Systemic Risk and Growth

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Abstract

We document the fact that countries that have experienced occasional financial crises have on average grown faster than countries with stable financial conditions. We measure the incidence of crisis with the *negative skewness* of credit growth, and find that it has a robust positive effect on GDP growth. This positive link helps explain why policies that facilitate systemic risk taking, such as financial liberalization, lead to higher growth, but also to a greater incidence of crises.

We show that the link between skewness and growth is independent of the negative link between variance and growth typically found in the literature. This is because unlike negative skewness, variance does not isolate the assymetry in the credit growth distribution of countries that experience systemic crises.

To rationalize our finding we present a growth model where credit market imperfections generate borrowing constraints that impede growth. We show that systemic risk taking relaxes borrowing constraints and induces higher growth, but as a by-product generates aggregate financial fragility, which leads to occasional crises. Furthermore, the model allows us to assess wether systemic risk-taking is socially efficient.

1. Introduction

Over the last two decades countries that have experienced occasional financial crises have on average grown faster than countries with stable financial conditions. It would thus appear that systemic risk-taking induces higher growth, but as a by-product generates aggregate financial fragility, which leads to occasional crises.

In this paper we document the link between higher long-run growth and the propensity to crises across various sets of countries. To rationalize this surprising link we present a model where weak institutions lead to severe financial constraints and low growth. Financial liberalization policies facilitate risk-taking, which relaxes financial constraints and increases growth. As a by-product, however, systemic risk and the possibility of crises arise. Furthermore, we establish conditions under which the costs of crises are outweighed by the benefits of higher growth.

Thailand and India are contrasting examples of a steep but risky growth path and a slow but safe growth path. Thailand has experienced lending booms and crises, while India has pursued a safe growth path (see Figure 1). GDP per capita grew by only 5% annually between 1980 and 2001 in India, whereas Thailand's GDP per capita grew by 7.5%annually, despite having experienced a major crisis.[1]

We proxy for the risk of systemic crises with the *negative skewness* of real credit growth. Negative skewness captures rare, large and abrupt contractions. In a long sample negative skewness is an appropriate proxy of systemic risk because crises happen only *occasionally* and during a crisis there is a large and abrupt downward jump in credit growth.[2]

We choose not use the *variance* to capture the uneven progress associated with financial fragility because high variance captures not only rare, large and abrupt contractions, but also frequent and symmetric shocks. Thus, unlike negative skewness, variance is not a good instrument to distinguish safe paths from risky paths associated with infrequent systemic crises.

We estimate a set of regressions that include the three moments of credit growth in standard growth equations. We find a positive link between per-capita GDP growth and negative skewness of real credit growth. This link is robust across alternative specifications and is independent of the negative effect of variance on growth.

The link between skewness and growth is economically important. Our benchmark estimates indicate that about a third of the growth difference between India and Thailand can be attributed to systemic risk taking. This finding *does not* imply that financial crises are good for growth. It suggests that undertaking systemic risk has led to higher growth, but as a side-effect, it has also led to *occasional* crises.

[1] This fact is more remarkable given that in 1980 India's GDP was only about one fifth of Thailand's.

[2] Financial crises are typically preceded by lending booms and followed by protracted credit crunches. Since credit growth does not experience sharp jumps during the boom and crises happen only *ocassionally,* the distribution of credit growth along a boom-bust cycle is characterized by negative outliers, i.e., it exhibits negative skewness. In other words, credit contractions are clustered farther away from the mean that credit expansions.

Our sample consists of all countries for which data is available over the period 1960-2000 (eighty three countries). Although there is a significant negative link between skewness and growth in this large set, the strength of this link varies across different subsets of countries. In particular, this link is strongest across the set of countries with a middle degree of contract enforceability. This is the group where the theoretical mechanism we propose is strongest because institutions are weaker than in countries with a high degree of contract enforceability, but no so weak that financial markets are unoperative. By contrast, negative skewness is associated with lower growth in countries that have experienced either severe war episodes or large terms of trade deteriorations. In this set negative skewness is induced by events other than endogenous systemic risk.

In order to investigate how robust are our findings we consider different estimation techniques that address the existence of unoberved variables. We also test for robustness against further control variables and potential outliers. The main finding holds across all specifications. In our model economy skewness is exogenous to growth. However, to overcome potential remaining endogeneity we estimate an instrumental variables regression, where we use a financial liberalization index to instrument for skewness. As we explain below, under our theoretical mechanism, this index is correlated with risk taking and does not have another independent effect on growth.

In the second part of the paper we formalize a mechanism that underlies the surprising link between growth and the propensity to crisis. This mechanism is generated by the interaction of *weak institutions* and *financial liberalization*. The former is reflected in a low degree of contract enforceability, which generates borrowing constraints as agents cannot commit to repay debt. This distortion leads to low growth because investment is constrained by firms' cash-flow.

In the presence of systemic bailout guarantees, financial liberalization may induce agents to coordinate and take on 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* and invest more. Risk taking, however, leads to aggregate financial fragility and to occasional crises.

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

This argument helps explain why the link between growth and negative skewness is strongest in countries with a middle degree of contract enforceability that we find in the data. It also shows why, by facilitating the development of systemic risk, financial liberalization relaxes borrowing constraints and leads to higher growth.

Notice that the link between growth and propensity to crisis does *not* derive from a 'mean-variance' channel. Our mechanism does not require that *high* variance technologies have a *higher* expected return than *low* variance technologies. Higher average growth derives from the ability to attain greater leverage that systemic risk taking provides.

The existence of systemic risk depends on systemic bailout guarantees. Since guarantees are funded by domestic taxation, the question arises as to whether such a scheme is feasible. We show that if taxpayers benefit from the production of the financially constrained sector and have access to complete financial markets, the present value of their income, net of taxes, is greater in a risky economy. The funding of the guarantees actually effects a *redistribution* from taxpayers to credit constrained firms. This redistribution is to the mutual benefit of both. Thus, even those who bear the costs of crises may be willing to pay their price.

Our findings bear relevance to the policy question of whether financial liberalization should be implemented before other reforms have been implemented. Liberalization strengthens financial development and contributes to higher long-run growth. However, it also induces risk-taking and leads to more frequent crises. Clearly, the first best is to implement judicial reform and improve contract enforceability. However, if such a judicial reform is not feasible, some degree of risk taking may be a second best instrument despite financial fragility. The results in this paper should not be interpreted as supporting the undertaking of unlimited risk that might simply mask overinvestment or corruption.

This paper is structured as follows. Section 2 presents the empirical analysis. Section 3 rationalizes the link between growth and crises. Section 4 concludes.

2. Crises and Growth: The Empirical Link

Here, we investigate whether countries with risky paths that have experienced financial crises have grown faster, on average, than other countries. We also investigate whether this link is stronger in countries with weak institutions, specially in those that are financially liberalized.

We use the *negative skewness* of real credit growth to measure the incidence of financial crises.[3] Negative skewness is a parsimonious indicator that captures *rare, large and abrupt* busts. It is an adequate proxy because crises happen only *occasionally* and during a crisis there is a large and abrupt downward jump in credit growth. Thus, the distribution of credit growth in crisis prone economies is characterized by negative outliers.

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

Before we proceed four comments are in order. First, occasional crises are associated not only with negative skewness, but also with high *variance* –the typical measure of volatility in the literature. We choose not to use the variance to identify risky paths that lead to *rare, large and abrupt* busts because high variance may also reflect other shocks, that could either happen more frequently or be symmetric. These other shocks might be exogenous or might be self-inflicted by, for instance, bad economic policy. Since there is an abundance of these other shocks in the sample, the variance is not a precise instrument to distinguish safe paths from risky paths associated with financial crises.

Second, typically crises are preceded by lending booms. This boom-bust pattern does not generate positive skewness. During a lending boom there are positive growth rates that are above normal. However, they are not positive outliers because the lending boom takes place for several years and in a given year it is not as large in magnitude as the typical bust. Only a large positive one-period jump in credit would create a positive outlier in growth rates.[4]

Third, in principle, negative skewness can miss cases of risk taking that have not lead to crisis yet. This omission, however, would make it more difficult to find a positive relationship between GDP growth and negative skewness. Moreover, empirically most countries that have followed risky paths have experienced at least one major crisis during our sample period (1980-2000).[5]

Fourth, we acknowledge that negative skewness can also be caused by forces other than systemic risk. To generate skewness these forces, however, must lead to abrupt and large falls in aggregate credit. In our empirical analysis, we control explicitly for the two exogenous events, we are aware of, that could lead to a comparably large fall in credit: severe wars and large terms of trade deteriorations.

To illustrate how skewness is linked to growth, the kernel distributions of credit growth rates for India and Thailand are given in Figure 1.[6] India, the safe country, has a low mean and is quite tightly distributed around the mean –with skewness close to zero. Meanwhile, Thailand, the risky country, has a very asymmetric distribution and is characterized by a much larger negative skewness. Between 1980 and 2001 GDP per capita in India grew by only 99%, whereas Thailand's GDP per capita grew by 148%, despite having experienced a major crisis.[7]

[4]For instance, Thailand experienced a lending boom for almost all of the sample period and most of the distribution is centered around a very high mean.

