	0.04		-0.037	
	0.134		*0.218*	
Moment of credit growth interacted:				
Mean credit growth * MEC_FL	0.278	**	0.132	
	0.113		*0.142*	
Standard deviation of credit growth * MEC_FL	0.095		0.075	
	0.06		*0.093*	
Skewness of credit growth * MEC_FL	-1.007	***	-1.222	***
	0.344		*0.437*	
MEC_FL	-1.899	*	-0.697	
(Medium contract enforceability*financial liberalization)	*1.028*		*2.063*	
Set of control variables	Simple set		Simple set	
No. countries / No. observations	49/144		32/93	
SPECIFICATION TESTS (*p*-values)				
(a) Sargan-Hansen Test:	0.32		0.35	
(b) Second-order serial correlation:	0.28		0.23	

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: 2-step system GMM estimates are reported. Robust standard errors are computed using Windmeijer's (2005) small sample correction. The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Table 6
Crisis Indexes and Growth
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1981-2000				
Unit of observations	Non-overlapping 10 year windows				
	[1]	[2]	[3]	[4]	[5]
Moment of credit growth:					
Real credit growth - mean	0.178 ***	0.165 ***	0.165 ***	0.159 ***	0.164 ***
	0.005	*0.007*	*0.007*	*0.01*	*0.008*
Real credit growth - standard deviation	-0.064 ***	-0.06 ***	-0.061 ***	-0.06 ***	-0.057 ***
	0.007	*0.007*	*0.007*	*0.007*	*0.006*
Crisis indexes:					
Banking crisis: Caprio Klingebiel index	0.258 **				
	0.127				
Banking crisis: Detragriache et al. index		0.223 **			
		0.105			
Banking crisis: Consensus index			0.228 **		
			0.11		
Sudden stop: Consensus index				0.464 **	
				0.201	
Currency crisis: Consensus index					0.072
					0.169
Set of control variables	Simple set	Simple set	Simple set	Simple set	Simple set
No. countries / No. Observations	58/114	58/114	58/114	58/114	58/114

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: A crisis index is equal to one if a country-decade experienced a crisis, zero otherwise. See Section 3.1 for the construction of the consensus crisis indexes. The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Table 7

Panel A: Investment and Skewness Regressions

Dependent variables: Domestic price-investment rate, PPP-investment rate

(Standard errors are presented below the corresponding coefficient.)

Dependent variable	Domestic price-investment rate		PPP-investment rate	
Estimation period	1971-2000			
Estimation technique	FGLS	GMM system	FGLS	GMM system
Unit of observations	Non-overlapping 10 year windows			
	[1]	[2]	[3]	[4]
Moment of credit growth:				
Real credit growth - mean	0.332 ***	0.499 ***	0.271 ***	0.39 ***
	0.036	*0.096*	*0.028*	*0.091*
Real credit growth - standard deviation	-0.081 ***	-0.125	-0.073 ***	-0.159
	0.024	*0.175*	*0.023*	*0.137*
Real credit growth - skewness	-0.765 ***	-1.127 **	-0.737 ***	-1.207 **
	0.191	*0.543*	*0.149*	*0.603*
Lagged investment rates:				
Lagged investment rate (domestic price)	0.718 ***	0.608 ***		
	0.036	*0.104*		
Lagged investment rate (PPP)			0.753 ***	0.548 ***
			0.031	*0.132*
Control set of variables	Simple set	Simple set	Simple set	Simple set
No. countries / No. observations	57/163	57/163	57/163	57/163
SPECIFICATION TESTS (*p* -values)				
(a) Sargan-Hansen Test:		0.16		0.14
(b) Second-order serial correlation:		0.23		0.24

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Panel B: Growth and Investment Regressions

Dependent variable: Real per capita GDP growth

(Standard errors are presented below the corresponding coefficient.)

Estimation period	1971-2000			
Estimation technique	FGLS	GMM system	FGLS	GMM system
Unit of observations	Non-overlapping 10 year windows			
	[1]	[2]	[3]	[4]
Investment rate domestic price	0.217 ***	0.224 ***		
	0.015	*0.041*		
Investment rate PPP price			0.166 ***	0.17 ***
			0.011	0.046
Control set of variables	Simple	Simple	Simple	Simple
No. countries / No. observations	57/171	57/171	57/171	57/171
SPECIFICATION TESTS (*p* -values)				
(a) Sargan-Hansen Test:		0.47		0.17
(b) Second-order serial correlation:		0.4		0.45

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Table 8
Skewness and Growth
Robustness: Extended Set of Controls
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1961-2000		1971-2000		1981-2000	
Unit of observations	Non-overlapping 10 year windows					
	[1]		[2]		[3]	
Moments of real credit growth:						
Real credit growth - mean	0.133	***	0.126	***	0.138	***
	0.011		*0.013*		*0.01*	
Real credit growth - standard deviation	-0.036	***	-0.037	***	-0.046	***
	0.01		*0.01*		*0.009*	
Real credit growth - skewness	-0.261	***	-0.234	***	-0.226	***
	0.072		*0.073*		*0.071*	
Control variables:						
Initial secondary schooling	0.001		0.008		0.01	
	0.005		*0.006*		*0.007*	
Initial income per capita	-0.27	*	-0.405	**	-0.217	
(in logs)	*0.15*		*0.162*		*0.179*	
Openness to trade	-0.045		0.346	**	0.769	***
	0.147		*0.159*		*0.159*	
Government consumption as a share of GDP	-0.042	***	-0.059	***	-0.063	***
	0.014		*0.014*		*0.014*	
Inflation rate	-0.016	***	-0.015	***	-0.007	*
	0.004		*0.004*		*0.004*	
Life expectancy at birth	0.083	***	0.073	***	0.039	***
	0.015		*0.015*		*0.014*	
Black market premium	-0.131		-0.178	*	-0.164	***
	0.081		*0.099*		*0.015*	
No. countries / No. observations	58/209		58/166		58/114	

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The specification of the regressions is identical to regressions 4 to 6, Table 2 and includes five additional control variables: Openness to trade, government consumption as a share of GDP, life expectancy at birth, and black market premium.

Table 9
Skewness and Growth: Country Groupings Estimations
Robustness: Alternative Definitions of the MEC set
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1981-2000		
Unit of observations	Non-overlapping 10 year windows		
	[1]	[2]	[3]
Moment of credit growth:			
Real credit growth - mean	0.084 ***	0.127 ***	0.106 ***
	0.019	*0.013*	*0.013*
Real credit growth - standard deviation	-0.057 ***	-0.066 ***	-0.047 ***
	0.011	*0.008*	*0.009*
Real credit growth -skewness	-0.01	-0.182 **	-0.172 **
	0.098	*0.072*	*0.069*
Moment of credit growth interacted:			
Mean credit growth * MEC_FL	0.195 ***	0.184 ***	0.312 ***
	0.037	*0.06*	*0.06*
Standard deviation of credit growth * MEC_FL	0.018	0.095 ***	-0.036
	0.023	*0.026*	*0.031*
Skewness of credit growth * MEC_FL	-0.814 ***	-0.551 ***	-0.625 ***
	0.189	*0.198*	*0.195*
MEC_FL	-0.238	-1.453 ***	-0.249
(Medium contract enforceability*financial liberalization)	*0.261*	*0.561*	*0.593*
Skewness (fully liberalized MEC countries):			
Coefficient	-0.82	-0.73	-0.8
Standard error	*0.16*	*0.18*	*0.19*
F-test Ho: Coefficient=0 (P-value)	0	0	0
Set of control variables	simple set	simple set	simple set
No. countries / No. observations	58/114	58/114	58/114

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The specification of the regressions is identical to regression 1, Table 3 with alternative definitions of the MEC set. Countries classified as MEC have a PRS law and order index equal to (i) 3, 4 or 5 (regression 1), (ii) 2, 3 or 4 (regression 2), (iii) 3 or 4 (regression 3). The coefficients for the other control variables (initial income per capita and secondary schooling) are not reported.

Table 10
Skewness and Growth
Robustness: Full Sample of 83 Countries
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1961-2000	1971-2000	1981-2000	1961-2000	1971-2000	1981-2000
Unit of observations	Non-overlapping 10 year windows					
	[1]	[2]	[3]	[4]	[5]	[6]
Moments of real credit growth:						
Real credit growth - mean	0.14 ***	0.137 ***	0.128 ***	0.115 ***	0.107 ***	0.106 ***
	0.009	*0.011*	*0.008*	*0.01*	*0.01*	*0.011*
Real credit growth - standard deviation	-0.031 ***	-0.038 ***	-0.031 ***	-0.023 ***	-0.026 ***	-0.018 **
	0.007	*0.008*	*0.006*	*0.008*	*0.008*	*0.007*
Real credit growth - skewness	-0.289 ***	-0.213 ***	-0.224 ***	-0.225 ***	-0.196 ***	-0.189 ***
	0.065	*0.065*	*0.05*	*0.063*	*0.058*	*0.067*
Control variables:						
Initial secondary schooling	0.005	0.012 **	0.017 **	0.006	0.012 **	0.012 **
	0.006	*0.005*	*0.007*	*0.004*	*0.005*	*0.005*
Initial income per capita	0.082	-0.182	-0.244 **	-0.472 ***	-0.601 ***	-0.485 ***
	0.122	*0.118*	*0.122*	*0.12*	*0.123*	*0.121*
Openness to trade				0.327 **	0.481 ***	0.711 ***
				0.137	*0.151*	*0.158*
Government consumption as a share of GDP				-0.03 ***	-0.034 ***	-0.032 **
				0.012	*0.012*	*0.014*
Inflation rate				-0.01 ***	-0.011 ***	-0.008 **
				0.004	*0.004*	*0.003*
Life expectancy at birth				0.117 ***	0.119 ***	0.096 ***
				0.014	*0.016*	*0.015*
Black market premium				-0.165 ***	-0.145 **	-0.120 ***
				0.064	*0.059*	*0.021*
No. countries / No. observations	83/299	83/237	83/161	83/299	83/237	83/161

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The specifications for regressions 1-3 are identical to regressions 4-6 in Table 2. The specifications for regressions 4-6 are identical to regressions 1-3, Table 8.

