SYSTEMIC CRISES AND GROWTH [*]

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Abstract

Countries that have experienced occasional financial crises have, on average, grown faster than countries with stable financial conditions. Because financial crises are realizations of downside risk, we measure their incidence by the skewness of credit growth. Unlike variance, negative skewness isolates the impact of the large, infrequent and abrupt credit busts associated with crises. We find a robust negative link between skewness and GDP growth in a large sample of countries over 1960-2000. This suggests a positive effect of systemic risk on growth. To explain this finding, we present a model in which contract enforceability problems generate borrowing constraints and impede growth. In financially liberalized economies with moderate contract enforceability, systemic risk taking is encouraged and increases investment. This leads to higher mean growth, but also to greater incidence of crises. In the data, the link between skewness and growth is indeed strongest in such economies.

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Key Words: Financial-Liberalization, Globalization, Lending-Booms, Skewness, Systemic-Risk, Volatility.

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I. 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 major exogenous shocks such as wars 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 or 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.

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. It can be interpreted as a positive effect of systemic risk on growth, and it is confirmed when banking crisis indicators are used instead of skewness. We also find that the link between skewness and growth is independent of the negative link between variance and growth that is typically found in the literature.

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 I). GDP per capita grew by only 114 percent between 1980 and 2002 in India, whereas Thailand's GDP per capita grew by 162 percent, 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 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 II presents the model. Section III presents the empirical analysis. Sections IV and V present a literature review and our conclusions. Finally, an unpublished appendix contains the proofs, the description of the data used in the regression analysis, and presents some additional empirical results.

[Figure I]

II. Model

Here, we present a stochastic growth model where growth depends on the nature of the financial system. 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. But is it possible for systemic risk taking to increase long-run growth by compensating for the effects of enforceability problems? Yes. Notice, however, that the positive effects of systemic risk do not arise in just any economy. It is necessary that contract enforceability problems are severe –so that borrowing constraints arise– but not too severe –so that the leverage effect is strong. Furthermore, in the presence of decreasing returns, if an economy is rich enough, systemic risk does not arise. When income reaches a certain threshold, the economy must switch to a safe path.

Finally, notice that the bailouts are financed by taxing firms in no-crisis times. We establish conditions for the expected present value of income net of taxes to be greater in a risky than in a safe equilibrium.

Setup. 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:

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

where I_t^s is the investment in the safe technology and I_t^r is the investment in the risky one.[1] 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

$$(2) \qquad w_t + b_t = I_t^s + I_t^r.$$

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 2005] 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 greater than the promised debt repayment:

$$(3) \qquad \pi_{t+1} = q_{t+1} - L_{t+1} > 0.$$

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.[2] Thus, a firm's internal funds evolve according to

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

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:

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

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

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

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.

II.A. Discussion of the Setup

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 world interest rate –or that it has access to an international lender of last resort– to bail out lenders, and that it repays this debt in no-crisis times by taxing solvent domestic firms. In the 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.

There are only 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 Ranciere et al. [2003], we describe how a mechanism analogous to ours emerges in a two-sector economy where systemic risk is generated by currency mismatch.

We will consider two types of production technologies: one with constant and one with decreasing returns to investment. The constant returns setup 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. We then show that with decreasing returns 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.

II.B. Constant Returns Technologies

Here, we consider the case in which the production functions in (1) are linear:

$$g(I) = \sigma I, \quad f(I) = \theta I, \qquad \text{with } \delta^{-1} \equiv 1 + r \leq u\theta < \sigma < \theta. \tag{7}$$

In the good state the risky return (θ) is greater than the safe one (σ). However, 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).[3] The condition $1 + r \leq u\theta$ guarantees that both projects have a positive net present value.

Equilibrium Risk Taking

Here, 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 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 ($u > 1/2$) and $h > \underline{h}$.
3. In *both safe and risky CMEs,* credit and investment are constrained by internal funds:

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

The intuition underlying the safe equilibrium is the following. Given that all other managers 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 $m^s = (1 - h\delta)^{-1}$).[4]

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: $u\pi^r_{t+1} > \pi^s_{t+1}$. 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 ($\sigma < \theta$).[5]

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 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 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:

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

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

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

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

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

The following proposition compares the mean growth rates in (12) and (13) and establishes conditions for systemic risk to be growth enhancing.[6]

Proposition 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 ($\frac{b^r_t}{w_t} - \frac{b^s_t}{w_t} = m^r - m^s$), 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 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 $(\underline{h}, \overline{h})$– 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.[7]

Notice that whenever systemic risk arises, it is growth enhancing. This is because the thresholds $\underline{h}$ and $\bar{h}$ in Propositions 1 and 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.

Skewness and Growth

In a risky equilibrium, firms face endogenous borrowing constraints and 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 or high in the no crisis state.

Figure II illustrates the limit distribution of growth rates by plotting different paths of $\log(w_t)$ corresponding to different realizations of the risky growth process. This figure makes it clear that 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.[8] The choice of parameters used in the simulation depicted in Figure II is detailed in the appendix. The probability of crisis (4.13 percent) corresponds to the historical probability of falling into a systemic banking crisis in our sample of 58 countries over 1981-2000.[9] The financial distress costs are set to 50 percent, 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 percent below the safe return. Nevertheless, growth in the risky equilibrium is on average 3 percent higher than in the safe equilibrium.