[5]Since crises are rare events, in a short sample period not all risky lending booms need to end in a bust (see Gourinchas et. al (2001) and Tornell and Westermann (2002)).

[6]The simplest nonparametric density estimate of a distribution of a series is the histogram. The histogram, however, is sensitive to the choice of origin and is not continuous. We therefore choose the more illustrative kernel density estimator, which smoothes the bumps in the histogram (see Silverman 1986). Smoothing is done by putting less weight on observations that are further from the point being evaluated. The Kernel function by Epanechnikov is given by: $\frac{3}{4}(1-(\Delta B)^2)I(|\Delta B| \leq 1)$, where ΔB is the growth rate of real credit and I is the indicator function that takes the value of one if $|\Delta B| \leq 1$ and zero otherwise. The bandwidth, h, controls for the smoothness of the of the density estimate. The larger is h, the smoother the estimate. For comparability, we choose the same h for both graphs.

[7]This fact is more remarkable given that in 1980 India's GDP was only about one fifth of Thailand's.

2.1. Regression Analysis

Here, we investigate the effect of skewness on growth in standard growth regressions. We consider several estimation techniques, address the issue of potential endogeneity and perform several robustness tests.

Our data set consists of all countries for which data is available in the World Development Indicators for the period (1960-2000).[8] Out off this set of 83 countries we identify eleven as severe war cases and fourteen as having experienced a large deterioration in the terms of trade.[9] The link between negative skewness and growth is present in the set of 83 countries as well as in the set of 57 countries that excludes the last two groups. Furthermore, consistent with the predictions of our theoretical mechanism, the link between systemic risk and growth is strongest in the set of countries with a middle degree of contract enforceability.

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

$$\Delta y_{it} = \lambda y_{i0} + \gamma' X_{it} + \beta_1 \mu_{\Delta B,it} + \beta_2 \sigma_{\Delta B,it} + \beta_3 S_{\Delta B,it} + \varepsilon_{it}, \tag{2.1}$$

where Δy_{it} is the average growth rate of per-capita GDP; y_{i0} is the initial level of per capita GDP; $\mu_{\Delta B,it}$, $\sigma_{\Delta B,it}$ and $S_{\Delta B,it}$ are the mean, standard deviation and skewness of the real credit growth rate, respectively. X_{it} is a vector of control variables that includes initial per capita income and secondary schooling. We do not include investment in (2.1) as we expect the three moments of credit growth, our variables of interest, to affect GDP growth through higher investment.

First, we estimate a standard cross-section regression by OLS. In this case 1980 is the initial year and the moments of credit growth are computed over the period 1981-2000. Then, we estimate a panel regression using generalized least squares. We consider two non-overlapping windows (1981-1990 and 1991-2000), and use two sets of credit growth moments, one for each window.

Table 1 reports the estimation results for both regressions. We find that, after controlling for the standard variables, the mean of the growth rate of credit has a positive effect and on long-run GDP growth. This has already been established in the literature. What we establish is that negative skewness –a risky growth path– accompanies high GDP growth rates. Skewness enters with negative point estimates of -0.40 and -0.30 in the cross-section and panel regressions, respectively. These estimates are significant at the 5% level.

Are these estimates economically meaningful? To address this question consider India and Thailand over the period 1980-2000. India has near zero skewness, and Thailand a skewness of about minus one. A parameter estimate of -0.40 implies that an increase in skewness (from 0 to -1), increases the average

[8] Although we focus on the period 1980-2000, we need the earlier data as some of the regressions require differencing the data as well as the use of lagged values.

[9] The severe war cases are: Algeria, Congo, El Salvador, Guatemala, Iran, Nicaragua, Peru, Philippines, Sierra Leone, South Africa and Uganda. Large terms of trade deterioration cases (with annual falls of more than 30% in a single year, average annual fall of 25% over two years, or an average annual fall of 20% over 3 years) are: Cote d'Ivoire, Algeria, Ecuador, Egypt, Ghana, Haiti, Pakistan, Sri Lanka, Nigeria, Syria, Togo, Trinidad and Tobago, Venezuela and Zambia. A detailed description of how these countries were identified is given in the appendix.

long-run GDP growth rate 0.40% per year. Notice that after controlling for the standard variables Thailand grows about 1% more per year than India. Thus, about 40% of this growth differential can be attributed to systemic risk taking, as measured by the skewness of credit growth. Over the course of twenty years this 0.40% per year amounts to a level difference of 16% in per-capita GDP.

Next, consider the variance of credit growth. Consistent with the literature, the variance enters with a negative sign and it is significant at the 5% level in both regressions.[10] We can interpret the negative coefficient on variance as capturing the effect of 'bad volatility' generated by, for instance, procyclical fiscal policy. Meanwhile, the positive coefficient on skewness captures the 'good volatility' associated with the type of risk taking that eases financial constraints and increases investment.[11] As mentioned, a country with high variance need not to exhibit negative skewness.

Figure 3 depicts the marginal effect of each moment of credit growth on per-capita GDP growth for our sample of countries.[12] It is evident that higher per-capita GDP growth is associated with (a) a higher mean growth rate in credit, (b) lower variance and (c) negative skewness. In other words, high per-capita GDP growth is associated with a risky path, that is punctuated by occasional crises.

Although we control for the main determinants of economic growth, there can in principle be other unobserved effects, like for instance geographical location or other fixed country characteristics. In order to address this issue, we follow Arellano and Bond (1991) and Arellano and Bover (1995), who employ a dynamic panel regression, where the data enter the regression in first differences (see appendix for details). Grouping all explanatory variables in vector X, the differenced equation has the form:

$$y_{i,t} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \tag{2.2}$$

By construction, this equation has autocorrelated residuals. To correct for this autocorrelation and potential joint endogeneity of the regressors, we estimate the regression using a GMM system estimator with lag values as internal instruments[13]. The results are reported in column (3) of Table 1. As we can see, the three moments of credit remain significant at the 5% level. Furthermore, the point estimates, although somewhat smaller, remain of the same order of magnitude and of the same sign as those in columns (1) and (2).

[10] Ramey and Ramey (1995), and Fatas and Mihov (2002) find that fiscal policy induced volatility is bad for economic growth.

[11] Imbs (2002) makes a similar point by arguing that aggregate variance reflects growth enhancing sector-specific variance as well as growth reducing, policy induced variance.

[12] In each graph, the residuals are computed from a cross-section regression that includes all variables except the variable on the horizontal axis.

[13] the system estimator correct for the potential imprecision of the difference estimator.See Appendix ** for details of the estimation procedure.

2.2. Country Groupings

We have identified a positive link between negative skewness and growth across the set of all countries for which data is available. Here, we investigate whether this link is strongest across the set of countries for which we expect our mechanism to be at work.

As we have discussed in the Introduction, and will show formally in the model of Section 3, the mechanism that links negative skewness and growth is strongest in countries with a middle degree of contract enforceability (MECs). In these countries the undertaking of systemic risk relaxes borrowing constraints and increases growth. By contrast, in high enforceability countries (HECs), agents have easy access to external finance, so growth is determined by investment opportunities not borrowing constraints. At the other extreme, in low enforceability countries (LECs) borrowing constraints are too severe. Thus, leverage is so small that risk taking is not reflected in a significant increase in growth.

We use two alternative criteria to determine the HEC set. The first criterion classifies as HECs countries with a per-capita income of at least $17,500 in year 2000.[14] According to the second criterion, HECs are countries with a rule of Law index greater than 1.3 according to Kaufman and Kraay (2003). The rule of law criterion selects nineteen countries. The income criterion selects these nineteen countries plus Italy. >From the remaining countries we define LECs as those whose stock market turnover relative to GDP was less than one percent in 1999. We take the nonexistence of an organized stock market, as an indicator that contract enforceability problems are very severe. This criterion selects seventeen LECs and twenty one (or twenty two) MECs.

As a first pass, Table 2 compares the moments of credit growth across the three country groups. We observe three striking facts: First, HECs don't exhibit negative skewness. Second, while both, LECs and MECs, have negative skewness, only the MEC set seems to benefit substantially from systemic risk. With an average mean credit growth rate of 7.7 percent, MEC credit grows almost twice as fast as that of LECs, (4.2 percent). Third, variance is highest in LECs and lowest in HECs. Since both groups have a lower growth than MECs, there is no obvious linear relationship between variance and growth.