Table 11
Skewness and Growth
Robustness: Outliers
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1961-2000						
Unit of observations	Non-overlapping 10 year windows						
Outlier omitted	None	Bolivia (60s)	Niger (70s)	Senegal (70s)	Jordan (80s)	Papua New Guinea (80s)	Niger (80s)
	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Moments of credit growth:							
Real credit growth - mean	0.16 ***	0.16 ***	0.16 ***	0.16 ***	0.16 ***	0.16 ***	0.15 ***
	0.01	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Real credit growth - standard deviation	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***
	0.01	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Real credit growth - skewness	-0.33 ***	-0.31 ***	-0.32 ***	-0.31 ***	-0.35 ***	-0.34 ***	-0.32 ***
	0.07	*0.07*	*0.07*	*0.07*	*0.07*	*0.08*	*0.07*
Set of control variables	Simple set	Simple set	Simple set	Simple set	Simple set	Simple set	Simple set
No. countries / No. observations	58/209	58/208	58/208	58/208	58/208	58/208	58/208

* significant at 10%; ** significant at 5%; *** significant at 1%

Estimation period	1961-2000							
Unit of observations	Non-overlapping 10 year windows							
Outlier omitted	Brazil (70s)	Indonesia (70s)	Singapore (70s)	Korea (80s)	Botswana (80s)	Japan (60s)	China (90s)	all outliers
	[8]	[9]	[10]	[11]	[12]	[13]	[14]	[15]
Moments of credit growth:								
Real credit growth - mean	0.16 ***	0.16 ***	0.16 ***	0.15 ***	0.16 ***	0.16 ***	0.15 ***	0.15 ***
	0.01	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Real credit growth - standard deviation	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***	-0.05 ***
	0.01	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*	*0.01*
Real credit growth - skewness	-0.34 ***	-0.33 ***	-0.33 ***	-0.31 ***	-0.33 ***	-0.35 ***	-0.30 ***	-0.24 ***
	0.07	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*	*0.07*
Set of control variables	Simple set	Simple set	Simple set	Simple set	Simple set	Simple set	Simple set	Simple set
No. countries / No. observations	58/208	58/208	58/208	58/208	58/208	58/208	57/208	57/196

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The specification of the regressions is identical to regression 4, Table 2. A country-decade is an outlier if the absolute value of its corresponding residual exceeds two standard deviations.

Appendix A.4 Definitions and Sources of Variables used in the Regression Analysis

Variable	Definition and construction	Source
GDP per capita	Ratio of total GDP to total population. GDP is in 1995 constant US$.	World Development Indicators (2003).
GDP per capita growth	Log difference of real GDP per capita.	World Development Indicators (2003).
Initial GDP per capita	Initial value of ratio of total GDP to total population (in logs). GDP is in 1995 constant US$.	World Development Indicators (2003).
Secondary schooling	Ratio of total secondary enrollment, regardless of age, to the population of the age group that officially corresponds to that level of education.	World Development Indicators (2003).
Real credit growth	Log difference of real domestic bank credit claims on the private sector.	Author's calculations using data from IFS - line 22, and central banks' publications. The method of calculations is based on Beck, Demirguc-Kunt and Levine (1999). Domestic bank credit claims are deflated with end of the year CPI index.
Investment rate PPP-prices	Ratio of investment to GDP measured in PPP-adjusted prices.	Penn World Tables 6.1
Investment rate domestic prices	Ratio of investment to GDP measured in domestic prices.	Penn World Tables 6.1
Terms of trade index	Terms of trade index shows the national accounts exports price index divided by the imports price index with a 1995 base year.	World Development Indicators (2003).
Terms of trade growth	Growth rate of terms of trade Index.	World Development Indicators (2003).
Government consumption	Ratio of government consumption to GDP.	World Development Indicators (2003).
CPI	Consumer price index (1995 = 100) at the end of the year.	Author's calculations with data from IFS.
Inflation rate	Annual % change in CPI.	Author's calculations with data from IFS.
Life expectancy	Life expectancy at birth.	World Development Indicators (2003).
Trade openness	Residual of a regression of the log of the ratio of exports and imports (in 1995 US$) to GDP (in 1995 US$), on the logs of area and population, and dummies for oil exporting and for landlocked countries.	Author's calculations with data from Global Development Network (2002)
Black market premium	Ratio of black market exchange rate and official exchange rate minus one (in percentage points).	Author's calculations with data from Global Development Network (2002)
MEC_FL index	See Section 3 for the construction of the composite index of financial liberalization and medium degree of contract enforceability.	Degree of contract enforceability: Law and order index from Political Risk Service (2004). Financial liberalization indexes: see Extended Appendix.
Financial liberalization indexes	See Extended Appendix.	See Extended Appendix.
Crisis indexes	See Extended Appendix.	See Extended Appendix.

Appendix A.5 Sample of Countries

Algeria		Haiti		Philippines	
Argentina	*	Honduras	*	Portugal	*
Australia	*	Iceland	*	Senegal	*
Austria	*	India	*	Sierra Leone	
Bangladesh	*	Indonesia	*	Singapore	*
Belgium	*	Iran		South Africa	
Bolivia	*	Ireland	*	Spain	*
Botswana	*	Israel	*	Sri Lanka	
Brazil	*	Italy	*	Sweden	*
Burkina Faso	*	Jamaica	*	Switzerland	*
Canada	*	Japan	*	Syria	
Chile	*	Jordan	*	Thailand	*
China	*	Kenya	*	Togo	
Colombia	*	Korea, Rep.	*	Trinidad and Tobago	
Congo, Dem. Rep.		Madagascar	*	Tunisia	*
Congo, Rep.		Malawi	*	Turkey	*
Costa Rica	*	Malaysia	*	Uganda	
Cote d'Ivoire		Mexico	*	United Kingdom	*
Denmark	*	Morocco	*	United States	*
Dominican Republic	*	Netherlands	*	Uruguay	*
Ecuador		New Zealand	*	Venezuela	
Egypt		Nicaragua		Zambia	
El Salvador		Niger	*	Zimbabwe	*
Finland	*	Nigeria			
France	*	Norway	*		
Gambia, The	*	Pakistan			
Germany	*	Panama	*		
Ghana		Papua New Guinea	*		
Greece	*	Paraguay	*		
Guatemala		Peru			

* Countries in the 58 countries sample

Extended Appendix to "Systemic Crises and Growth"

A Proofs

Proof of Proposition 2.1. Consider three plans: A 'safe plan' where there is no-diversion and the firm will be solvent in both states; a 'risky plan' where there is no-diversion and the firm will be solvent in the good state but not in the bad state; and a 'diversion plan' where the firm never repays debt. In a safe plan, the entrepreneur offers $1 + \rho_t = 1 + r$, and lenders lend up to $b_t(1 + r) \leq h(w_t + b_t)$ in order to deter diversion (i.e., $q_{t+1} - b_t(1 + r) \geq q_{t+1} - h(w_t + b_t)$. Let s be the share of available funds ($w + b = m^j w$) invested in the risky technology and $1 - s$ the share invested in the safe technology $s \in [0, 1]$. It follows that in a safe plan, expected profits are (wlog set $w_t = 1$):

$$
\begin{aligned}
\text{good state} \quad &: \quad \pi^s_{t+1} = [s\theta + (1 - s)\sigma]m^s - \delta^{-1}(m^s - 1) = \{[s\theta + (1 - s)\sigma] - h\}\, m^s \\
\text{bad state} \quad &: \quad \pi^s_{t+1} = \{(1 - s)\sigma - h\}\, m^s, \quad \text{with } m^s = \frac{1}{1 - h\delta}. \\
E\pi^s_{t+1} \quad &= \quad \{su\theta + (1 - s)\sigma - h\}\, m^s = \{[s(u\theta - \sigma) + \sigma] - h\}\, m^s
\end{aligned}
$$

A plan is safe because profits are positive in both states, and therefore a plan is safe when $s < 1 - \frac{h}{\sigma}$. Since $u\theta < \sigma$, the best safe plan sets $s = 0$.