[Figure II]

Using equation (13), the credit growth process in the risky equilibrium satisfies $\log(b_t) - \log(b_{t-1}) = \log(\gamma^n) + c_t$, where $\log(\gamma^n)$ is the credit growth in tranquil times and c_t is the growth downfall during crisis: it equals 0 with probability u, and $\log(\alpha)$ with probability $1 - u$. We show in the appendix that the skewness of credit growth in the risky equilibrium is

$$sk = \left(\frac{1-u}{u}\right)^{1/2} - \left(\frac{u}{1-u}\right)^{1/2}. \tag{14}$$

We know from Proposition 1 that a risky equilibrium exists only if crises are rare events. In particular, the probability of crisis $1-u$ must be less than half. Thus, the distribution of growth rates must be negatively skewed in a risky equilibrium. 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), our model predicts that there is a positive link between mean growth and negative skewness. Since the probability of falling into a systemic banking crisis in our sample is 4.13 *percent*, (14) implies that the credit growth distribution in the risky equilibrium exhibits large negative skewness: -4.6.

Net Expected Value of Managers' Income

There are fiscal costs associated with systemic risk because along a risky path bailouts must be granted during crises, and these bailouts are financed by taxing firms during good times. Proposition 2 states that bailouts are fundable, but is the expected present value of managers' income net of taxes greater along a risky path than along a safe path? To address this question consider the present value of managers' net income in a risky and in a safe equilibrium:

$$\begin{aligned} Y^r &= w + \delta(1-d)(\theta u - (1+r))m^r \frac{w}{1-\delta\gamma^r}, \\ Y^s &= w + \delta(1-d)(\sigma - (1+r))m^s \frac{w}{1-\delta\gamma^s}. \end{aligned} \tag{15}$$

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 degree of leverage (m^r, m^s), and the mean growth rate of the economy (γ^r, γ^s).[10] 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 $(\gamma^r > \gamma^s)$. The next corollary shows that if the leverage effect is strong enough, the increase in expected income generated by systemic risk is greater than the associated expected bailout cost.

Corollary 1 When bailouts are financed by taxing non-defaulting firms, there exists a unique threshold for the degree of contract enforceability $\widehat{h} < u\delta^{-1}$, such that the expected present value of managers' income net of taxes is greater in a risky than in a safe equilibrium for any financial distress cost of crisis (i.e., for all $\alpha \in (0,1)$) if and only if $h > \widehat{h}$.

Because of the leverage effect introducing a –small– likelihood of financial crises can actually increase managers' income net of taxes. The reason is that since firms are credit constrained, taking on insolvency risk allows them to borrow and invest more. Since crises are rare, if h is large the resulting increase in income more than compensates for the expected bailout costs. Crises must be rare in order for them to occur in equilibrium. If the probability of crisis were high, agents would not find it profitable to take on risk in the first place. Notice that since the threshold $\hat{h}$ might be higher than the risk taking threshold $\underline{h}$, there may be a range $(\underline{h}, \hat{h})$ where systemic risk increases mean growth but reduces Y.

Finally, we would like to stress that our risk-neutral setup is not designed to analyze the welfare effects of a greater propensity to crisis. For such analysis it would be more appropriate to consider a setup with risk aversion, so that one could tradeoff the growth-enhancing effect of systemic risk taking against the costs of greater income uncertainty.[11]

II.C. Decreasing Returns Technologies

Here, we consider the case in which the production functions in (1) are concave. We 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.

To capture the parameter restrictions in (1) we let the safe production function be proportional to the risky one ($g(I) \equiv \chi \cdot f(I)$) and use the following parametrization:

$$f(I) = I^{\lambda}, \qquad g(I) = \chi \cdot I^{\lambda}, \qquad \lambda \in (0,1), \quad 0 < u < \chi < 1. \tag{16}$$

Since $u < \chi < 1$, 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, since $f(I)$ is concave, the condition analogous to $1 + r < u\theta$ only holds for low levels of capital.

In order to reduce the number of cases we need to consider, 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. Also, we assume 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 remains the same. Under these assumptions one can derive the following proposition, which is the analogue of Proposition 1.

Proposition 3 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 $w^* \in (\frac{\tilde{I}}{m^r}, \tilde{I})$, such that there also exists a risky CME in which $\zeta_{t+1} = u$ if and only if $w < w^*$ and $h \in (\underline{h}^{\dagger}, \bar{h})$, where $\underline{h}^{\dagger}$ is defined in the appendix.
- In the safe and risky CME borrowing constraints bind for internal funds lower than $\frac{\hat{I}}{m^s}$ and $\frac{\tilde{I}}{m^r}$, respectively. Investment is given by

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

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 $w = \frac{\tilde{I}}{m^r}$ $(\frac{\hat{I}}{m^s})$. 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 3 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 that whenever borrowing constraints bind, a risky CME exists. This is because w^* is larger than $\frac{\tilde{I}}{m^r}$. 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.