In order to capture more formally these differences, we add to our benchmark regression (column (2) in Table 1) an interaction dummy that equals one if a country is an MEC and zero otherwise. This dummy is interacted with the three moments of credit growth. Consistent with the prediction of the model, the effect of risk taking on growth is strongest across MECs. We can see in Column (1) of Table 3 that across MECs a one unit increase in negative skewness enhances growth by 0.472% (the sum of the coefficient on skewness and that on skewness interacted with the MEC dummy), while for the remaining countries it only leads to an increase of 0.136%. This finding means that the growth enhancing effect of systemic risk is more than three

[14] This criterion builds up on the finding of the growth and instituitions litterature that the high income countries are the ones with a strong mechanism of contract enforceability.

times higher in MECs than in the other countries. Column (2) shows that if we use the rule of law index instead of income per-capita to define the HEC set, the point estimates are very similar and significance levels remain the same.

The impact of variance on growth does not seem to differ between MECs and other countries, as the interaction dummy for variance is not significant. Meanwhile, the effect of mean credit growth is substantially more important in MECs. It is more than twice as high in MECs than in other countries.

We would like to emphasize that our findings also hold if we consider the MEC set by itself, as shown in column (3). This shows that the link between negative skewness and growth is not driven by the difference between MECs and either of the other two country groups. That is, there is a trade-off between smoothness and growth across the MEC set, as the one observed between India and Thailand above.

Wars and terms of trade deteriorations

We should not expect a link between skewness and growth to exist when skewness is generated by exogenous shocks. Column (4) shows that in a regression that includes all 83 countries in our sample skewness nevertheless remains statistically significant, although magnitude of the point estimate is reduced to -0.216. This does not mean that crisis are good for countries that have experienced a war, or large terms of trade deteriorations. In particular, if we include an interaction dummy for countries with severe wars or large terms of trade deteriorations, we find a negative effect of skewness on growth for this subset of countries –the sum of the interaction coefficient and the unconditional coefficient. This means that for these countries, wars or episodes of large term of trade deteriorations have been detrimental to long-run growth performance. A Wald test indicates that this effect is statistically significant.

Financial liberalization

As we have discussed, weak institutions are not sufficient for the mechanism that links growth and crises to be present. In addition, it is necessary that policy measures that facilitate the development of systemic risk be in place. Financial liberalization can be viewed as such a policy measure. In non-liberalized economies, regulations do not permit agents to take on significant risk.

To capture the fact that the interaction of weak institutions with liberalizations is key, we classify our data in country-years that are liberalized and those that are not liberalized. Table 4 shows that negative skewness as well as high mean growth rates are associated with financial liberalization. This indicates that in the presence of weak institutions, liberalization has facilitated systemic risk taking and has lead to both higher mean growth and occasional crisis.

To capture this difference more formally we introduce a liberalization dummy that equals one for decades in which a country was liberalized, and zero for decades in which it was not.[15,16] Column (6) of Table 3 shows a significant difference in the effect of skewness between liberalized and not liberalized countries. In non-liberalized countries, the skewness coefficient is positive and insignificant while in liberalized countries it is negative and significant. This strongly suggests that the risk-taking mechanism we described is present only in liberalized economies. By contrast, the mean and variance enter significantly and with the expected signs in the two set of countries.

2.3. Instrumental Variables Estimation

In our model economy, the risk-taking mechanism that generates skewness is exogenous to growth.[17] Thus, there is no reverse causality from mean GDP growth to the asymmetric shape of the credit growth distribution. Nevertheless, in order to overcome potential remaining endogeneity we use the index of financial liberalization to instrument for skewness. In the presence of contract enforceability problems, financial liberalization permits the undertaking of systemic risk, which both relaxes borrowing constraints and leads to occasional crises. Thus, in our model economy financial liberalization is correlated with negative skewness, but it does not have another independent effect on growth, making it an appropriate instrument.[18]

Column (1) in Table 5 displays the estimates of the second stage of a two-stage least squares regression. We can see that skewness is statistically significant and enters with a point estimate that is greater than the one from our benchmark regression. Furthermore, the mean remains significant and of similar magnitude, but variance is no longer statistically significant.

Two things are necessary for financial liberalization to be a valid instrument. It needs to be correlated with skewness, and it needs to be uncorrelated with the error term. The first stage shows a significant negative link between financial liberalization and skewness.[19] While the second condition is satisfied in our model economy, we acknowledge that there may be other mechanisms that generate an independent link between liberalization and growth, that we have not accounted for in the model.[20]

Finally, regressions (1) and (3) estimated by GMM are given in column (2) (second stage) and (4) (first stage). They lead to qualitatively similar results as the two stage least squares regression.

[15] See appendix for a discription of how the liberalization index is constructed.

[16] Country-decades, where there was a transition from closed to open were droped from this regression.

[17] Risk taking allows agents to attain greater leverage, which increases investment and growth. Risk taking, however, also implies that crises will occur occasionally. Since there is no reversed impact of growth on crisis, there is also no causal impact of growth on skewness, making skewness a valid right hand side variable.

[18] We recognize that there might exist other models in which financial liberalization impacts growth through other channels than the one we propose. We nevertheless feel that the liberalization index is an adequate instrument because financial deepening is the main mechanism through which financial liberalization affects growth.

[19] However, as the F-statistic has only a value of 5.02, it must be considered only a weak instruments according to the standard reference value of 10 in the literature.

[20] We perform a Hausman test to check the consistency of the panel OLS estimator, and find that the consistency of the OLS estimator cannot be rejected by the data.

2.4. Robustness

Here, we show that the link between negative skewness and growth is robust to the elimination of extreme observations and to the introduction of more control variables.

There are no statistical outliers in our regressions in the sense that a country's residual deviates by more that two standard deviations from the mean. Nevertheless, to see whether extreme observations have an influence on our results we exclude, from our benchmark panel-regression, the countries with the three largest and three lowest residuals, both individually and collectively. The countries with the largest positive residuals are China, Korea and Botswana. Those with the most negative residuals are Jordan, Niger and Papa New Guinea. As Table 6 shows, the exclusion of these extreme observations does not change our results. In particular, the coefficient on skewness is negative and significant at the 5% level. The point estimates range between -0.24 and -0.32, which are quite similar to our benchmark estimate of -0.30.

In Table 7 we add to our benchmark regression several control variables that are often used in the empirical growth literature: the government share in GDP, life expectancy, inflation and the terms of trade growth. In no case does the addition of these variables have in impact on the estimates of the three moments of credit growth. Among the new variables, only the government share and inflation enter the regression significantly. The finding that the government share is an important determinant of long run growth is consistent with the findings of Ramey and Ramey (1995).

In sum, our findings show that countries that followed a risky credit path have on average grown faster than countries with stable credit conditions. These results *do not* imply that crises are good for growth. They say that undertaking credit risk has led to higher growth, but as a side-effect, it has also led to *occasional* crises. This link between skewness and growth is robust and quite stable across alternative specifications. Furthermore, this effect is independent of the negative effect of variance and growth.

3. Model

Here, we formalize the argument presented in the Introduction and show that it is internally consistent. The model captures the essential features of the mechanism through which policies that permit systemic risk taking lead to faster growth in economies where weak institutions give rise borrowing constraints. The link between growth and propensity to crises derives from the fact that risk taking allows firms to attain greater leverage. Furthermore, the model allows us to assess wether systemic risk-taking is socially efficient. In our simple economy, the condition for systemic risk to be growth enhancing are consistent with the empirical findings presented in Section 2.

We consider an 'Ak' growth model with uncertainty. During each period the economy can be either in a good state ($\Omega_t = 1$), with probability u, or in a bad state ($\Omega_t = 0$). To allow for the endogeneity of systemic risk we assume that there are two production technologies: a safe and a risky. Under the safe technology, production is *perfectly uncorrelated* with the state, while under the risky one the correlation is perfect. For concreteness, we assume that the risky technology yields a return $\Omega_{t+1}\theta$, and the safe one yields σ. Thus,

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

where s_t is the investment in the safe technology and I_t is the investment in the risky one.[21]

Production is carried out by a continuum, of measure one, of firms that are owned by consumers and controlled by managers. The investable funds of a firm consist of its cash flow w_t plus the one-period debt it issues b_t. Since the firm promises to repay next period $b_t[1+\rho_t]$, the firm's time t budget constraint and time $t+1$ profits are, respectively

$$w_t + b_t = s_t + I_t \tag{3.1}$$

$$\pi_{t+1} = \max\{q_{t+1} - b_t[1+\rho_t],\ 0\} \tag{3.2}$$

The debt issued by firms is acquired by international investors that are competitive risk-neutral agents with an opportunity cost equal to the international interest rate $1+r$.

In order to generate both borrowing constraints and systemic risk we follow Schneider and Tornell (2004) and assume that firm financing is subject to two credit market imperfections: contract enforceability problems and systemic bailout guarantees. We model the first imperfection 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, a manager makes investment and diversion decisions. In the second period of her life she receives a share e of profits and consumes. For concreteness, we make the following assumption.

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

The representative manager's goal is to maximize next period's expected payoff net of diversion costs. We model the second imperfection by introducing an agency that grants bailouts when there is a systemic default, but not when there is an idiosyncractic default.