In a risky plan, the interest rate must satisfy $u(1+\rho_t)b_t + (1-\zeta_{t+1})(1+\rho_t)b_t = (1+r)$. If a bailout is expected ($\zeta_{t+1} = u$), then $1 + \rho_t = 1 + r$ and the borrowing constraint is $ub_t(1 + r) \leq h(w_t + b_t)$. If no bailout is expected ($\zeta_{t+1} = 1$), then $1 + \rho_t = u^{-1}(1 + r)$ and the borrowing constraint is $b_t(1 + r) \leq h(w_t + b_t)$. It follows that:

$$
\begin{aligned}
\text{good state} \quad &: \quad \pi^r_{t+1} = [s\theta + (1 - s)\sigma]m^r(\zeta_{t+1}) - [m^r(\zeta_{t+1}) - 1]\delta^{-1} \\
\text{bad state} \quad &: \quad \pi^r_{t+1} = 0, \qquad \text{with } m^r(\zeta_{t+1}) = (1 - h\delta\zeta^{-1})^{-1} \\
E\pi^r_{t+1} \quad &= \quad \{u[s\theta + (1 - s)\sigma] - h\}m^r(\zeta_{t+1})
\end{aligned}
$$

A plan is risky because the firm is insolvent in the bad state, and therefore a plan is risky provided $s > 1 - \frac{h}{u\sigma}$. Since $\theta > \sigma$, the best risky plan sets $s = 1$ if $\zeta_{t+1} = u$.

Consider a diversion plan. Since a firm must be solvent to divert, the promised repayment is never set greater than $L_{t+1} \leq q_{t+1}$. Since lenders will get repaid only if a bailout will be granted, they only lend up to $b_t \leq (1 - \zeta_{t+1})(1 + r)^{-1}L_{t+1}$. Thus, in a diversion plan $b_t = m^d w_t$, with $m^d(\zeta_{t+1}) = [1 - (1 - \zeta_{t+1})\delta\theta]^{-1}$. It follows that young managers' expected payoffs under a safe, risky and diversion plan are, respectively:

$$S_{t+1} = [d-\tau][\sigma-h]m^s w_t,\ R_{t+1} = [d-\tau][\theta u-h]m^r(\zeta_{t+1})w_t,\ D_{t+1} = [d-\tau][\theta u-h]m^d(\zeta_{t+1})w_t \quad (20)$$

In a safe symmetric CME, all firms choose a safe plan, and no bailout is expected. In a risky symmetric CME, all firms choose a risky plan, and a bailout is expected in the bad state. To show that there always exists a safe symmetric CME note that if all other managers choose the safe plan, no bailout is expected next period (i.e., $\zeta_{t+1} = 1$). Thus, $m^d(\zeta_{t+1} = 1) = 1$ and $m^r(\zeta_{t+1} = 1) = m^s$. Since $\theta u < \sigma$, (20) implies that if all other managers choose a safe plan, the manager strictly prefers the safe plan over the other two plans. Next, consider a risky symmetric CME. If all other managers choose the risky plan, a bailout will be granted in the bad state. Since $m^r(\zeta_{t+1} = u) = (1 - h\delta u^{-1})^{-1}$, the manager prefers a risky over a safe plan if and only if

$$0 \leq E_t\pi^r_{t+1} - \pi^s_{t+1} = \frac{\theta u - h}{1 - h\delta u^{-1}} w_t - \frac{\sigma - h}{1 - h\delta} w_t := Z(h)w_t \quad (21)$$

It follows from (7) and (8) that $Z(h)$ has three properties: $Z(0) = u\theta - \sigma < 0$, $\lim_{h\to u\delta^{-1}} Z(h) = \infty$ and $\frac{\partial Z(h)}{\partial h} = \left(\frac{1}{1-u^{-1}h\delta}\right)^2 (\delta\theta - 1) - \left(\frac{1}{1-h\delta}\right)^2 (\delta\sigma - 1) > 0$. Thus, for any $u < 1$ there exists a unique threshold $\underline{h} \in (0, u\delta^{-1})$ such that $E_t\pi^r_{t+1} > \pi^s_{t+1}$ for all $h \in (\underline{h}, u\delta^{-1})$, where $\underline{h}$ is given by (9).

Next, a risky plan is preferred to a diversion plan if and only if $0 < R_{t+1} - D_{t+1} = [\theta u - h][m^r - m^d]$, which is equivalent to: (a) $[1 - u]\theta < u^{-1}h$. The question is whether (a) can hold simultaneously with (b) $h < \bar{h} := u\delta^{-1}$ and (c) $u\theta > \delta^{-1}$. For large enough u, (a) holds for any θ and any $h < \bar{h}$. Meanwhile, for $u \leq 0.5$ (a)-(c) cannot hold simultaneously. Thus, a risky plan is preferred to a diversion plan if and only if u is large enough (in particular, $u > 0.5$). Summing up, a risky CME exists if and only if $h > \underline{h}$ and u is large enough, so a risky plan is preferred to a safe and a diversion plan, respectively.

Distortionary taxes. In this case the expected payoff of a non-diverting manager is $[d - \tau^{old}]u[q_{t+1} - L_{t+1}]$, while that of a diverting manager is $d[uq_{t+1} - h(w_t + b_t)]$. If $\tau^{old} \in [0, dh/u\theta]$, the borrowing constraint and the expected payoff of a risky plan are

$$b_t \leq [m^r - 1]w_t, \quad E(\pi^r_{t+1})[d - \tau^{old}] = [u\theta - h]dm^r w_t, \quad m^r = \frac{1}{1 - \frac{\delta}{u}\frac{dh - u\theta\tau^{old}}{d - \tau^{old}}}$$

The payoff of diversion is the same as in the benchmark case. It follows that a risky plan is preferred to a diversion plan if and only if $\tau < dh/u\theta$ and $m^r > m^d \Leftrightarrow [1 - u]\theta < \frac{1}{u}\frac{dh - u\theta\tau}{d - \tau}$. This condition holds for large enough u.□

Proof of Proposition 2.2. The mean annual long-run growth rate is given by $E(1 + g^r) = \lim_{T\to\infty}\left[E_t \prod_{i=t+1}^{T}(1 + g^r_i)\right]^{1/T}$. The expression in (13) follows from the fact that the probability of crisis is independent across time. Comparing (12) and (13) we have that

$E(1+g^r) > (1+g^s)$ for any $\alpha \in (0,1)$ if and only if $E\pi^r > \pi^s$, which is equivalent to $h > \underline{h}$ (defined in (9)). Part (2) follows from $\partial Z(h)/\partial h > 0$. The sign of this derivative is established in the proof of Proposition 2.1.

To prove the fundability of the guarantees, it suffices to show that in a risky equilibrium the present value of pre-tax dividends during solvent times ($d\pi_t \equiv y_t^n$) is greater than the bailout costs ($L_t - a_t \equiv y_t^c$) for all $\alpha \in (0,1)$. In this case there exists a tax rate $\tau < d$ such that (6) holds. Notice that

$$\begin{aligned} y_t^c &\equiv -\frac{b_{t-1}}{\delta} - a_t = -\frac{(m^r-1)}{\delta} w_{t-1} - \alpha\gamma^n w_{t-1} = -w_t\left[1 + \frac{m^r-1}{\alpha\delta\gamma^n}\right] \\ y_t^n &\equiv d\pi_t = \frac{d}{1-d} w_t \end{aligned}$$

Next, we obtain $Y^r \equiv E_0 \sum_{t=0}^{\infty} \delta^t y_t$, where $y_t = y_t^n$ under solvency and $y_t = y_t^c$ otherwise. To compute this expectation, consider the process $\frac{y_{t+1}}{y_t}$, which follows a four-state Markov chain with transition matrix Φ

$$\Delta = \begin{pmatrix} \varrho^{nn} := \frac{y_{t+1}^n}{y_t^n} = (1-d)(\theta - \frac{h}{u})m^r \ := \gamma^n \\ \varrho^{nc} := \frac{y_{t+1}^c}{y_t^n} = -\alpha\gamma^n[1 + \frac{m^r-1}{\alpha\delta\gamma^n}]\frac{1-d}{d} \\ \varrho^{cn} := \frac{y_{t+1}^n}{y_t^c} = -\gamma^n\left[1 + \frac{m^r-1}{\alpha\delta\gamma^n}\right]^{-1}\frac{d}{1-d} \\ \varrho^{cc} := \frac{y_{t+1}^c}{y_t^c} = \alpha\gamma^n \end{pmatrix}, \qquad \Phi = \begin{pmatrix} u & 1-u & 0 & 0 \\ 0 & 0 & 1-u & u \\ 0 & 0 & 1-u & u \\ u & 1-u & 0 & 0 \end{pmatrix} \tag{22}$$

To obtain (22), note that if there is no crisis at t, $\frac{w_t}{w_{t-1}} = \gamma^n$, while if there is a crisis at t, $\frac{w_t}{w_{t-1}} = \alpha\gamma^n$. We will obtain Y^r by solving the following recursion:

$$V(y_0, \varrho_0) = E_0 \sum\nolimits_{t=0}^{\infty} \delta^t y_t = y_0 + \delta E_0 V(y_1, \varrho_1), \quad V(y_t, \varrho_t) = y_t + \delta E_t V(y_{t+1}, \varrho_{t+1}) \tag{23}$$

Consider the following conjecture: $V(y_t, \varrho_t) = y_t v(\varrho_t)$, with $v(\varrho_t)$ an undetermined coefficient. Substituting this conjecture into (23) and dividing by y_t, we get $v(\varrho_t) = 1 + \delta E_t(\varrho_{t+1} v(\varrho_{t+1}))$. Combining this condition with (22), it follows that $v(\varrho_{t+1})$ satisfies

$$(v_1, v_2, v_3, v_4)' = (1,1,1,1)' + \delta\Phi(\varrho^{nn}v_1, \varrho^{nc}v_2, \varrho^{cc}v_3, \varrho^{cn}v_4)'$$