Notice that a poor economy behaves like an Ak economy. If $w_t < \frac{\tilde{I}}{m^r}$, 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 I^λ by θI, we can see that internal funds evolve identically as in subsection II.B. Next, we derive a result analogous to Proposition 2 by comparing the expected growth rate $(\gamma^j_{t+1} = E_t(w^j_{t+1}/w_t))$ 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 $w < w^*$.

Proposition 4 Under the proportional aid assumption (11), there exists a threshold for the degree of contract enforceability $\underline{h}^\dagger$, such that for any financial distress cost of crises, i.e., for any $\alpha \in (0, 1)$:

1. Systemic risk arises in equilibrium *only if* $w_t < w^*$ and $h \in (\underline{h}^\dagger, \bar{h})$.
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.[12] 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 before w reaches the Pangloss level $\tilde{I}$. This shift is a key difference with respect to the results derived in the Ak setup. This result 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 $w = \frac{\tilde{I}}{m^r}$, which is less than w^*. Finally, we show in the proof that under the 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 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.

III. 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 III.A, 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 III.B, 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 III.C, we present an alternative analysis of the link between systemic risk and growth based on several indexes of financial crises. In subsection III.D, we test a further implication of our theoretical mechanism which is that skewness increases growth via its effect on investment. Finally, subsection III.E presents a set of additional robustness tests.

III.A. 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.[13] When there are no other major shocks, rare crisis countries exhibit strictly negative skewness.[14]

To illustrate how skewness is linked to systemic risk, the kernel distributions of credit growth rates for India and Thailand are given in Figure III.[15] 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 are 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.[16]

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.[17]

[Figure III]

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, though, 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.[18] 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 episode 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 percent.[19]

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 79 percent of these extreme observations correspond to coded crises. Table I, panel A shows that among the countries with negative skewness, 90 percent (79 percent) 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 79 percent (90 percent) 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 I shows that this procedure eliminates virtually all negative skewness. Moreover, 79 percent of the omitted observations correspond to coded crises.[20]

[Table I]

Second, there is significantly less negative skewness once we exclude consensus crises. Table I, panel C, shows that if we eliminate the observations with a consensus crisis, skewness increases in 32 out of the 35 crisis countries.[21] On average, skewness increases from -0.41 to 0.32 and the percentage of crisis countries with skewness below -0.2 shrinks from 63 percent to 11 percent.[22]

In sum, there is a fairly close correspondence between both measures. There are, however, 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 an aggregate financial 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, skewness signals in a parsimonious way the severity of rare credit busts. In contrast, de jure banking crisis indexes are based on more direct information. Unfortunately, they are subjective, limited in their coverage over countries and time, and do not provide information on the relative severity of crises.[23] Other financial crisis indexes –e.g., currency crisis and sudden stops– are, like skewness, de facto indexes.[24] However, the rules followed to construct these indexes differ from one author to another. As a result, it is not unusual for these crisis indexes to identify different episodes.

Finally, consider Thailand as an example to illustrate the two procedures. Figure IV, 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 IV, 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 although coded crises indexes capture the well-known 1998-2000 crisis, they do not report the severe 1980 bust and place the mild 1985-1986 episode on an equal footing with the severe 1998-2000 crisis episode.[25] As a result, when 1985-1987 and 1998-2000 are eliminated, 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 -0.196. If we also eliminate 1986, the year with the next smallest growth rate, skewness becomes virtually zero (+0.04).

[Figure IV]

Variance and Excess Kurtosis

Rare and severe crises are associated not only with negative skewness but also with high *variance* and *excess kurtosis*. We consider each in turn.

Variance is the typical measure of volatility. For the purpose of identifying systemic risk there are, however, two key differences between variance and skewness. First, variance reflects not only large and abrupt busts that occur during crises, but may also reflect other more symmetric shocks. In contrast, skewness captures specifically asymmetric and abnormal patterns in the distribution of credit growth.[26] Second, if crises were not rare but the usual state of affairs, unusually high variance, not large negative skewness, would arise.[27] Therefore, unlike variance, skewness isolates the incidence of severe and rare crises from other sources of more frequent or more symmetric volatility.

Our model does not make predictions on how symmetric shocks affect growth.[28] As we shall show below, our regression results do not contradict the negative link between variance and growth found by Ramey and Ramey [1995] and others.

Excess kurtosis captures both the fatness of the tails and the peakedness of a distribution relative to those of a normal distribution.[29] Positive excess kurtosis can be generated either by extreme events or by a cluster of observations around the mean that affect the peakedness of the distribution.[30] Consider the sample of 35 countries with at least one consensus crisis. For the vast majority of countries, excess kurtosis is driven by extreme observations associated with crises. In about one fifth of the sample, however, excess kurtosis is predominantly affected by observations near the center of the distribution. As a result, in our sample, the link between skewness and crises is empirically stronger than the link between excess kurtosis and crises.[31]

III.B. 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. 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.