Systemic Bailout Guarantees. The bailout agency pays lenders the outstanding debts of all defaulting firms if and only if a majority of firms becomes insolvent (i.e., $\pi_{t+1} \leq 0$). Bailouts are financed by lump-sum taxes.

Since guarantees are systemic, the decisions of managers are interdependent. Therefore, their decisions will be determined in the following credit market game. During each period, every young manager proposes

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

a plan $P_t = (I_t, s_t, b_t, \rho_t)$ that satisfies budget constraint (3.1). Lenders then decide whether to fund these plans. Finally, funded young managers make investment and diversion decisions.

If the firm is solvent at $t+1$ ($\pi_{t+1} > 0$) and no diversion scheme is in place, the old manager receives $e\pi_{t+1}$ and consumers receive a dividend $d_{t+1} = [d-e]\pi_{t+1}$. In contrast, if the firm is solvent and there is diversion, the old manager gets eq_{t+1}, consumers get $[d-e]q_{t+1}$ and lenders receive the bailout if any is granted. Finally, under insolvency consumers and old managers get nothing, while lenders receive the bailout if any is granted. The problem of a young manager is then to choose an investment plan P_t and a diversion strategy η_t to solve:

$$\max_{P_t,\eta_t} \quad E_t \xi_{t+1}\{[1-\eta_t]\pi_{t+1} \ + \ \eta_t[q_{t+1} - h[w_t + b_t]]\}e \quad \text{ s.t. } (3.1),$$

where $\eta_t = 1$ if the manager has set up a diversion scheme, and zero otherwise; and $\xi_{t+1} = 1$ if $\pi_{t+1} > 0$, and zero otherwise.

To sharpen the argument we assume that crises have very steep costs: everything is lost in case of insolvency. In order to restart the economy in the wake of a systemic crisis we assume that if a firm is insolvent, it receives an aid transfer from the bailout agency a_t that can be arbitrarily small. Thus, a firm's cash-flow evolves according to

$$w_t = \begin{cases} [1-d]\pi_t & \text{if } \ \pi_t > 0 \\ a_t & \text{otherwise} \end{cases} \tag{3.3}$$

In order to cover the bailout costs we introduce a continuum, of measure one, of infinitely lived consumers that can borrow and lend at the world interest rate. During every period the representative consumer receives dividends from firms, pays taxes, and consumes. Thus, he solves the following problem

$$\max_{\{c_j\}} E_t \sum_{j=0}^{\infty} \delta^{t+j} v(c_{t+j}), \quad \text{s.t.} \quad E_t \sum_{j=0}^{\infty} \delta^{t+j}[d_{t+j} - c_{t+j} - \tau_{t+j}] \ \geq 0, \quad \delta := \frac{1}{1+r}$$

We impose the condition that the sequence of taxes is such that the bailout agency breaks even

$$E_0 \textstyle\sum_{j=0}^{\infty} \delta^j \left\{[1-\xi_{j+1}][b_j[1+\rho_j] + a_j] - \tau_j\right\} = 0 \tag{3.4}$$

To close the model we assume that in the initial period cash flow is $w_0 = [1-d]w_{-1}$, dividends are $d_0 = [d-e]w_{-1}$ and the old managers' payment is ew_{-1}.

3.1. Discussion of the Setup

We have considered a very stylized model to focus on the essentials of the mechanism that links growth and systemic risk in the presence of weak institutions. An attractive feature of this setup is that all results depend on two key parameters: the degree of h, and the likelihood of crisis $1 - u_{t+1}$.

In our setup there are two states of nature and agents' choice of production technology determines whether or not systemic risk arises. This setup is meant to capture more complicated situations, like for instance, the oft-cited phenomenon of currency mismatch whereby systemic risk is endogenously generated through risky debt denomination.

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

$$1 + r \leq u\theta < \sigma < \theta \tag{3.5}$$

The assumption $u\theta < \sigma$ is not necessary for our results. It just charges the dies against finding them. The assumption that the risky technology has a positive NPV ($u\theta \geq 1 + r$) is also not necessary. If we allowed $\theta u < 1 + r$, we could consider a more complicated setup with externalities, where greater use of the risky technology has beneficial effects on the economy.

The mechanism that links growth and the propensity to crisis requires that both borrowing constraints and systemic risk arise simultaneously in equilibrium. In general, the forces that give rise to the former act in opposite direction than the forces that lead to the latter. This is why in most of the literature there are models with either borrowing constraints or excess risk, but not both. As Schneider and Tornell (2004) show, the interaction of enforceability problems and systemic guarantees is essential for the coexistence of borrowing constraints and risk taking. If only enforceability problems were present, agents would be overly cautious and the equilibrium would feature borrowing constraints, but no risk taking. If only guarantees were present, there would be no borrowing constraints. Thus, there would be no force that would make risk-taking growth enhancing. Furthermore, if institutions were so weak that guarantees were not systemic, but bailouts were granted whenever there was an individual default, borrowing constraints would not arise because lenders would always be repaid (by taxpayers). Finally, notice that, the two distortions act in opposite directions, and in general, neutralize each other. The remainder of this section determines when it is that the correct balance between these opposing forces exists.

The degree of contract enforceability h is the key parameter in this paper. We will assume throughout that enforceability problems are 'severe'

$$0 \leq h < u[1 + r] \tag{3.6}$$

This condition is necessary for borrowing constraints to arise in equilibrium. Lenders are willing to lend up the point where borrowers do not find it optimal to divert. If (3.6) did not hold, the expected debt repayment in a risky equilibrium would be lower than the diversion cost $h[w_t + b_t]$ for all levels of b_t.

Our setup makes difficult to prove that systemic risk is growth enhancing and socially efficient. First, we have assumed that there are 100% bankruptcy costs (in case of crisis all output is lost). Second, in the wake of crisis firms cash-flow collapses (it equals the tiny aid payment a_t). Since the production technology is linear, this collapse has long-run depressing effects on output.

Consumers do not play a central role. They are simply a device to transfer fiscal resources from firms to the bailout agency. We will use this device to show that the fiscal costs of the guarantees can be lower than the benefits. The assumption that consumers have access to complete financial markets captures the fact that some agents in the economy are financially unconstrained and benefit from greater investment by constrained agents. The funding of the guarantees operates a *redistribution* from the unconstrained to the constrained agents, which might benefit both. In Ranciere, Tornell and Westermann (2003) we consider a more complicated setup with two productive sectors: a tradables sector with access to international FM that uses inputs from the constrained nontradables sector. Greater investment by the latter benefits the former through cheaper inputs. That paper generates systemic risk via currency mismatch, and also generates several of the stylized facts associated with recent boom-bust cycles. The present paper is not designed to generate such stylized facts. The gain is that the link between systemic risk and guarantees is transparent.

3.2. Equilibrium Risk Taking

In this subsection, we characterize the conditions under which borrowing constraints and systemic risk can arise simultaneously in a symmetric equilibrium.

Let us define a *systemic crisis* as a situation where all firms go bust, and let us denote the probability that this event occurs next period by $1 - u_{t+1}$. Then, a plan (I_t, s_t, b_t, ρ_t) is part of a symmetric equilibrium if it solves the representative manager's problem, taking u_{t+1} as given. The next proposition characterizes equilibria at a point in time.

Proposition 3.1 (Symmetric Credit Market Equilibria (CME)). *Borrowing constraints arise if and only if the degree of contract enforceability is not too high:* $h < u_{t+1}\delta^{-1}$. *If this condition holds, credit and investment are*

$$b_t = [m_t - 1]w_t, \qquad I_t + s_t = m_t w_t, \qquad \text{with } \ m_t = \frac{1}{1 - u_{t+1}^{-1} h\delta}. \tag{3.7}$$

- *There always exists a 'safe' CME in which all firms only invest in the safe technology and a systemic crisis next period cannot occur:* $u_{t+1} = 1$.
- *There also exists a 'risky' CME in which* $u_{t+1} = u$ *and all firms only invest in the risky technology if and only if* $h > \underline{h}(u)$, *where* $\underline{h}(u)$ *is given by (3.17).*

This Proposition makes three key points. First, binding borrowing constraints arise in equilibrium only if contract enforceability problems are severe ($h < \bar{h}$). In this case a financial accelerator arises as investment is constrained by cash flow. Second, systemic risk eases, but does not eliminate, borrowing constraints and allows firms to invest more than under perfect hedging: the investment multiplier increases from $m^s = \frac{1}{1-h\delta}$ to $m^r = \frac{1}{1-u^{-1}h\delta}$. Third, systemic risk may arise endogenously only if bailout guarantees are present. Guarantees, however, are not enough. It is also necessary that a majority of agents coordinate in taking on risk, and that contract enforceability problems are not 'too severe' ($h > \underline{h}$).