Notice that $v_1 = v_4$ and $v_2 = v_3$. Thus, the system collapses to two equations: $v_1 = 1 + u\delta\varrho^{nn}v_1 + (1-u)\delta\varrho^{nc}v_2$ and $v_2 = 1 + (1-u)\delta\varrho^{cc}v_2 + u\delta\varrho^{cn}v_1$. The solution is

$$v_1 = \frac{1 - (1-u)\delta(\varrho^{cc} - \varrho^{nc})}{(1 - u\delta\varrho^{nn})(1 - (1-u)\delta\varrho^{cc}) - (1-u)u\delta^2\varrho^{cn}\varrho^{nc}} = \frac{1 - (1-u)[\delta\alpha\gamma^n + (m^r-1)(1-d)]d^{-1}}{1 - \delta u\gamma^n - \delta(1-u)\alpha\gamma^n}$$

To derive the second equality substitute $\varrho^{cn}\varrho^{nc} = \alpha(\gamma^n)^2$, $\varrho^{cc} - \varrho^{nc} = [\alpha\gamma^n + \delta^{-1}(m^r-1)(1-d)]d^{-1}$

and simplify the denominator. This solution exists and is unique provided $1-\delta u\gamma^n-\delta(1-u)\alpha\gamma^n \equiv 1-\delta\gamma^r>0$. Since this expression is strictly decreasing in α, it follows that $1-\delta\gamma^r>0$ for all $\alpha\in(0,1)$ iff $1-\delta u\gamma^n>0$, which holds iff d is high enough:

$$1-\delta(1-d)\frac{\theta-hu^{-1}}{1-\delta hu^{-1}}>0 \quad\Longleftrightarrow\quad d>\underline{d}:=\frac{\theta-\delta^{-1}}{\theta-hu^{-1}} \tag{24}$$

The lower bound $\underline{d}$ is less than one for any $h<\bar{h}\equiv u\delta^{-1}$ because $\theta-\delta^{-1}<\theta-hu^{-1}$. Next, notice that since there cannot be a crisis at $t=0$, the state at $t=0$ is v_1. Therefore, $V(y_0,\varrho_0)=v_1y_0^n$. Substituting $y_0^n=dw$ we get:

$$\begin{aligned} Y^r &= \tfrac{d-(1-u)[\delta\alpha\gamma^n+(m^r-1)(1-d)]}{1-\delta\gamma^r}w & \gamma^r &= u\gamma^n-(1-u)\alpha\gamma^n \\ &= w+\tfrac{(1-d)(\delta\theta u-1)m^r}{1-\delta\gamma^r}w, & \gamma^n &= [1-d][\theta-u^{-1}h]m^r \end{aligned} \tag{25}$$

In the first line, the first term in the numerator represent the average dividend, while the second term represents the average bailout, which covers the seed money given to firms $\alpha\gamma^n w_{t-1}$ and the debt that has to be repaid to lenders. The latter equals the leverage times the reinvestment rate $\frac{b_{t-1}}{w_{t-1}}\frac{w_{t-1}}{\pi_{t-1}}w_{t-1}=\delta^{-1}(m^r-1)(1-d)w_{t-1}$. To prove part (3) note that the numerator in the second line is positive because $d\in(0,1)$ and $\theta u\geq\delta^{-1}$ by assumption (7). The denominator is positive because $d>\underline{d}$.$\square$

Expected present value of managers' income

The next corollary shows that if the leverage effect is strong enough, the increase in expected dividends generated by systemic risk is greater than the associated expected bailout cost.

Corollary A.1 *There exists a unique threshold for the degree of contract enforceability $\widehat{h}<u\delta^{-1}$, such that the expected present value of dividends net of bailout payments is greater in a risky than in a safe equilibrium for any aid policy $\alpha\in(0,1)$ if and only if $h>\widehat{h}$ and $d>\underline{d}$.*

Proof. We just need to find conditions under which $Y^r>Y^s$. First, we know from the proof of Proposition 2.2 that Y^r converges and is given by (25) if $d>\underline{d}$ and $h>\underline{h}$. Second, in a safe equilibrium there is no systemic risk and there are no bailouts. Thus, $Y^s=\sum_{t=0}^{\infty}\delta^t d\pi_t^s$. If $\delta(1-d)(\sigma-h)m^s\equiv\delta\gamma^s<1$, this sum converges to

$$Y^s=\frac{dw}{1-\delta\gamma^s}=w+\frac{(1-d)(\delta\sigma-1)m^s}{1-\delta\gamma^s}w,\quad \gamma^s\equiv\ (1-d)(\sigma-h)m^s \tag{26}$$

Recall that a risky equilibrium exists only if $h>\underline{h}$, in which case $\gamma^s<\gamma^r$. Since $\delta\gamma^r<1$ for any $d>\underline{d}$, it follows that Y^s converges whenever a risky equilibrium exists and Y^r converges. As a third step we find the values of h for which $Y^r>Y^s$ for any $\alpha\in(0,1)$. Since Y^r is increasing in α

(by (25)), it suffices to compare $\lim_{\alpha \to 0} Y^r$ with Y^s. It follows that for any $\alpha \in (0,1)$

$$Y^r > Y^s \Longleftrightarrow h > \widehat{h} \equiv \frac{d\,(\sigma - u\theta)}{\left(\frac{1}{u} - 1\right)(\sigma\delta - 1) + \delta d(\sigma - u\theta)} < \frac{\delta}{u}$$

To show that $\widehat{h} < \bar{h} \equiv \delta u^{-1}$ notice that $\widehat{h}\delta u^{-1} < 1$ if and only if $(\sigma\delta - 1) > d(\sigma\delta - u\theta\delta)$, which is true because $d \in (0,1)$ and $\theta u \geq \delta^{-1}$ by assumption (7).□

Proof of Proposition A.1. We prove this proposition by comparing three plans: safe, risky and diversion. In a safe plan the firm invests in the safe technology and it repays debt in both states. In a risky plan, the firm invests in the risky technology and repays debt if it is solvent. In a diversion plan, the firm does not repay debt in any state.

Consider the best safe plan. The borrowing constraint is as in the Ak setup: $b_t \leq (m^s - 1)w_t$. It follows from (18) that for any $w < \hat{I}/m$ the marginal return on investment $g'(I)$ is greater than the return on saving $1 + r$. Thus, it is optimal to borrow up to the limit and not to save (it does not pay to borrow in order to save as both have the same interest rate). Hence, investmetn is the same as that in the model section. For $w \geq \hat{I}/m$ the firm invests $\hat{I}$ and only borrows $\hat{I} - w$, so the borrowing constraint does not bind. For $w \geq \hat{I}$ it saves $w - \hat{I}$ and does not borrow. Since $\delta^{-1}b_t = \delta^{-1}(m-1)w_t = hmw$, in the best safe plan profits are

$$\pi^s(w) = \begin{cases} g(wm) - hmw & \text{if } w < \hat{I}/m \\ g(\hat{I}) - \delta^{-1}(\hat{I} - w) & \text{if } w \geq \hat{I}/m \end{cases} \tag{27}$$

Consider a risky plan. If a bailout is expected in the bad state but not in the good state, lenders set $\rho = r$ and lend up to $b_t \leq (m^r - 1)w_t$. For $w < \tilde{I}/m^r$ it is optimal to borrow up to the limit and not to save. For $w \in [\tilde{I}/m, \tilde{I})$ the firm sets investment to $\tilde{I}$ and borrows less than the maximum possible. For $w \geq \tilde{I}$ the firm saves $w - \tilde{I}$, does not borrow and does not default in any state. Replacing $u\delta^{-1}b_t$ by $u\delta^{-1}(m^r - 1)w_t{=}hm^r w_t$, we have that expected profits are

$$E\pi^r(w) = \begin{cases} uf(wm^r) - hm^r w & \text{if } w < \tilde{I}/m^r \\ uf(\tilde{I}) - u\delta^{-1}[\tilde{I} - w] & \text{if } w \in [\tilde{I}/m^r, \tilde{I}) \\ uf(\tilde{I}) + \ \delta^{-1}[w - \tilde{I}] & \text{if } w \geq \tilde{I} \end{cases} \tag{28}$$

The term $u\delta^{-1}$ appears in the second row becasue for $w < \tilde{I}$ the firm will be solvent in the good state and insolvent in the bad state. Thus, with probability $1 - u$ lenders will be repayed by the bailout. To characterize the CME define the expected profit differential

$$\Lambda(w) := E(\pi^r(w)) - \pi^s(w)$$

To compute $\Lambda(w)$ consider the efficient and the panglossian investment levels defined in (**??**)

$$\hat{I} = (\chi\lambda\delta)^{\frac{1}{1-\lambda}}, \quad \tilde{I} = (\lambda\delta)^{\frac{1}{1-\lambda}}, \quad \text{so} \quad \hat{I} = \chi^{\frac{1}{1-\lambda}}\tilde{I} \tag{29}$$

Notice that $\hat{I}/m^s > \tilde{I}/m^r$ if and only if $h > h^*$ defined in (31). This result implies that for $h > h^*$ if the borrowing constraint binds under the risky plan, it must also bind under the safe plan. Since all propositions are stated for "large enough h", $h > h^*$ is the relevant case to consider when comparing π^s and $E\pi^r$. That is, we just need to consider the case $\hat{I}/m^s > \tilde{I}/m^r$.