Baseline Estimation

In the first set of equations we estimate, we include the three moments of credit growth in a standard growth equation:[32]

$$\Delta y_{it} = \gamma' X_{it} + \beta_1 \mu_{\Delta B,it} + \beta_2 \sigma_{\Delta B,it} + \beta_3 sk_{\Delta B,it} + \eta_t + \varepsilon_{it}, \tag{17}$$

where Δy_{it} is the average growth rate of per-capita GDP; $\mu_{\Delta B,it}$, $\sigma_{\Delta B,it}$ and $sk_{\Delta B,it}$ 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.[33] Here, we consider a *simple control set* that includes initial per-capita GDP and the initial ratio of secondary schooling. In section III.E 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.[34] We do not include investment in (17) as we expect the three moments of credit growth, our variables of interest, to affect GDP growth through investment.[35]

We consider three sample periods: 1961-2000, 1971-2000 and 1981-2000.[36] 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.[37] All panel regressions are estimated with time effects.[38]

Table II 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 percent level in the cross-section regressions and at the 1 percent 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.

[Table II]

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.[39] 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 percent 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.

The negative partial correlation between skewness and growth is consistent with our model's prediction that a risky economy grows, on average, faster than a safe one. This is because the former exhibits negative skewness, while the latter has no skewness. The baseline estimation assumes an homogenous and linear effect of skewness on growth. Below we relax the homogeneity assumption and test whether the link between skewness and growth depends on the degree of financial liberalization and of contract enforceability. In the robustness subsection, we relax the linearity assumption and enter negative and positive skewness separately in the growth regression.

Identification of the Mechanism

Here, we test an identification restriction implied by the equilibria of our model. Namely, whether the 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.[40]

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. First, 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. Second, 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. Next, we exploit cross-country differences in financial liberalization and contract enforceability to test this identifying restriction.

We use the law and order index of the Political Risk Service Group in 1984 to construct the set of countries with a medium degree of contract enforceability (MEC).[41] We classify as MECs the countries with an index in 1984 ranging between 2 and 5.[42] 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 International Monetary Fund 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.[43]

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

$$MEC_i\_FL_{i,t} = MEC_i \bullet \frac{1}{10}\sum_{j=0}^{9} fl_{i,t+j} \ , \qquad t \in \{1961, 1971, 1981, 1991\}. \tag{18}$$

For each liberalization index, we interact the MEC_FL index with the three moments of credit growth and add them to regression equation (17).[44] Table III 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 percent 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 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 III– range between -1.02 and -0.81 and are significant at the 1 percent level.An estimate of -0.81 means that a one unit increase in negative 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 II. [Table III]

We have shown that the negative link 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 systemic risk is growth enhancing.

III.C. Crisis Indexes and Growth

In subsection III.A we showed that our skewness measure coincides closely with several financial crisis indexes. 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.[45] 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.[46] [Table IV]

The empirical specification is the same as in the panel analysis of Table II, substituting the crisis dummies for skewness. Table IV shows that the three banking crisis dummies enter positively (with point estimates ranging from +0.22 to +0.26) and significantly at the 5 percent level. Thus, we find that countries that experienced a systemic banking crisis in a given decade also experience on average a 0.24 percent 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 II). 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.[47] Finally, in Table EA1, in the appendix we show that the results of Table IV persist when the estimation is done with the full set of control variables.

III.D. 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 V]

Table V, panel A presents the results of the GLS and GMM panel estimations performed over the period 1971-2000 for the two investment rates using the simple set of control variables.[48,49] The estimation yields very similar results for the two investment rates. Skewness enters negatively and is significant at the 1 percent level in the GLS estimations and at the 5 percent level in the GMM estimation. 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.[50]

In order to relate the investment effects to growth outcomes, we present in Table V, panel B, a set of growth regressions in which the investment rate replaces the moments of credit growth. Investment enters significantly at the 1 percent 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 II for the same sample period ($-$ 0.24), although it is slightly lower.[51]

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.

III.E. Robustness

Here, we summarize a series of robustness tests of the link between skewness and growth.

Generalized Method of Moments System Estimation. In order to control for unobserved time- and country-specific effects, and account for some endogeneity in the explanatory variables, we use a GMM system estimator developed by Blundell and Bond [1998]. The system is estimated over the period 1970-2000. Tables EA6 and EA7 in the appendix show that (i) the negative link between skewness and growth is significant in the GMM estimation and its point estimate is actually larger than in the GLS estimation; (ii) relaxing the exogeneity on skewness while treating the other regressors as jointly endogenous, has little effect on the estimates; and (iii) the interaction effects presented in subsection III.B are also significant in the GMM specification. The details of the GMM estimation are presented in the appendix.[52]

Extended Set of Control Variables. Table EA8 in the appendix 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 to the panel estimates obtained in Table II. Notice also that in most of the regressions, the control variables enter with the expected sign and their point estimates are significant.[53]

Alternative MEC Sets. Table EA9 in the appendix shows the results of section III.B are robust to alternative definitions of the set of countries with a medium degree of contract enforceability. In the three regressions presented in Table EA9, we exclude successively from the MEC set: (i) countries with an index of 2, (ii) countries with an index of 5, and (iii) countries with an index equal to either 2 or 5. In the first regression, the 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 times larger in this set.[54]

Negative Skewness and Growth. Table EA10 in the appendix shows that the negative link between skewness and growth reflects mainly a positive relationship between the magnitude of negative skewness and growth. The magnitude of negative (positive) skewness is computed as a variable equal to the absolute value of skewness if skewness is negative (positive) and equal to zero otherwise. When these two variables are introduced in place of skewness in our benchmark panel estimations (Table II, regressions 4 to 6), we find that (i) the magnitude of negative skewness enters positively and significantly at the one percent confidence level, with point estimates ranging between 0.48 and 0.55; and (ii) the magnitude of positive skewness enters negatively but not significantly different from zero.