The intuition behind these results is the following. Given that all other managers choose a *safe plan*, a manager knows that no bailout will be granted next period. Since the expected return of the safe technology is greater than that of the risky technology (i.e., $\sigma > u\theta$), she will choose a safe plan. Since the firm will not go bust in any state and lenders must break even, 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 accelerator: investment equals cash-flow times a multiplier ($s_t = m^s w_t$, where $m^s = (1 - h\delta)^{-1}$).

Notice that in a safe equilibrium borrowing constraints arise only if $h < 1 + r$. If h, the index of contract enforceability, were greater than the cost of capital, it would always be cheaper to repay debt rather than to divert. Thus, lenders would be willing to lend any amount.

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. Since lenders will get repaid in full in both states, the interest rate that allows lenders to break-even is again $1 + \rho_t = 1 + r$. It follows that the benefits of a risky 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 bailout agency 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 and u is not too low, expected profits under a risky plan exceed those under a safe plan: $u\pi^r_{t+1} > \pi^s_{t+1}$.

To sum up, systemic risk taking allows agents to exploit the subsidy implicit in the guarantees via a lower expected cost of capital. In the presence of borrowing constraints this subsidy allows firms to attain greater leverage and invest more. Importantly, this argument is not always valid. If h were too large, investment would be determined by investment opportunities not by cash-flow. Thus, systemic risk taking would not increase investment. If h were too small, taking on risk would not pay because the increase in leverage would be too small.

3.3. Long Run Growth

We have charged the dies 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 ($\theta u < \sigma$). Second, we have allowed crises to have large financial distress costs as cash-flow collapses in the wake of crisis and the aid payment (a_t) can be arbitrarily small. Since the technology is linear, this fall in cash-flow reduces the level of output permanently: crises have long-run effects.

Here we investigate whether, in the presence of borrowing constraints, systemic risk taking can be growth-enhancing by comparing two symmetric equilibria: safe and risky. In a safe(risky) equilibrium agents choose every period the safe(risky) plan characterized in Proposition 3.1. We ask whether average long-run 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 ($1-u_{t+1}$) has opposing effects on long-run growth. One the one hand, a greater $1-u_{t+1}$ increases investment and growth along the lucky no-crisis path by increasing the subsidy implicit in the guarantee and allowing firms to be more leveraged. On the other hand, a greater $1-u_{t+1}$ makes crises more frequent, which reduces average long-run growth. Therefore, to evaluate this trade-off we compare the long-run geometric means of growth rates in safe and risky equilibria: $E(1+g^{r,s}) = \lim_{T\to\infty}\left[E_t\left(\frac{q^{r,s}_{t+T}}{q^{r,s}_{t+1}}\right)\right]^{1/T}$.

In a safe symmetric equilibrium, crises never occur –i.e., $u_{t+1}=1$ during every period. Thus, cash flow dynamics are given by $w^s_{t+1} = [1-d]\pi^s$. Since equilibrium output and credit are proportional to cash flow, their long run mean growth rate is given by

$$1+g^s = [1-d][\sigma-h]m^s \qquad\qquad m^s = \frac{1}{1-h\delta} \tag{3.8}$$

Since firms face borrowing constraints, output growth is determined by cash-flow growth, which in turn is determined by the firms' profits ($\pi^s = [\sigma-h]m^s w_t$) and the payout rate d.

Consider now a risky symmetric equilibrium. Since firms use the risky technology during every period t, there is a probability u that they will be solvent at $t+1$ and their cash-flow will be $w^r_{t+1} = [1-d][\theta - u^{-1}h]m^r w_t$. However, with probability $1-u$ firms will be insolvent at $t+1$ and their cash flow will equal the aid payment from the bailout agency: $w^r_{t+1} = a_{t+1}$. To ensure that a_t is always lower than what cash-flow would have been had there no crisis occurred, we parametrize a_t as follows

$$a_t = \alpha(1-d)(\theta - u^{-1}h)m^r w_{t-1}, \qquad \alpha \in (0,1) \tag{3.9}$$

The smaller α, the greater the financial distress costs of crises. Since crises can occur in consecutive periods, the long-run mean growth rate is given by[22]

$$E(1+g^r) = (1+g^n)^u(1+g^c)^{1-u}, \qquad \begin{array}{ll} 1+g^n = [1-d][\theta - u^{-1}h]m^r & \\ 1+g^c = \alpha[1+g^n], & m^r = \frac{1}{1-u^{-1}h\delta} \end{array} \tag{3.10}$$

A comparison of long run growth rates in (3.8) and (3.10) allows us to determine the conditions under which systemic risk is growth enhancing. A shift from a safe to a risky equilibrium increases the likelihood of crisis from 0 to $1-u$. This shift results in greater leverage ($\frac{b_t^r}{w_t} - \frac{b_t^s}{w_t} = m^r - m^s$), which is good for growth. However, it also increases the frequency of crises and the associated collapse in credit and investment, which is bad for growth. The following proposition states the conditions under which the first effect dominates.

Proposition 3.2 (Long-run Growth). *Systemic risk arises in equilibrium and increases average long-run growth, for arbitrarily large financial distress costs ($\alpha < u^{\frac{1}{1-u}}$), if and only if contract enforceability problems are severe, but not too severe: $h^* \in (\underline{h}, u\delta^{-1})$, where h^* is uniquely defined by (3.18). Meanwhile, if $\alpha \geq u^{\frac{1}{1-u}}$, systemic risk is necessarily growth enhancing.*

This proposition makes two key points. First, systemic risk is growth enhancing even if crisis distress costs are arbitrarily large, provided the degree of contract enforceability is high enough. In this case the undertaking of systemic risk translates into a large increase in leverage. Second, when distress costs are large, there is a range for h in which systemic risk is individually optimal, but not growth-enhancing. This is because the threshold h^* is greater than the threshold $\underline{h}$ for the existence of a risky equilibrium in Proposition 3.1. This means that the leverage gains obtained by the firms are big enough to justify individual risk-taking, but not big enough to compensate for the long run growth costs of financial crises.

Figure 4 illustrates the limit distribution of output growth rates by plotting different output paths corresponding to different realizations of the stochastic process associated with the risky technology. This figure makes clear that greater long-run growth comes at the cost of occasional busts. We can see that over the long-run most of the risky paths outperform the safe path, except for a few unlucky risky paths. If we increased the number of paths, the cross section distribution would converge to the limit distribution. Figure 5 exhibits risky growth paths associated with different degrees of contract enforceability.

3.4. From Model to Data

The equilibrium of the model shows why in the presence of weak institutions there might be a positive link between systemic risk and growth, and it identifies the set of countries over which our mechanism is at work. As we have seen, it is not true that this link exists unconditionally in any country with weak institutions.

[22] Note that the long run growth rate we consider is equivalent to the mean of the limit distribution of the log growth rate: $\log(E(1+g^r)) = u\log(1+g^n) + (1-u)\log(1+g^c) = \lim_{T\to\infty} \frac{1}{T} E(\log(q_{t+T}) - \log(q_t))$.

First, the link does not exists if either institutions are *too weak* or if policies that permit risk-taking are absent. Let us consider each in turn.

There are two related, but distinct, aspects of the quality of institutions that determine the set of economies in which we should observe the link between systemic risk and growth. The first aspect has to do with the degree of contract enforceability h. On the one hand, recall from Proposition 3.1 that borrowing constraints arise in equilibrium only if contract enforceability problems are 'severe': $h < \bar{h}$. On the other hand, Proposition 3.2 shows that in borrowing constrained economies, systemic risk can arise and be growth enhancing only if $h > \underline{h}$. Thus, a positive link between systemic risk and long-run growth may exist only in the set of countries where contract enforceability problems are severe, but not too severe: $h \in (\underline{h}, \bar{h})$.

The second aspect of the quality of institutions that is key is how bailouts are granted. If institutions are *too weak* that a bailout is granted whenever there is an isolated default –because authorities cannot withstand the political or corruption pressures, the mechanism does not work. What is observed instead is a collusion between politically connected lenders and borrower to run and finance unproductive projects and extract taxpayer money through bailout guarantees.[23] Institutions must be sufficiently strong so that bailouts are granted only in case of a systemic crisis.

Consider next the policy environment. The moderately weak institution framework we have described above is not sufficient to generate systemic risk. Proposition 3.1 makes clear that it is necessary the presence of policies that liberalize financial markets and allow agents to take on systemic risk. The key for the risk-growth link is the combination of moderately weak institutions with financial liberalization.

Our argument has two empirical implications that underlie the country grouping criterion and the instrument selection in Section 2. First, on average we should observe a stronger link between systemic risk and higher long-run growth in countries with a middle degree of institutional quality and contract enforceability (MECs) than in other groups of countries. Second, this link should be stronger in the set of financially liberalized countries.