$$\Lambda(w) = \begin{cases} [u[m^r(\zeta_{t+1})]^\lambda - \chi[m^s]^\lambda]w^\lambda - h[m^r(\zeta_{t+1}) - m^s]w & \text{if } w < \tilde{I}/m^r(\zeta_{t+1}) \\ u\tilde{I}^\lambda - \zeta_{t+1}\delta^{-1}[\tilde{I} - w] - \chi[m^s w]^\lambda + hm^s w & \text{if } w \in [\tilde{I}/m^r(\zeta_{t+1}), \hat{I}/m^s) \\ u\tilde{I}^\lambda - \zeta_{t+1}\delta^{-1}[\tilde{I} - w] - \chi\hat{I}^\lambda + \delta^{-1}[\hat{I} - w] & \text{if } w \in [\hat{I}/m^s, \tilde{I}) \\ u\tilde{I}^\lambda - \chi\hat{I}^\lambda + \delta^{-1}[\hat{I} - \tilde{I}] & \text{if } w \geq \tilde{I} \end{cases} \tag{30}$$

Proof of Part 1. In a safe CME no bailout is expected: $\zeta_{t+1} = 1$. Thus, given that all other firms choose a safe plan, a manager has no incentive to choose a risky plan. To see this set $\zeta_{t+1} = 1$ and $m^r(\zeta_{t+1} = 1) = m^s$ in (30) and notice that $\Lambda(w)$ is negative for all w, i.e., $E\pi^r < \pi^s$. Next, note that only plans that do not lead to diversion are financeable because diversion implies zero debt repayment in both states. Hence, if $\zeta_{t+1} = 1$, the best safe plan is optimal for all levels of w.

Proof of Part 2. Lemma A.1 below characterizes $\Lambda(w)$ for $\zeta_{t+1} = u$ and $h > h^*$. It shows that for high h : $\Lambda(w) > 0$ if $w \leq \tilde{I}/m^r$; $\Lambda(w) < 0$ if $w \geq \tilde{I}$ and that $\Lambda(w)$ is continuous and decreasing. Thus, there is a unique w^*, such that $\Lambda(w) < (>)0 \Longleftrightarrow w > (<)w^*$. Since a bailout is granted only if there is no diversion, only non-diversion plans that don't default in the good state are financeable. Thus, the best risky plan characterized above is optimal for $w < w^*$ when $\zeta_{t+1} = u$. This completes the proof of part 2.

Lemma A.1 (Characterization of $\Lambda(w)$) *There exists a lower bound $\underline{h} < \bar{h}$, defined in (31), such that if $h > \underline{h}$, there exists a unique threshold $w^* \in (\tilde{I}/m^r, \tilde{I})$, such that $\Lambda(w) \geq (<)0$ if and only if $w \leq (>)w^*$.*

$$\begin{aligned} \underline{h} &= \max\{h^*, h^{***}\} \\ h^* &\equiv \frac{1 - \chi^{\frac{1}{1-\lambda}}}{1 - u\chi^{\frac{1}{1-\lambda}}}\bar{h}, \quad h^{***} \equiv \inf\left\{h < \bar{h} \;\middle|\; \left(u - \chi\left(\frac{m^s}{m^r}\right)^\lambda\right)\frac{1}{\lambda\delta} - h\left(1 - \frac{m^s}{m^r}\right) > 0\right\} \end{aligned} \tag{31}$$

Proof. The proof is in three parts.

(i) $\Lambda(w)$ is negative for all $w \geq \tilde{I}$. Since $h > h^*$, we have that $\tilde{I} > \hat{I} > \hat{I}/m^s$. Thus,

$$\Lambda(w \geq \tilde{I}) = uf(\tilde{I}) - \chi f(\hat{I}) - \delta^{-1}[\tilde{I} - \hat{I}] < f(\tilde{I}) - f(\hat{I}) - (\delta u)^{-1}[\tilde{I} - \hat{I}] < 0$$

The first inequality follows from dividing by u and substracting $(1 - \chi u^{-1})f(\hat{I}) < 0$. The negative sign follows from the mean value theorem. There is a constant $c \in (\hat{I}, \tilde{I})$ such that $f'(c) = \frac{f(\tilde{I})-f(\hat{I})}{\tilde{I}-\hat{I}}$. Since $f(I)$ is concave, $f'(c) < f'(\hat{I}) := (\delta\chi)^{-1}$ by (18). Since $u < \chi$, it follows that $f(\tilde{I}) - f(\hat{I}) < (\delta\chi)^{-1}[\tilde{I} - \hat{I}] < (\delta u)^{-1}[\tilde{I} - \hat{I}]$. Hence, $\Lambda(w \geq \tilde{I}) < 0$.

(ii) $\Lambda(w)$ is positive for all $w \leq \tilde{I}/m^r$. First, we find the sign of $\Lambda(\tilde{I}/m^r)$. Since $\hat{I}/m^s > \tilde{I}/m^r$, we have that if $w = \tilde{I}/m^r$, investment in a safe plan is $m^s[\tilde{I}/m^r]$. Since $\tilde{I} = (\lambda\delta)^{\frac{1}{1-\lambda}}$,

$$\begin{aligned}
\vartheta &\equiv \lim_{w \to \tilde{I}/m^r-} \Lambda(w) = u\,(\lambda\delta)^{\frac{\lambda}{1-\lambda}} - \chi\left(m^s\frac{(\lambda\delta)^{\frac{1}{1-\lambda}}}{m^r}\right)^{\lambda} - h[m^r - m^s]\frac{(\lambda\delta)^{\frac{1}{1-\lambda}}}{m^r} \\
&= (\lambda\delta)^{\frac{1}{1-\lambda}}\left\{\left(u - \chi\left(\frac{m^s}{m^r}\right)^{\lambda}\right)\frac{1}{\lambda\delta} - h\left(1 - \frac{m^s}{m^r}\right)\right\} \qquad (32)
\end{aligned}$$

To see that h^{***}, defined in (31), exists note that

$$\lim_{h \to \bar{h}} \vartheta = (\lambda\delta)^{\frac{1}{1-\lambda}}\left\{u(\lambda\delta)^{-1} - \bar{h}\right\} = (\lambda\delta)^{\frac{1}{1-\lambda}}\frac{u}{\delta}\left\{\frac{1}{\lambda} - 1\right\} > 0$$

The positive sign follows from $\lambda < 1$. Continuity of ϑ in h implies that there is a threshold h^{***} such that $\Lambda(\tilde{I}/m^r) > 0$ for all $h \in (h^{***}, \bar{h})$. Next, the first and second order derivatives of $\Lambda(w)$ are

$$\begin{aligned}
\Lambda'(w)|_{w<\tilde{I}/m^r} &= [u[m^r]^{\lambda} - \chi[m^s]^{\lambda}]\lambda w^{\lambda-1} - h[m^r - m^s] \\
\Lambda''(w)|_{w<\tilde{I}/m^r} &= \lambda[\lambda - 1][u[m^r]^{\lambda} - \chi[m^s]^{\lambda}]w^{\lambda-2}
\end{aligned}$$

Note that $\Lambda' > 0$ and $\Lambda'' < 0$ for all $w < \tilde{I}/m^r$ if and only if $h > h^{**}$, where h^{**} is defined by $\xi(h^{**}) = \left(\frac{m^r}{m^s}\right)|_{h=h^{**}} - \left(\frac{\chi}{u}\right)^{\frac{1}{\lambda}} = 0$. Notice that h^{**} is lower than h^{***} because $\xi(h)$ equals the first term in (32). Thus, if $h = h^{**}$, (32) equals $(\lambda\delta)^{\frac{1}{1-\lambda}}\left\{0 - h\left(1 - \frac{m^s}{m^r}\right)\right\}$, which is negative. Finally, we have shown that for any $h \in (\underline{h}, \bar{h})$: $lim_{w\to\tilde{I}/m^r}\Lambda(w) > 0$, $\Lambda'(w) > 0$ and $\Lambda''(w) < 0$. Since $\lim_{w\to 0}\Lambda(w) = 0$, $\Lambda(w)$ is a concave parabola that is zero at $w = 0$ and has a positive value at $\tilde{I}/m^r$. Thus, it must be positive in the entire range $(0, \tilde{I}/m^r)$.
(iii) We have established that $\Lambda(\tilde{I}) < 0$ and $\Lambda(w \leq \tilde{I}/m^r) > 0$. We will show that $\Lambda(w)$ is continuous and decreasing on $[\tilde{I}/m^r, \tilde{I})$, so a unique threshold w^* exists. To show continuity of $\Lambda(w)$ at $w = \hat{I}/m^s$ note that $\lim_{w\to(\hat{I}/m^s)^-}\Lambda(w) - \Lambda(\hat{I}/m^s) = h\hat{I} - \delta^{-1}[\hat{I} - \hat{I}/m^s] = 0$. This is

because $\hat{I}\delta^{-1}[1-1/m^s] = \hat{I}\delta^{-1}[\delta h] = h\hat{I}$. The first order derivative is

$$\Lambda'(w) = \begin{cases} \frac{u}{\delta} - m^s\left[\chi\lambda(m^s w)^{\lambda-1}\right] + hm^s < 0 & \text{if } w \in (\tilde{I}/m^r, \hat{I}/m^s) \\ \frac{u}{\delta} - \frac{1}{\delta} < 0 & \text{if } w \in (\hat{I}/m^s, \tilde{I}) \end{cases}$$