Skewness vs. Crises Indexes. In order to run a horse race between coded crisis indexes and skewness, we add the skewness of credit growth to each of the regressions presented in Table IV. The results are presented in Table EA11 of the appendix. The skewness coefficients are significant and their point estimates are only slightly lower than the coefficient estimated in the baseline regression (Table II, regression 6). In contrast, the coefficients of systemic banking crises indexes and the coefficient of the sudden stops index lose their significance, and their point estimate fall sharply once skewness is introduced.

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 negative link between skewness and growth is observed in an unconditional sample, we re-estimate the panel regression presented in Table II including the *full sample of 83 countries* for which we have available data. Table EA12 shows that skewness still enters negatively and remains statistically significant at the 1 percent level, although the magnitude of the average point estimate is reduced from -0.29 to -0.22.

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 II). There are 13 country-decades whose residuals deviate by more than two standard deviations from the mean.[55] As Table EA13 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 benchmark estimate of -0.33.

IV. 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.[56] Veldkamp [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 rare disasters 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], Fatas and Mihov [2003] and others. 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 sectoral 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 and Pathak [2006] 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. 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.

V. 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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Notes

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

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

[3] 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.

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

[5] Taxes in our current setup do not distort the incentives to divert income. In the proof of Proposition 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 that the equilibria of Proposition 1 exist provided $\tau^{old} < dh/u\theta$ and u is large enough.

[6] 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 simply compares situations where a safe equilibrium is played every period with situations where a risky equilibrium is played every period.

[7] 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.

[8] If instead of (11), the aid payment were a constant, the result in Proposition 2 illustrated in Figure II 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 $1 - u$.

[9] Notice that this is the probability of shifting 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.

[10] The sums Y^r and Y^s converge if and only if the manager's payout rate d is greater than $\underline{d}$ defined in the appendix.

[11] Barro (2007) considers a rare disasters setup and shows that, in the presence of risk aversion, changes in the probability of disaster have major implications for welfare.

[12] This follows because the thresholds for w_t and h are the same as those in Proposition 3. The intuition is the same as in Proposition 2.

[13] Skewness is a measure of the degree of asymmetry of a distribution and is computed as $sk = \frac{1}{n}\sum_{i=1}^{n} \frac{(y_i - \bar{y})^3}{var^{3/2}}$, where $\bar{y}$ is the mean and var is the variance. If the left tail is more pronounced that the right tail, the distribution is said to have negative skewness. If the reverse is true, it has positive skewness.

[14] 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.

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

[16] 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 appendix.

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

[18] These indexes are described in the appendix.

[19] This last criterion ensures that the beginning of the crisis is the year in which it actually starts having macroeconomic consequences. For example, the indexes of Caprio and Klingbiel (CK) and Detragiache and Demirguc-Kunt (DD) report 1997 as the start of the crisis in Thailand when credit growth was still strong (+12 percent) before contracting abruptly in 1998 (-12 percent). 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).

[20] Table EA4 in the 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.

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

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

[23] 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 timing of crisis is the same.

[24] The appendix describes the crisis indexes.

[25] Kaminsky and Reinhart [1999] in their well-known study on twin banking and currency crises do record a crisis in 1979. Moreover, the 1980 International Monetary Fund 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.

[26] In the appendix we consider an economy that is subject to two types of independent shocks: severe crises and symmetric business cycle fluctuations. We show that total variance is equally affected by the variance of the crisis component and the variance of the business cycle component. In contrast, total skewness is increasing in the variance of the crisis component, but *decreasing* in the variance of the business cycle component.

[27] In our model, variance is equal to $var = [\log(\alpha)]^2\, u(1-u)$. It follows that variance reaches its maximum when the probability of crisis $1-u$ equals one half. In contrast, negative skewness is large when $1-u$ is small (see (14)). Brazil is a good example. Here, hyperinflation, unsustainable government debt, and pro-cyclical fiscal policy have led, according to our indexes, to crisis in more than half of the sample years. 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 percent of country-years are coded as having a consensus crisis by the ten indexes we consider.

[28] See Barlevy [2004] for an example of an Ak model in which symmetric fluctuations reduce long-run growth because of adjustment costs in the installation of capital.

[29] Excess kurtosis is computed as $ek = \frac{1}{n}\sum_{i=1}^{n}\frac{(y_i-\bar{y})^4}{var^2} - 3$, where $\bar{y}$ is the mean and νar is the variance. We show in the appendix that in the risky equilibrium of the model, excess kurtosis of credit growth is $\frac{1}{u(1-u)} - 6$, which is positive and large when crises are rare.