Skewness and Growth

Next, we explain why a negatively skewed growth distribution identifies economies that have undertaken growth-enhancing systemic risk. In a risky equilibrium firms face endogenous borrowing constraints, and so credit is constrained by cash flow. Since along the lucky path –in which no crises occur– cash flow accumulates gradually, credit can grow fast but only *gradually.* In contrast, when a crisis erupts there are widespread bankruptcies and cash flow collapses. Thus, credit and output growth fall abruptly. The upshot is that in a risky equilibrium the growth rate can take on two values: low in the crisis state (g^c), or high in the lucky no crisis state (g^n).

[23] This phenonenon has been described by Faccio (2004) and Khawaja and Mian (2004).

Empirically, financial crises are rare events. In terms of our model, this fact means that the probability of the bad state $1-u$ is rather small, and in particular less than a half. This implies that the low growth rate realizations (g^c) are farther away from the mean than the high realizations (g^n). Thus, in a long enough sample, the distribution of growth rates is characterized by negative outliers and so it is negatively skewed. In contrast, in the safe equilibrium there is no skewness because the growth rate takes only one value.[24]

Combining these observations with Proposition 3.2 it follows that the limit distributions of output and credit growth rates have a higher mean if and only if they are negatively skewed. In a finite sample, whether systemic risk has been reflected in crises is an empirical question that the regressions in Section 2 address.

In our model, growth rates exhibit more variance in the risky equilibrium than in the safe one. Empirically, however, the variance is not a good instrument for identifying economies that have followed growth-enhancing risky credit paths that lead to infrequent crises. This is because higher variance of credit and output growth may also reflect shocks that are not *rare, abrupt and asymmetric*. In our setup, greater mean output growth is *not* associated with *higher variance* generated by frequent or asymmetric shocks.

In sum, in order to uncover the link between systemic risk and growth, it is essential to distinguish booms punctuated by rare abrupt busts from other up-and-down pattern that are more frequent or symmetric. Both lead to higher variance, but only the former leads to negative skewness. This is why the empirical part of the paper uses the skewness of credit growth and not the variance.

3.5. Financing of the Guarantees

The existence of systemic risk and the resultant higher mean growth depend on systemic guarantees, which are funded domestically via lump-sum taxes on consumers. The funding of the guarantees can be interpreted as a *redistribution* from the financially unconstrained to the constrained agents in the economy. On the one hand, consumers benefit from the guarantees because higher mean growth means higher dividend growth. On the other hand, consumers bear the fiscal costs associated with the risk taking that permits constrained agents to exploit the subsidy implicit in the guarantees.

Here, we ask whether the expected value of the dividend stream net of taxes is greater in a risky than in a safe equilibrium. Notice that our setup is biased against finding such a gain. There are 100% bankruptcy costs, there is no externality associated with higher investment, and the risky technology is restricted to have a lower expected return than the safe technology. This means that all the gains from risk taking come from the ability to attain greater leverage.

To simplify notation we set, without loss of generality, the interest rate r to zero. Thus, the expected

[24] In our setup two crises can occur in consecutive periods. However, if a crisis is followed by a recovery during which systemic risk and another crisis can not happen (as in RTW(2003)), then no-crisis times will be more frequent that crisis times. Thus, an abrupt downward jump in credit during a crisis will suffice to generate negative skewness in the credit growth distribution.

present value of the representative consumer's net income is

$$Y = E_0 \sum_{j=0}^{\infty} [d_j - \tau_j], \tag{3.11}$$

where the dividend d_j equals $[d - e]\pi_j$ in no-crisis times and zero otherwise, and the sequence of taxes $\{\tau_j\}$ satisfies the bailout agency's break-even constraint (3.4). In a safe equilibrium taxes are always zero because insolvencies never occur. Since during every period $t \geq 1$ profits are $\pi_j^s = [\sigma - h]m^s w_{j-1}$ and initially $d_0 = [d - e]w_{-1}$ and $w_0 = [1 - d]w_{-1}$, (3.11) becomes

$$Y^s = \sum\nolimits_{j=0}^{\infty} [d - e]w_{j-1} = \frac{d - e}{1 - \gamma^s} w_{-1}, \qquad \gamma^s = [1 - d][\sigma - h]m^s \tag{3.12}$$

Consider next the risky equilibrium. When a crisis erupts the bailout agency pays lenders the debt they were promised (b_{j-1}) and gives firms a small amount of seed money (a_j). Since the bailout agency needs to break-even, the expected present value of the taxpayer's net income is

$$\begin{aligned} Y^r &= E_0 \sum_{j=0}^{\infty} \big\{[d - e]\pi_j^r \xi_j - [b_{j-1} + \mu w_{j-1}][1 - \xi_j]\big\} \qquad (3.13) \\ &= \frac{d - e[1 - (1 - u)\alpha\gamma^n] - [1 - u][\alpha\gamma^n + (m^r - 1)(1 - d)]}{1 - \gamma^r} w_{-1}, \qquad \begin{aligned} \gamma^n &:= (1 - d)(\theta - u^{-1}h)m^r \\ \gamma^r &:= [u + (1 - u)\alpha]\gamma^n \end{aligned} \end{aligned}$$

where $\xi_j = 0$ if there is a crisis at time j. The sequence of taxes in (3.13) is feasible because consumers have access to complete financial markets.

During the typical period, the taxpayer receives a dividend and pays taxes to finance the expected value of the bailout cost, which has two components: (i) the seed money given to firms $a_t = \alpha\gamma^n w_{t-1}$; and (ii) the debt that has to be repaid to lenders, which equals the leverage times the reinvestment rate $\frac{b_{t-1}}{w_{t-1}} \frac{w_{t-1}}{\pi_{t-1}} w_{t-1} = (m^r - 1)(1 - d)w_{t-1}$.[25]

The next proposition compares the gains and losses involved in shifting from a safe to a risky economy. It states that if enforceability problems are not too severe, the fiscal costs of crises are outweighed by the benefits of greater investment and growth derived from the fact that the funding of the guarantees allows credit constrained agents to attain greater leverage.

Proposition 3.3 (Financing of the Guarantees). *If the manager's payout rate e is small enough, there exists a unique threshold h^{**} for the degree of contract enforceability, such that the expected present value of taxpayers' net income is greater in a risky economy than in a safe one for any aid policy $\alpha \in (0, 1)$.*

[25] The term $-e[1 - (1 - u)\alpha g^n]$ reflects the fact that during no crisis times the old manager gets a share e of profits, while in a crisis she gets nothing. This is as if, with probability $1 - u$, the owner does not pay her $e\alpha g^n w_{t-1} = e\mu w_{t-1}$.

The simplicity of Proposition 3.3 is surprising. In particular, it holds without imposing any restrictions on the aid rate α. This neutrality with respect α is due to the fact that a higher aid payment reduces taxpayers' net income in a given period, but it increases investment and hence the growth rate of dividends received by taxpayers.

To get further insight let the manager's share e tend to zero, and rewrite (3.12) and (3.13) as follows

$$\begin{aligned} Y^s - w_{-1} &= (1-d)(\sigma-1)\frac{m^s w_{-1}}{1-\gamma^s} = (1-d)(\sigma-1)\sum_{t=0}^{\infty} s_t \\ Y^r - w_{-1} &= (1-d)(u\theta-1)\frac{m^r w_{-1}}{1-\gamma^r} = (1-d)(u\theta-1)E_0\sum_{t=0}^{\infty} I_t \end{aligned}$$

The second equality follows by noticing that investment is $s_t(I_t) = m^{s(r)}w_t$ and cash flow evolves according to $w_t = \gamma^s w_{t-1}$.

We can interpret $Y^s - w_{-1} = \frac{R^s}{1-\gamma^s}w_{-1}$ as the expected excess return, on the representative taxpayer's equity, from a firm that operates in a safe economy. This excess return has a static component $R^s = (1-d)(\sigma-1)m^s$ and a dynamic one $\frac{1}{1-\gamma^{s(r)}}$. The same interpretation applies to $Y^r - w_{-1}$. The key insight that underlies Proposition 3.3 is that whether the financing of the guarantees increases taxpayers' net income depends only on the condition $\frac{R^r}{R^s} - \frac{1-\gamma^r}{1-\gamma^s} > 0$. Since we have imposed the condition that $u\theta < \sigma$, the rate of return per unit invested is greater in a safe economy. However, if h is sufficiently high, the risky economy dominates because leverage and the growth rate are higher than in the the safe economy: $m^r > m^s$ and $\gamma^r > \gamma^s$.

The key trade-off is the following. Projects have a higher rate of return in a safe economy that in a risky one ($u\theta < \sigma$), but the scale is smaller ($m^s < m^r$). In a risky economy, the subsidy implicit in the guarantees attracts projects with a lower return but permits greater scale by relaxing borrowing constraints. This relaxation of the financial bottleneck is dynamically propagated and if h is high enough, but lower than $\bar{h} = u$, then $Y^r > Y^s$.

Notice that Proposition 3.3 implies that in the absence of a mechanism to relax borrowing constraints, bailout guarantees are unambiguously bad. This occurs if either if h is too high, so that borrowing constraints do not arise, or if h is too low, so that there is no significant increase in leverage.