The second line is negative because $u < 1$. For the first line note that by the definition of $\hat{I}$, $\chi\lambda\hat{I}^{\lambda-1} = \delta^{-1}$. Thus, $\chi\lambda(m^s w)^{\lambda-1} > \delta^{-1}$ for $w < \hat{I}/m^s$. Also, $hm^s = \delta^{-1}[m^s - 1]$. Hence, the first line equals $\frac{u}{\delta} - m^s\left[\chi\lambda(m^s w)^{\lambda-1}\right] + \delta^{-1}[m^s - 1] < \frac{u}{\delta} - 1 < 0$.□

Proof of Proposition A.2. It is the same as in the model section, and follows directly from the sign of $\Lambda(w)$. The expected growth rate in the risky economy is greater than in the safe one ($E_t(w^r_{t+1}/w_t) > E_t(w^s_{t+1}/w_t)$) if and only if

$$\begin{aligned} E_t(w^r_{t+1}) - w^s_{t+1} &= [1-d]\left[E_t(\pi^r_{t+1}) - \pi^s_{t+1} + [1-u]\alpha\pi^r_{t+1}(\Omega = 1)\right] \\ &= [1-d]\left[\Lambda(w_t) + [1-u]\alpha\pi^r_{t+1}(\Omega = 1)\right] \end{aligned}$$

It follows that $E_t(w^r_{t+1}) > w^s_{t+1}$ for any $\alpha \in (0,1)$ iff $\Lambda(w_t) := E_t(\pi^r_{t+1}) - \pi^s_{t+1} > 0$. Lemma A.1 shows that if $\zeta_{t+1} = u$ and $h > \underline{h}$, then $\Lambda(w) > 0$ for $w \leq \tilde{I}/m^r$; $\Lambda(w) < 0$ for $w \geq \tilde{I}$ and $\Lambda(w)$ is continuous and decreasing. Thus, there is unique threshold w^*, such that $\Lambda(w) < (>)0$ iff $w > (<)w^*$. This proves parts 1 and 2. For part 3 note that if $d \leq 1-\delta$, then $w_{t+1} > w_t$ along both the safe path and the lucky path along which crises do not occur (i.e., where $\Omega_{j+1} = 1$ for all $j \leq t$). To see this, suppose there is a switch at t (i.e., $w_t \geq w^*$). If $w^* < \hat{I}/m^s$,

$$\begin{aligned} w_{t+1} - w_t &= [1-d][g(w_t m^s) - \delta^{-1}[m^s - 1]w_t] - w_t \\ (w_{t+1} - w_t)|_{d=1-\delta} &= \delta g(w_t m^s) - m^s w_t > 0 \end{aligned}$$

Note that $\delta g(wm^s) - m^s w > 0$ for $w < \hat{I}/m^s$ because $g'(\hat{I}) = \delta^{-1}$ and $g'' < 0$. Next, if $w^* \geq \hat{I}/m^s$,

$$\begin{aligned} w_{t+1} - w_t &= [1-d][g(\hat{I}) - \delta^{-1}(\hat{I} - w_t)] - w_t \\ (w_{t+1} - w_t)|_{d=1-\delta} &= \delta g(\hat{I}) - \hat{I} > 0 \end{aligned}$$

If along the safe path $w_{t+1} > w_t$ for $d = 1-\delta$, the same must hold for $d < 1-\delta$. Since along the lucky path realized profits are greater than along a safe path for any $w_t < w^*$, it must be true that along the lucky path $w_{t+1} > w_t$.□

B Description of Crisis Indexes

Banking Crisis Indexes. De Jure indexes of banking crisis are based on surveys of financial press articles as well as previous academic papers. They are not original country-case studies and therefore are subjective not only based on the judgment of the index authors but also based on that of the underlying sources. The most comprehensive survey is provided by Caprio and Klingebiel (2003) [CK]. They define a systemic crisis as much or all of bank capital being exhausted. CK reports episodes of systemic banking crisis in 93 countries between the late 1970s and 2000.[55] Detriagache and Demirguc-Kunt (2005) [DD] is a meta-survey that uses crisis information from CK and four other indexes**.** Unlike CK, DD reports the unconditional country dataset in which they search for banking crises over the period 1980-2000.[56] In order to distinguish between severe and not severe (borderline) crises, DD impose one of four restrictions that a country-year must satisfy to be a crisis: (i) a share of non-performing loans greater than 10% of the banking sector total assets; (ii) a cost of rescue operations greater than 2% of GDP; (iii) large scale nationalization of banks; (iv) bank runs or deposit freezes. The third banking crisis index we use is Kaminsky and Reinhard (1999) [KR] that covers 20 countries over the period 1970-1995.

Currency Crisis Indexes. They are de facto indexes based on measures of currency pressure, which is a weighted average of changes over a period of time in exchange rates, reserves and interest rates. We consider four currency crisis indexes. Glick and Hutchison (2001) [GH] cover 83 countries from 1970 to 1999. They use a monthly weighted average of the change in the real exchange rate and reserves losses (where the weight is the inverse of the variance of each series). Garcia and Soto (2004) [SG] cover 65 countries from 1975 to 2002. They use the same average as Glick and Hutchison, but with a different threshold: there is a crisis if the index is larger than the mean plus two standard deviations. Frankel and Wei (2004)[FW] cover 58 countries over the period 1974-2000. Their index is a monthly unweighted average of real exchange rate changes and reserves losses. A crisis is identified if the level of the index is above 15%, 25%, or 35% and when there is a change in the index of 10%. Furthermore, they have a restriction that there cannot be more than one crisis in a three-year window. Finally, Becker and Mauro (2006)[BM1] cover 81 countries from 1960 to 2000. According to their definition, a crisis takes place if : (i) there was a cumulative nominal depreciation of at least 25% over 12 months, (ii) the nominal depreciation rate is at least 10 percentage points greater than in the preceding 12 months and (iii)at least 3 years have passed since the last crisis.[57]

[55] The majority of the crisis episodes are precisely dated, but several are referred by vague indications such as "Nigeria, early 1990s."

[56] DD consider a sample of 94 countries with data on real interest rate and inflation, excluding communist or transition economies. The sample of DD covers 52 countries in our sample of 58 countries without wars or large terms of trade deteriorations.

[57] The coverage of the currency crisis indexes for our sample of 58 countries without war or large terms of trade deterioration is: 58(GH), 48(GS), 34 (FW) and 58(BM1).

Sudden Stops. We consider three sudden stops indexes. Mauro and Becker (2006) [BM2] look at 77 countries from 1977 to 2000 and define a sudden stop as a situation where the financial account balance worsens by more than 5 percentage points of GDP compared with the previous year. Calvo, Izquierdo and Mejia (2004)[CIM] examine 26 countries from 1992 to 2000, and identify a crisis when there is a decline of more than two standard deviations of the individual country distribution. Frankel and Cavallo (2006) [FC] look at 81 countries and identify a crisis by combining the definition of CIM with the requirement of a fall in GDP the year of the sudden stop or the following year in order to ensure that the episode is *disruptive.*[58]

As mentioned in the text, we construct an index of consensus crises that identifies crises that have been confirmed by at least two banking crises indexes or two currency crisis indexes or two sudden stop indexes. Table EA5 reports all the consensus crises in our 58 country sample. Table EA4 reports both consensus crises (labeled CC) and simple coded crises (labeled C) that are associated with any of the three extreme credit growth observations for each country.

C Description of Financial Liberalization Indexes

De Facto Financial Liberalization Index. This index signals the year when a country has liberalized. We construct the index by looking for trend-breaks in financial flows. We identify trend-breaks by applying the CUSUM test of Brown et. al. (1975) to the time trend of the data. This method tests for parameter stability based on the cumulative sum of the recursive residuals. To determine the date of financial liberalization, we consider net cumulative capital inflows (KI).[59] A country is financially liberalized (FL) in year t if: (i) KI has a trend break at or before t and there is at least one year with a KI-to-GDP ratio greater than 5% at or before t, or (ii) its KI-to-GDP ratio is greater than 10% at or before t, or (iii) the country is associated with the EU or the G10.[60] The 5% and 10% thresholds reduce the possibility of false liberalization and false non-liberalization signals, respectively. When the cumulative sum of residuals starts to deviate from zero, it may take a few years until this deviation is statistically significant. In order to account for the delay problem, we choose the year where the cumulative sum of residuals deviates from zero, provided that it eventually crosses the 5% significance level. The FL index does not allow for policy reversals: once a country liberalizes, it does not close thereafter. We consider that this approach is appropriate to

[58] The coverage of the sudden stops indexes for our sample of 58 countries without war or large terms of trade deterioration is: 53(BM2), 26(CIM) and 57 (FC).

[59] We compute cumulative net capital inflows of non-residents since 1980. Capital inflows include FDI, portfolio flows and bank flows. The data series are from the IFS: lines 78BUDZF, 78BGDZF and 78BEDZ. For some countries not all three series are available for all years. In this case, we use the inflows to the banking system or the inflows of FDI.