[30] According to Kotz and Johnson [1983], excess kurtosis indicates "an excess of values *in the neighborhood of the mean*, as well as *far away from it*." (p. 424). To illustrate this point, in the appendix we present a theoretical example in which excess kurtosis can be created by adding mass either at the mean or at the tails of a Normal distribution.

[31] The details of this analysis are included in the appendix.

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

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

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

[35] In section III.D, we analyze the link between investment and the three moments of credit growth.

[36] 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.

[37] 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.

[38] We do not include fixed-effects in our baseline regressions. The GMM estimation presented in the robustness section 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.

[39] 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 I.

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

[41] 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.

[42] Table EA9 in the appendix shows that our estimation results are robust to alternative definitions of the MEC set.

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

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

[45] 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.

[46] 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.

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

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

[49] The GMM estimation is performed using the GMM system estimator proposed by Blundell and Bond [1998]. The details of the estimation technique are presented in the appendix.

[50] 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.

[51] 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.

[52] Table EA3 in the appendix shows that similar results are obtained with a three stage least squares estimation procedure.

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

[54] 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.

[55] The 13 outliers are: Bolivia (sixties), Niger (seventies and eighties), Senegal (seventies), Jordan (eighties), Papua New Guinea (eighties), Brazil (seventies), Indonesia seventies), Singapore (seventies), Bostwana (eighties), Korea (eighties), Japan (sixties) and China (nineties).

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

Table I
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 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 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 distributions	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 joint 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 of credit growth	
	Complete distributions	Distributions 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 III.A. The sample period is 1981-2000.
Source: Table EA5 in the appendix.

Table II

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 III
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; MEC_FL=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	49/163	32/96

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

Note: See Section III.B 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 IV
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: Detragiache 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 III.A 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 V

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

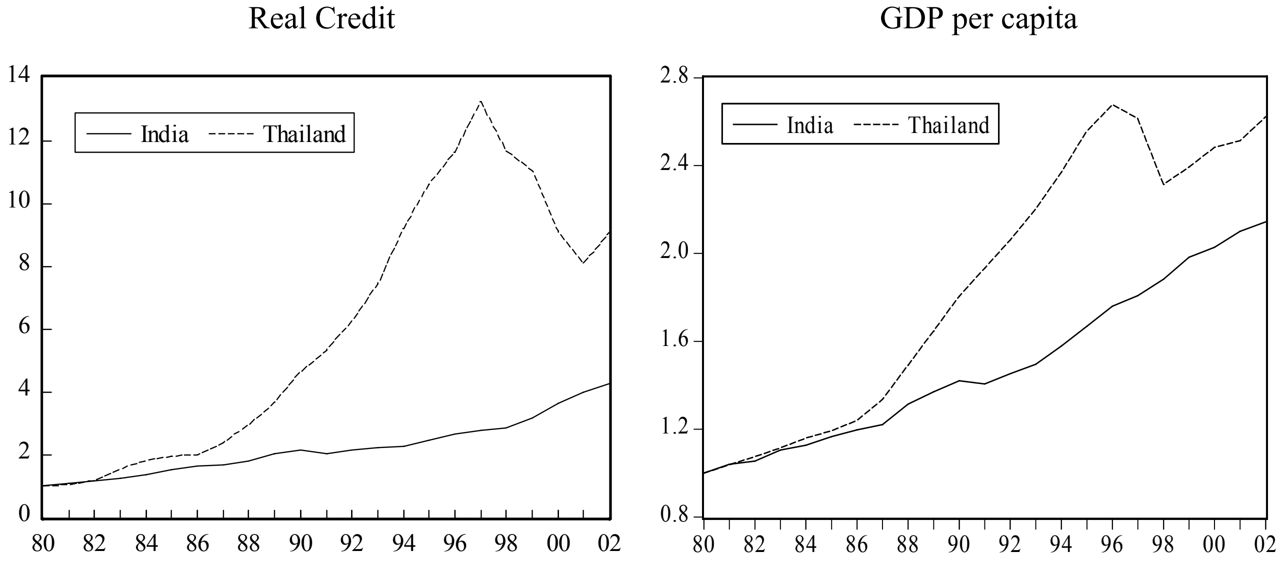
(Standard errors are presented below the corresponding coefficient.)

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.