Notice that the cost of bailing out lenders does not appear in Y^r. This is because the social cost of borrowing is identical in safe and risky economies. In the former, the firm pays 100% of the debt costs. By contrast, in a risky economy the firms cover a share u of the debt costs, while the taxpayers cover the remaining share.

Is risk taking necessarily socially efficient whenever it is individually optimal? The answer depends on the the degree of contract enforceability h and the aid policy α as stated in the next corollary.

Corollary 3.4. *If α is small, the threshold h^{**} is greater than the threshold $\underline{h}$ beyond which risk taking is individually optimal. In this case risk-taking is individually optimal but socially inefficient if $h \in (\underline{h}, h^{**})$.*

Finally, Proposition 3.3 implies that the bailout scheme is implementable in the sense that taxpayers will be willing to foot the bill associated with guarantees. It also implies that, in our model economy, higher average growth translates into higher social welfare. Since the representative consumer has access to complete financial markets, he can perfectly smooth the cost of the guarantees. Thus, we can measure their ex-ante welfare with the expected discounted sum of their consumption: $E_0 \sum_{j=0}^{\infty} c_j = E_0 \sum_{j=0}^{\infty} [d_j - \tau_j]$. It then follows from Proposition 3.3 that consumers' ex-ante welfare is greater in a risky than in a safe economy. How about managers? Since they are risk neutral, all manager cohorts are ex-ante better-off in a risky economy as they do not pay taxes and receive an implicit subsidy via the ability to attain higher leverage.[26]

[26] Notice that some cohorts born during crises times might be worse off because they would attain lower leverage that what they would have attained in a safe economy.

Appendix:

Proof of Proposition 3.1. We will compare the payoffs of a safe plan ($I_t = 0$) and a risky plan ($s_t = 0$). In a safe plan with no-diversion the firm will be solvent in both states. Thus, the entrepreneur offers $1+\rho_t = 1+r$, and the no-diversion condition is $b_t(1+r) \le h(w_t + b_t)$. It follows that $s_t = m^s w_t$ and $b_t = [m^s - 1]w_t$, with $m^s = \frac{1}{1-h\delta}$.

In a risky plan with no-diversion the firm will be solvent only in the good state. Thus, the interest rate must satisfy $u(1+\rho_t)b_t + (1-u_{t+1})(1+\rho_t)b_t = (1+r)$. If a bailout is expected ($u_{t+1} = u$), then $1+\rho_t = 1+r$ and the no-diversion condition is $ub_t(1+r) \le h(w_t + b_t)$. It follows that $I_t = m^r w_t$ and $b_t = [m^r - 1]w_t$, with $m^r = \frac{1}{1-h\delta u^{-1}}$. If no bailout is expected ($u_{t+1} = 1$), then $1+\rho_t = u^{-1}(1+r)$ and the no-diversion condition is $ub_t(1+r) \le h(w_t + b_t)$. It follows that expected payoffs are

$$\pi^s_{t+1} = [\sigma - h]m^s; \qquad E_t(\pi^r_{t+1}|BG) = [\theta u - h]m^r, \qquad E_t(\pi^r_{t+1}|\text{no } BG) = [\theta u - h]m^s \tag{3.14}$$

If all other entrepreneurs choose the safe plan, no bailout is expected. Since $\theta u < \sigma$, it follows that $[\theta u - h]m^s < [\sigma - h]m^s$. Thus, the entrepreneur will strictly prefer the safe plan. Hence, there always exists a safe symmetric equilibrium. If all other entrepreneurs choose the risky plan, a bailout is expected in the bad state. Thus, an entrepreneur will strictly prefer a risky plan if and only if $[\theta u - h]m^r > [\sigma - h]m^s$,

$$0 \le Z(h) := E_t(\pi^r_{t+1}|BG) - \pi^s_{t+1} = \frac{\theta u - h}{1 - h\delta u^{-1}} - \frac{\sigma - h}{1 - h\delta} \tag{3.15}$$

To show that a risky symmetric equilibrium exists if and only if h is large enough (but smaller than $u\delta^{-1}$) notice that (3.15) is equivalent to

$$Z(h) = -h^2\delta(1-u) + h\delta(\sigma - \theta u^2) - u(\sigma - \theta u) > 0 \tag{3.16}$$

The function $Z(h)$ has three properties: (i)$\frac{\partial Z}{\partial h} > 0 \Leftrightarrow h < \frac{\sigma - \theta u^2}{2(1-u)}$; (ii)$Z(0,u) < 0$; and (iii)$Z(u\delta^{-1}, u) > 0$ because $\theta > \delta^{-1}$. It follows that there is a unique $\underline{h}$ such that $E_t(\pi^r_{t+1}) > \pi^s_{t+1}$ for all $h \in (\underline{h}, u\delta^{-1})$ where

$$\underline{h} = \frac{\sigma - \theta u^2}{2(1-u)} - \frac{\left[(\sigma - \theta u^2)^2 - 4u\delta^{-1}(1-u)(\sigma - \theta u)\right]^{1/2}}{2(1-u)} < u\delta^{-1} \tag{3.17}$$

Proof of Proposition 3.2. It follows from (3.12) and (3.13) that the mean long run growth rate is greater in the risky equilibrium (RSE) than in the safe one (SSE) if and only if $(1+\gamma^n)^u(1+\gamma^c)^{1-u} > 1 + \gamma^s$. If we parametrize the financial distress cost $\mu = \alpha \cdot (1-d)(\theta - u^{-1}h)m^r$, we have that $1 + g^c = \alpha(1 + g^n)$. Thus, the preceding condition becomes $(1+g^n)\alpha^{1-u} > 1+g^s$, which is equivalent to

$$\Gamma := E(1+g^r) - (1+g^s) = \left[\alpha^{1-u}\frac{u\theta - h}{u - h\delta} - \frac{\sigma - h}{1 - h\delta}\right][1-d] > 0 \tag{3.18}$$

Proposition 3.1 shows that an RSE exists iff $h > \underline{h}$,where $\underline{h}$ is the unique solution of (3.16), over $(0, u\delta^{-1})$. Comparing risk taking condition (3.15) with the growth condition (3.18), we have that

$$\Gamma > 0 \Leftrightarrow \frac{\alpha^{1-u}}{u}E\pi^r > \pi^s \qquad \text{and} \qquad h > \underline{h} \Leftrightarrow E\pi^r > \pi^s$$

If $\frac{\alpha^{1-u}}{u} \geq 1$, then $\Gamma > 0$ for any $h \in (\underline{h}, u)$. In the alternative case $\frac{\alpha^{1-u}}{u} < 1$ notice that $\lim_{h \to u\delta^{-1}} \frac{u\theta - h}{u - h\delta} = \infty$. Since $\frac{\sigma - u}{1 - u\delta}$ is bounded for any $u < 1$, there exists an $h' < u$ such that $\Gamma > 0$ for all $h > h'$. To show that this threshold h' is unique notice that $\Gamma > 0$ is equivalent to

$$L(h) = -h^2\delta(1 - \alpha^{1-u}) + h(u + \sigma\delta - \alpha^{1-u}(u\theta\delta + 1)) + u\theta\alpha^{1-u} - u\sigma > 0$$

Observe that $L(0) < 0$, $\lim_{h \to u\delta^{-1}} L(h) > 0$ and $L(h)$ is a second order concave polynomial. Thus, $L(h)$ has one and only one root in $(0, u\delta^{-1})$, which we denote by h^*. Finally, to show that $h^* > \underline{h}$ notice that since $\underline{h}$ equalizes $E\pi^r$ and π^s, it follows that $\Gamma(\underline{h}) < 0$, or equivalently $L(\underline{h}) < 0$. Since $L(h)$ is a second order concave polynomial that is strictly negative at $h = 0$ and strictly positive at $h = u\delta^{-1}$, it has the property that $L(h) < 0 \Rightarrow \frac{\partial L}{\partial h} > 0$. Hence, $L(\underline{h}) < 0$ implies that $h^* > \underline{h}$.