[60] The G10 is the group of countries that have agreed to participate in the General Arrangements to Borrow (GAB). It includes Belgium, Canada, France, Italy, Japan, the Netherlands, the United Kingdom, the United States, Germany, Sweden and Switzerland.

analyze the decadal effects of liberalization on growth over the period 1980-2000.[61]

De Jure Financial Liberalization Indexes. We use two indexes of de jure financial liberalization. The first index is due to Abiad and Mody (2005) and has been extended by Abiad, Detragiache and Tressel (2006). This index codes the restrictions on international financial restrictions on the following scale: 0 (fully repressed), 1 (partially repressed), 2 (largely liberalized), 3 (fully liberalized). The orginal sources are listed in Abiad and Mody (2005) and include previous surveys, central bank bulletins and IMF country reports. We have rescaled the index on a zero to one range by dividing the value of each observation by four. The Abiad and Mody index covers 32 countries in our sample of 58 countries since the 1970s. The second index is due to Quinn (1997) and has been updated by Quinn and Toyoda (2003). This index codes the intensity of restriction on capital account restriction on a zero to 100 scale. The orginal sources are various issues of the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions. We have rescaled the index on a zero to one range by dividing each observation by 100. The Quinn index covers 49 countries in our sample of 58 countries since the 1960s.

D Bailouts

Here, we present stylized facts of ex-post bailouts that support the assumptions of our model. First, most of the crises in our sample are associated with IMF rescue packages that are large relative to GDP. Second, bailout packages are in large part designed to insure the repayment of external liabilities resulting in the bailout of lenders. Third, in most cases governments repay these loans in full rather quickly. Our model assumes that during a systemic crisis the government can borrow internationally in order to bail out lenders and that it repays these loans during good times.

In our sample of 58 countries over the period 1984-2000, we find that 18 of the 28 banking crises (64%) were associated with an IMF crisis support package in the year of or the year following the start of the crisis. If we look at the subset of banking crises that coincided with a currency crises (i.e., twin crises), this share increases to 84%. This share is quite high considering that some crisis countries opted not to make use of IMF credit (e.g., Finland, Malaysia and Sweden).

These IMF packages are large relative to GDP: Turkey 1999 (11.19%), Uruguay 1983 (7.96%) Mexico 1995 (6.39%), Chile 1983 (5.08%), Indonesia 1998 (5.2%) or Korea 1998 (4.14%). Moreover, international financial assistance comes not only from the IMF, but also from other agencies (e.g. the Asian Development Bank) or from bilateral sources (e.g. the US Treasury). Jeanne and Zettelmeyer (2001) report the following total sizes of international bailouts as a percentage of GDP: Mexico 1995 (18.3%), Thailand 1998 (11.5%), Indonesia 1998 (19.6%) and Korea (12.3%).

[61] Incomplete data coverage on financial inflows prevents us from computing the de facto index before the 1980s. Only 11 out of our 58 countries sample have a complete coverage over the 1970s.

Crises and IMF-Supported Crisis Facilities (Stand-By Arrangement and Exceptional Fund Facility

	"Twin"crises	Systemic banking crises	Currency crises
Number of crises	19	28	54
Number of crises associated with an IMF-supported crisis package	16	18	39
Percentage of crises matched with IMF-supported crisis facilities	84%	64%	72%

Note: Crises are identified by the consensus indexes described in Section 3.1. The 58 countries sample is used. The period covered is 1984-2000. To be matched with a crisis, the IMF facility should occur the year of the crisis or the year after.

In addition, domestic resources used in bailouts can be also quite large: Malaysia 1998 (13% of GDP) or Finland 1991-1992 (5% of GDP).[62]

Several important features of crisis rescue packages – central bank liquidity support and goverment guarantees – are explicitly designed to insure that external obligations are repaid.[63] *Liquidity support* provided by central banks allow banks to service their short-term liabilities and usually includes dollar loans that are used to repay short-term foreign currency denominated debts. Hoelscher et.al. (2003) report liquidity support in quantities ranging from 2.5 % of GDP (Korea 1998-2000) to 22% of GDP (Thailand 1998-2000). In addition to liquidity support, the government often provides its *guarantee to the external liabilities* of the banking sector during a systemic crisis. Hoelscher et al. (2003) report the presence of such guarantees in many crisis countries including Finland, Indonesia, Jamaica, Korea, Malaysia, Mexico, Sweden, Thailand and Turkey. As these government guarantees are implemented only during systemic crises –in contrast to "normal times" where protection is limited to deposit insurance– and tend to apply to all the foreign currency liabilities of banks, they are indeed a close equivalent to the systemic bailout guarantees described in our model.

The third stylized fact is documented by Jeanne and Zettelmeyer (2001). They show that, with the exception of highly indebted poor countries, complete debt cycles by far outweigh incomplete debt cycles (where the IMF rolls over the debt in the end). The transfer element in crisis lending for "non-poor" countries is less than 1% of GDP, much less than the actual fiscal cost of crises. Consider the case of Mexico. The full value of the IMF and BIS loans was disbursed by the end of 1995. By the middle of 1997, Mexico had repaid two thirds of its loans, and had repaid them fully by early 2000.

[62] These two figures correspond to the ratio of emergency central bank loans to GDP.

[63] According to the governor of the central bank of Mexico, Guillermo Ortiz "The emergency financial package with the U.S. government, the IMF, the World Bank, and the Inter-American Development Bank was designed to avoid suspending payments on the country's external obligations (..) and included the following measures: provision of liquidity in foreign exchange by the central bank to commercial banks to prevent them from becoming delinquent on their foreign obligations" (Ortiz, 1998).

E Wars and Large Term of Trade Deteriorations

Out of our sample of eighty-three countries, we construct a restricted sample of 58 countries that have not experienced an episode of large deterioration in their terms of trade or a severe war episode over the period 1980-2000. The source for war episodes is the Heidelberg Institute of International Conflict Research (HIICK). We use the variable "Average Number of Violent Death" in the HIICK database. A country is classified as having experienced a severe war episode if the ratio of average violent deaths to average population *100 is above 0.005 for two consecutive years. We identify twelve war cases: Algeria, Congo Rep., Congo, Dem. Rep, El Salvador, Guatemala, Iran, Nicaragua, Peru, Philippines, Sierra Leone, South Africa and Uganda. A country is classified as having experienced a large terms of trade deterioration if its terms of trade index has suffered a drop of more than 30% in a single year, or an average annual drop larger than 25% (20%) in 2 (3) consecutive years.[64] Large terms of trade deterioration cases are: Algeria, Congo, Rep., Congo, Dem. Rep., Cote d'Ivoire, Ecuador, Egypt, Ghana, Haiti, Iran, Pakistan, Sri Lanka, Nicaragua, Nigeria, Sierra Leone, Syria, Togo, Trinidad and Tobago, Uganda, Venezuela and Zambia.

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Table EA1
Crisis Indexes and Growth
Robustness: Extended Set of Control Variables
Dependent variable: Real per capita GDP growth
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1981-2000				
Unit of observations	Non-overlapping 10 year windows				
	[1]	[2]	[3]	[4]	[5]
Moment of credit growth:					
Real credit growth - mean	0.138 ***	0.13 ***	0.129 ***	0.136 ***	0.138 ***
	0.008	*0.009*	*0.009*	*0.008*	*0.008*
Real credit growth - standard deviation	-0.06 ***	-0.06 ***	-0.062 ***	-0.061 ***	-0.057 ***
	0.009	*0.009*	*0.009*	*0.009*	*0.008*
Crisis indexes:					
Banking crisis: Caprio Klingebiel index	0.361 ***				
	0.138				
Banking crisis: Detragriache et al. index		0.248 **			
		0.112			
Banking crisis: Consensus index			0.254 **		
			0.122		
Sudden stop: Consensus index				0.464 **	
				0.191	
Currency crisis: Consensus index					0.11
					0.176
Control set of variables	Extended set	Extended set	Extended set	Extended set	Extended set
No. countries / No. observations	58/114	58/114	58/114	58/114	58/114

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The coefficients for control variables (initial income per capita, secondary schooling, inflation rate, trade openness, government expenditures, life expectancy, black market premium) and period dummies are not reported.

Table EA2
Investment Regression
Robustness: Extended Set of Control Variables
Dependent variables: Domestic price-investment rate, PPP-investment rate
Estimation: Panel feasible GLS
(Standard errors are presented below the corresponding coefficient.)

Dependent variable	PPP-investment rate		Domestic price-investment rate	
Estimation period	1981-2000	1971-2000	1981-2000	1971-2000
Unit of observations	Non-overlapping 10 year windows			
Moment of credit growth:				
Real credit growth - mean	0.223 ***	0.218 ***	0.26 ***	0.263 ***
	0.023	*0.027*	*0.038*	*0.036*
Real credit growth - standard deviation	-0.065 ***	-0.049 **	-0.083 ***	-0.061 **
	0.019	*0.024*	*0.026*	*0.026*
Real credit growth - skewness	-0.777 ***	-0.676 ***	-0.448 **	-0.546 ***
	0.145	*0.178*	*0.197*	*0.202*
Lagged investment rate:				
Lagged investment rate (PPP)	0.631 ***	0.706 ***		
	0.025	*0.031*		
Lagged investment rate (domestic price)			0.697 ***	0.718 ***
			0.039	*0.036*
Control set of variables	Extended set	Extended set	Extended set	Extended set
No. countries / No. observations	57/112	57/163	57/112	57/163

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The coefficients for control variables (initial income per capita, secondary schooling, inflation rate, trade openness, government expenditures, life expectancy, black market premium) and period dummies are not reported.

Table EA3
Three Stage Least Square Estimation

Dependent variable: Real per capita GDP growth
Estimation: Three stage least square estimation
(Standard errors are presented below the corresponding coefficient.)