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

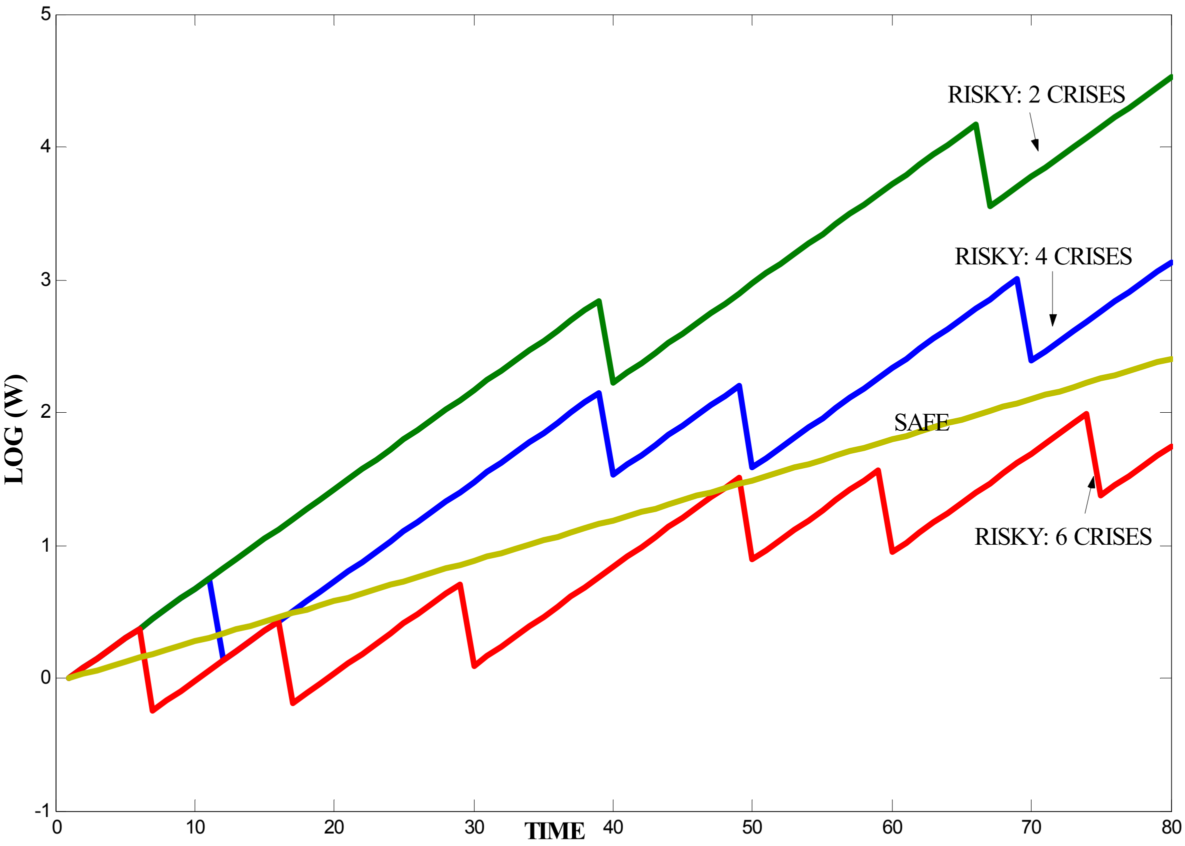


Real Credit

GDP per capita

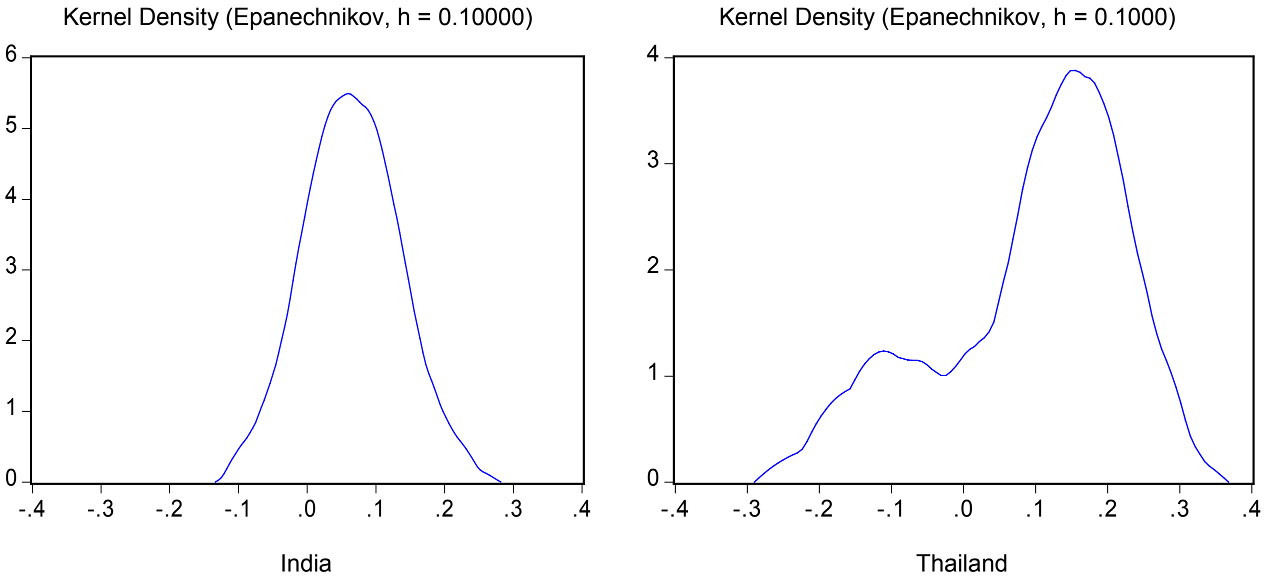
Note: The values for 1980 are normalized to one. The figures display annual credit and per-capita GDP series.