Estimation period	1971-2000	
Unit of observations	Non-overlapping 10 year windows	
	[1]	[2]
Moment of credit growth:		
Real credit growth - mean	0.330 ***	0.325 ***
	0.027	*0.031*
Real credit growth - standard deviation	-0.061 ***	-0.154 ***
	0.014	*0.026*
Real credit growth - skewness	-0.669 ***	-0.498 ***
	0.151	*0.164*
Control set of variables	Simple set	Simple set
No. countries / No. observations	58/114	58/114

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: The regression specification is identical to regression 1, Table 2. In regression 1, mean credit growth is treated as endogenous and instrumented by lagged mean credit growth. In regression 2, mean credit growth and standard deviation of credit growth are treated as endogenous and are instrumented by the lagged mean credit growth and lagged standard deviation of credit growth. The coefficients for the control variables (initial income per capita and secondary schooling) and period dummies are not reported.

Table EA4
Extreme Observations, Coded Crises, and Skewness
Sample: 29 countries with negative skewness (1981-2000)

Country	Extreme observation 1			Extreme observation 2			Extreme observation 3			Skewness		
	Year	Credit Growth	Crisis info*	Year	Credit growth	Crisis info*	Year	Credit growth	Crisis info*	All Years	2 Extreme observations excluded	3 Extreme observations excluded
Indonesia	1999	-0.83	CC	1998	-0.29	CC	1991	0.07		-2.56	1.11	1.14
Senegal	1994	-0.51	CC	1984	-0.08	CC	1983	-0.08	CC	-2.01	0.77	0.78
Argentina	1990	-0.55	CC	1983	-0.23	CC	1984	-0.19	CC	-1.59	-0.27	0.25
Jordan	1989	-0.20	CC	1988	-0.05	CC	1997	-0.01		-1.11	0.73	0.87
Thailand	2000	-0.19	CC	1998	-0.12	CC	1999	-0.06	CC	-1.09	-0.71	-0.20
Sweden	1993	-0.26	CC	1991	-0.08	CC	1994	-0.07		-1.01	0.15	0.25
Panama	1988	-0.23	CC	1982	-0.03	C	1983	-0.03	C	-0.94	-0.10	-0.14
Bolivia	1984	-0.75	CC	1983	-0.74	CC	2000	-0.07		-0.93	1.51	1.60
Israel	1983	-0.08	CC	1985	-0.04	CC	1989	0.01		-0.92	-0.18	-0.04
Niger	1995	-0.58	C	1994	-0.27	CC	1997	-0.24		-0.88	0.57	0.85
Zimbabwe	1984	-0.46	CC	1999	-0.33	CC	1983	-0.20	CC	-0.84	-0.05	0.26
Kenya	1993	-0.38	CC	1990	-0.09	C	1981	-0.07	CC	-0.62	1.46	1.54
Singapore	1999	-0.04		1986	-0.02	C	1985	0.00		-0.62	-0.36	0.02
Jamaica	1991	-0.26	CC	1985	-0.16	C	1992	-0.15	C	-0.55	-0.48	-0.43
Gambia	1986	-0.52	CC	1992	-0.34	C	1987	-0.19	C	-0.53	0.87	1.10
Costa Rica	1981	-0.41	CC	1982	-0.24		1995	-0.20		-0.53	-0.06	0.14
Dominican Republic	1990	-0.32	CC	1984	-0.23	CC	1988	-0.19	CC	-0.53	-0.12	0.25
United States	1991	-0.06	C	1990	-0.05	C	1992	-0.03	C	-0.48	-0.12	0.13
Botswana	1985	-0.22	CC	1982	-0.13		1995	-0.13	C	-0.43	-0.29	-0.09
Finland	1994	-0.12	CC	1993	-0.12	CC	1992	-0.11	CC	-0.36	-0.25	-0.01
Malawi	1995	-0.51	CC	1987	-0.45	CC	1993	-0.29		-0.33	0.42	0.65
Chile	1983	-0.12	CC	1985	-0.09	CC	1990	-0.08	C	-0.28	0.08	0.76
Korea, Rep.	1998	0.04	CC	1988	0.05		1993	0.07		-0.28	-0.11	-0.04
Madagascar	1994	-0.25	CC	1981	-0.17	CC	1995	-0.17	CC	-0.22	0.09	0.32
France	1993	-0.05	C	1994	-0.03	C	1996	-0.03		-0.20	-0.17	-0.15
Malaysia	1998	-0.02	CC	1999	-0.01	CC	1987	-0.01	CC	-0.15	-0.08	0.11
Mexico	1995	-0.49	CC	1982	-0.48	CC	1996	-0.41	CC	-0.14	-0.03	0.15
Turkey	1994	-0.26	CC	1988	-0.15	CC	1999	-0.15	CC	-0.06	0.13	0.23
Papua New Guinea	1999	-0.16		1995	-0.13		1993	-0.12	C	-0.04	-0.01	0.04

*C refers to a crisis coded by any of the ten crisis indexes we list in the extended appendix; CC refers to a crisis coded by any of the consensus indexes described in Section 3.1.

Note: 17 observations are not associated with a coded crisis and can be explained as follows. First, if we allow a one-year lag, we can explain 4 extreme observations where a credit crunch occurs the year following a coded crisis: Costa Rica (1982 and 1995), Malawi (1993), and Sweden (1994). Second, 5 additional extreme observations correspond to an actual crisis, but have not been coded by any of the ten indexes we have considered. These include Papua New Guinea (1995, 1999), where Milesi-Ferreti and Razin (1998) report a currency crisis in 1995 and 1998 and the IMF granted rescue packages of 1.2% and 3.2% of GDP in 1995 and 2000, respectively; Jordan (1997), where a bailout of 4.2% of GDP was granted; Niger (1997), with credit growth of -24%, is the continuation of the 1994-95 crisis discussed above; Bostwana (1982), where Milesi-Ferreti and Razin (1988) and the IMF staff report (IMF, 1982) record a currency and current account crisis as well as a credit crunch. Third, the remaining 8 country-years had indeed no crisis. Six of these observations correspond to the third extreme observation and, in 4 cases, skewness is either positive or substantially reduced after the elimination of two observations: Indonesia (1993), Bolivia (2000), Israel (1989) and Korea (1988).
All credit growth series are required to have 20 observations over the 1981-2000 period. This restriction excludes Colombia, which does not have data for 1986-1987 and 1989-1990, and China, whose credit growth series starts in 1986.

Table EA5

Consensus Crisis Years and Skewness in 58 Country Sample (1981-2000)

Country	Banking crises	Currency crises	Sudden stops	Skewness all years	Skewness without crisis years	Difference in skewness
Indonesia	1992;1998;1999;2000	1998;1999		-2.56	1.09	3.65
Senegal	1988	1981;1994	1982	-2.01	0.96	2.97
Argentina	1982;1990;1995	1983;1984;1990;1995		-1.59	0.02	1.61
Jordan	1989	1984;1988;1989	1984;1989;1992	-1.11	0.63	1.73
Thailand	1985;1986;1987;1998;1999;2000	1998	1998	-1.09	-0.10	0.99
Sweden	1991;1992;1993	1993		-1.01	0.05	1.06
Panama	1988;1989		2000	-0.94	-0.25	0.69
Bolivia		1982;1983;1984;1985		-0.93	0.00	0.93
Israel	1983	1983	1983;1985	-0.92	-0.18	0.74
Niger	1983	1981;1994		-0.88	-1.03	-0.15
Zimbabwe	1995;1996;1997;1998	1983;1984;1998;1999		-0.84	0.15	0.99
Kenya	1993;1994;1995	1981		-0.62	0.46	1.08
Jamaica	1994;1995;1996;1997;1998;1999;2000	1991;1994		-0.55	-0.32	0.23
Gambia		1982;1984;1986	1982;1984;1986	-0.53	0.01	0.54
Costa Rica		1981		-0.53	-0.15	0.38
Dominican Republic		1984;1985;1988;1990;1991		-0.53	0.28	0.81
Botswana		1985		-0.43	-0.30	0.13
Finland	1991;1992;1993;1994	1993		-0.36	-0.14	0.23
Malawi		1982;1987;1997	1981;1995	-0.33	0.35	0.68
Chile	1982;1983	1982;1983;1985	1998	-0.28	0.11	0.38
Korea, Rep.	1998;1999;2000			-0.28	-0.08	0.19
Madagascar	1988	1981;1987;1994;1995	1981	-0.22	0.17	0.39
Malaysia	1986;1987;1988;1998;1999;2000			-0.15	0.00	0.15
Mexico	1982;1983;1984;1995;1996;1997	1982;1985;1995	1995	-0.14	0.11	0.25
Turkey	1982;1991;1994	1984;1988;1994;1998;1999	1988;1994	-0.06	0.44	0.50
India		1991		0.07	0.10	0.02
Spain		1992		0.11	0.01	-0.10
Uruguay	1981;1982;1983;1984	1982;1985;1991	1983	0.15	1.21	1.06
Norway	1988;1989;1990;1991;1992;1993			0.23	0.27	0.03
Burkina Faso	1988;1989;1990;1991;1992;1993;1994	1994		0.28	2.21	1.93
Honduras		1990;1994		0.30	0.76	0.46
Paraguay	1995;1996;1997;1998;1999	1984;1985;1988;1989	1988	0.55	0.88	0.34
Denmark			1989	0.63	0.65	0.02
Brazil	1990;1995;1996;1997;1998;1999	1982;1985;1987;1990;1991;1995;1996	1983	0.92	0.26	-0.66
Morocco		1984;1985;1986		1.38	2.40	1.03

Note: Consensus crises are meant to capture truly severe crises. They are defined in subsection 3.1.