Figure II. Model Economy: Growth and Crises



parameters: $\sigma = 1.10$ $\theta = 1.12$ $r = 0.051$ $d = 0.10$ $\alpha = 0.5$ $1\text{-}u = 0.0413$ $h = 0.5$

Figure III. Kernel Distributions of Real Credit Growth 1980-2002

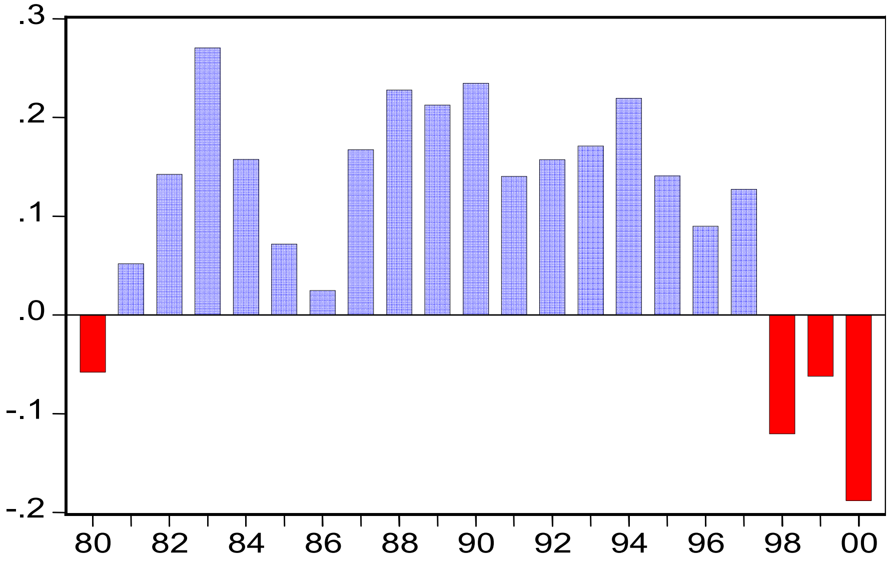


Moments of real credit growth (1980-2002)

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

Figure IV. 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)

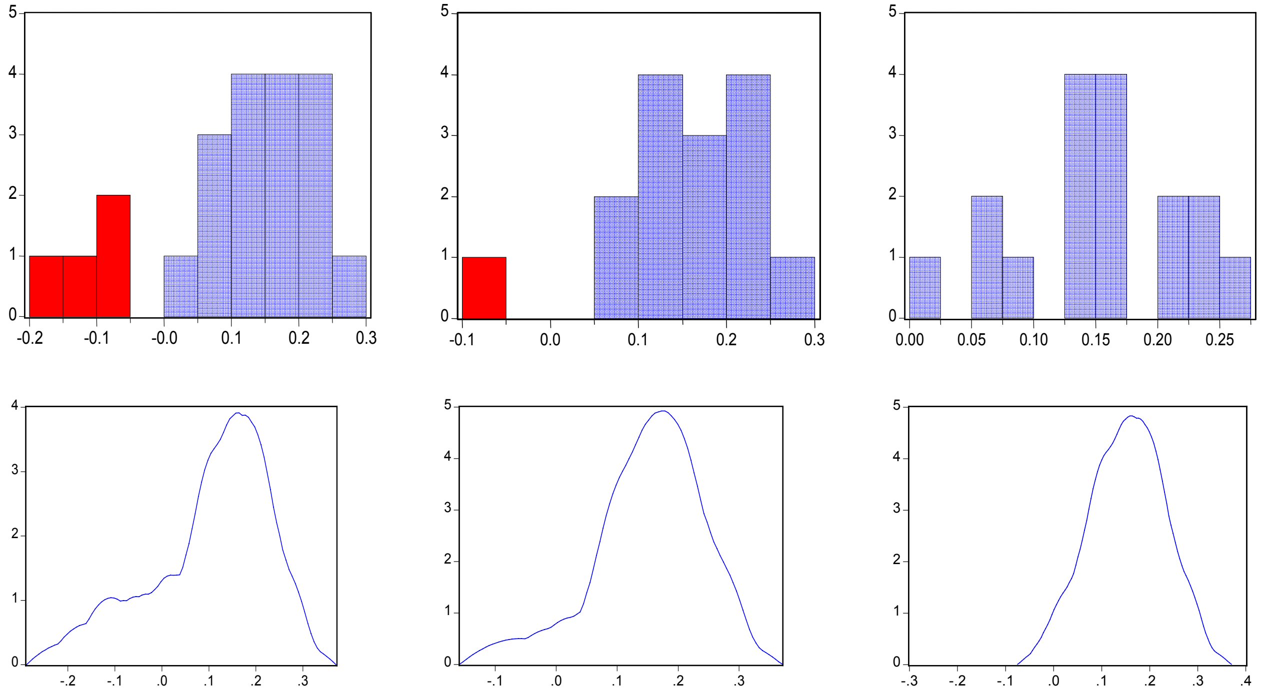
A) All years

B) Without *de jure* crises

years excluded: 1985-1987; 1998-2000

C) Without outliers

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 IIII.A. The outliers are the four negative extreme observations.