Proof of Proposition 3.3. We start by deriving Y^r. Without loss of generality consider a tax sequence in which, during each period, taxes equal the bailout payments. It then follows that the representative consumer's net income in crisis and no-crisis times (y_t^c and y_t^n) are, respectively

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

In order to compute $Y^r = E_0 \sum_{t=0}^{\infty} y_t$ in closed form we consider the process $\frac{y_{t+1}}{y_t}$. This process follows a four-state Markov chain with transition matrix Φ

$$\Delta = \begin{pmatrix} \delta^{nn} := \frac{y_{t+1}^n}{y_t^n} = (1-d)(\theta - \frac{h}{u})m^r \ := \gamma^n \\ \delta^{nc} := \frac{y_{t+1}^c}{y_t^n} = -[\alpha\gamma^n + m^r - 1]\frac{1-d}{d-e} \\ \delta^{cn} := \frac{y_{t+1}^n}{y_t^c} = -\gamma^n\left[1 + \frac{m^r - 1}{\alpha\gamma^n}\right]^{-1}\frac{d-e}{1-d} \\ \delta^{cc} := \frac{y_{t+1}^c}{y_t^c} = \alpha\gamma^n \end{pmatrix}, \qquad \Phi = \begin{pmatrix} u & 1-u & 0 & 0 \\ 0 & 0 & 1-u & u \\ 0 & 0 & 1-u & u \\ u & 1-u & 0 & 0 \end{pmatrix} \tag{3.19}$$

To obtain (3.19) note that if there is no crisis at t, $\frac{w_t}{w_{t-1}} = \gamma^n$, while if there is a crisis at t, $\frac{w_t}{w_{t-1}} = \alpha\gamma^n$. We will obtain Y^r by solving the following recursion

$$\begin{aligned} V(y_0, \delta_0) &= E_0 \sum\nolimits_{t=0}^{\infty} y_t = y_0 + E_0 V(y_1, \delta_1) \\ V(y_t, \delta_t) &= y_t + E_t V(y_{t+1}, \delta_{t+1}) \end{aligned} \tag{3.20}$$

Since the system is linear consider the following guess: $V(y_t, \delta_t) = y_t v(\delta_t)$, with $v(\delta_t)$ an undetermined coefficient. Substituting this guess into (3.20) and dividing by y_t, we get $v(\delta_t) = 1 + \delta E_t(\delta_{t+1} v(\delta_{t+1}))$. Combining this condition with (3.19), it follows that $v(\delta_{t+1})$ satisfies

$$\begin{pmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \end{pmatrix} = \begin{pmatrix} 1 \\ 1 \\ 1 \\ 1 \end{pmatrix} + \begin{pmatrix} u & 1-u & 0 & 0 \\ 0 & 0 & 1-u & u \\ 0 & 0 & 1-u & u \\ u & 1-u & 0 & 0 \end{pmatrix} \begin{pmatrix} \delta^n v_1 \\ \delta^{nc} v_2 \\ \delta^c v_3 \\ \delta^{cn} v_4 \end{pmatrix}$$

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

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

To derive the second equation substitute $\delta^{cn}\delta^{nc} = \alpha(\gamma^n)^2$ and $\delta^c - \delta^{nc} = \frac{1}{d-e}[(1-e)\alpha\gamma^n + (m^r - 1)(1-d)]$. This solution exists and is unique provided $1 - u\gamma^n - (1-u)\alpha\gamma^n > 0$. We can always ensure that this condition holds by setting d large enough.

Notice that since there cannot be a crisis at $t = 0$, the state at $t = 0$ is v_1. Therefore, $V(y_0, \delta_0) = v_1 y_0^n$. Substituting $y_0^n = dw_{-1}$ and simplifying the denominator of v_1 we get (3.13). To determine the threshold h^{**} set $e = 0$ and rewrite (3.12) and (3.13) as follows

$$\begin{aligned} Y^s &= 1 + \frac{(1-d)(\sigma - 1)}{1 - h - (1-d)(\sigma - h)} \\ Y^r &= 1 + \frac{(1-d)(u\theta - 1)}{1 - u^{-1}h - (1-d)(\theta - u^{-1}h)U}, \qquad U := u + \alpha(1-u) \end{aligned}$$

There exists an upper bound h', such that $\lim_{h \to h'} Y^r(h) = \infty$

$$h' = \frac{1 - (1-d)U\theta}{1 - (1-d)U} \cdot u$$

Notice that: (i) $Y^s(h') < \infty$; (ii) $h' < u$, so borrowing constraints arise for any $h < h'$; (ii) $h' > \underline{h}$, so a risky equilibrium exists in a neighborhood of h'. Next, notice that Y^r and Y^s are strictly increasing in h and there exist a unique threshold $h'' < h'$ such that $Y^r \geq (<) Y^s$ iff $h \geq (<) h''$

$$h'' = \frac{(1-\theta(1-d)U)(\sigma-1)-(1-\sigma(1-d))(u\theta-1)}{-d(u\theta-1)-u^{-1}((1-d)U-1)(\sigma-1)}$$

Since a RSE exists for all $h \in (\underline{h}, u)$, by Proposition 3.1, and $Y^r > Y^s$ iff $h > h''$, it follows that Proposition 3.3 holds if we set $h^* > \max\{h'', \underline{h}\}$. Next, we prove that $h'' > \underline{h}$.

Proof of Corollary (3.4). Rewrite the excess returns ratio as

$$\frac{Y^r - w_0}{Y^s - w_0} = k(h)\frac{E\pi_r}{\pi_s}\frac{1-(1-d)\pi_s}{1-(1-d)E\pi_r}, \tag{3.21}$$

where $k(h) = \frac{u\theta-1}{u\theta-h}\frac{\sigma-h}{\sigma-1}$. Notice that $u\theta > 1 \Leftrightarrow k(h) < 1$ and recall that $h = \underline{h} \Leftrightarrow \frac{E\pi_r}{\pi_s} = 1$. Therefore, (3.21) implies that if $h = \underline{h}$, risk-taking translates into a social loss. Since $Y^r - Y^s$ is increasing in h, it follows that $\underline{h} < h^{**}$. That is, the treshold level for efficiency gains ($Y^r > Y^s$) is above the treshold for optimal risk-taking ($\frac{E\pi_r}{\pi_s} > 1$).

Panel GMM Methodology

In the panel GMM regression we are interested in estimating the following equation:

$$y_{i,t} - y_{i,t-1} = (\alpha - 1) y_{i,t-1} + \beta' CV_{i,t} + \gamma CE_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \tag{3.22}$$

where y is the logarithm of real per capita GDP, CV is the set of control variables other than initial income, $CE_{i,t}$ are the moments of credit expansion, μ_t is the time-specific effect, η_i is the country-specific effect, and ε is the error term.

The estimation of equation (3.22) poses some challenges. The first, is the presence of time and country specific effects. Time effects can be accounted for by including period-specific dummies, however, the common methods to account for individual effects (within or difference estimators) are not valid since the resulting error term is correlated with initial income. The second problem is the likely joint endogeneity of most explanatory variables and economic growth. Simultaneous or reverse causation can generate biases in the estimates of the contribution of moments of credit expansion to growth.

We use the Generalized-Method-of-Moments (GMM) estimators developed for dynamic models of panel data, introduced by Holtz-Eakin, Newey, and Rosen (1988), Arellano and Bond (1991), and Arellano and Bover (1995). Taking advantage of the panel nature of the data, these estimators are based on, first, differencing regressions and/or instruments to control for unobserved effects, and, second, using previous observations of the explanatory variables in levels as instruments (called "internal" instruments). After accounting for the time-specific effects and grouping all explanatory variables in a vector X, equation (3.22) can be rewritten as follows:

$$y_{i,t} = \alpha y_{i,t-1} + \beta' X_{i,t} + \eta_i + \varepsilon_{i,t} \tag{3.23}$$

In order to eliminate the country-specific effect, we take first-differences of equation (3.23):

$$y_{i,t} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + \varepsilon_{i,t} - \varepsilon_{i,t-1} \tag{3.24}$$

The use of instruments must deal with the two challenges of the estimation: (i) the likely endogeneity of the explanatory variables, and (ii) the problem that, by construction, the new error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$, is correlated with the lagged dependent variable, $y_{i,t-1} - y_{i,t-2}$. Taking advantage of the panel nature of the data set, the instruments consist of previous observations of the explanatory and lagged dependent variables. Given that the estimation uses past values of the regressors, the estimation procedure is valid only under the assumption of weak exogeneity of explanatory variables, that is they can be correlated with current and past realizations of the growth rate, but they are assumed to be uncorrelated with future realizations of the error term.[27]

Under the assumptions that (a) the error term, ε, is not serially correlated, and (b) the explanatory variables,X, are weakly exogenous, the GMM dynamic panel estimator uses the following moment conditions:

$$E[y_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2, t = 3, ..., T \tag{3.25}$$

$$E[X_{i,t-s} \cdot (\varepsilon_{i,t} - \varepsilon_{i,t-1})] = 0 \text{ for } s \geq 2, t = 3, ..., T \tag{3.26}$$

The GMM estimator based on these conditions is known as the difference estimator. As shown by Alonso-Borrego and Arellano (1999) and Blundell and Bond (1998) when the explanatory variables are persistent over time, the use of lagged levels of these, make weak instruments for the equations in differences. Arellano and Bover (1995) and Blundell and Bond (1997) propose an estimator that reduces potential biases and imprecision associated with the difference estimator. This new estimator combines in a system the regression in differences with the regression in levels. The instruments for the regression in differences are the same as above. The instruments for the regression in levels are the lagged differences of the corresponding variables. These lagged differences are valid instruments under the additional assumption of no correlation between the change in the explanatory variables and the country-specific effect (which does not rule out the possibility of correlation between the level of these variables and the country-specific effect) :

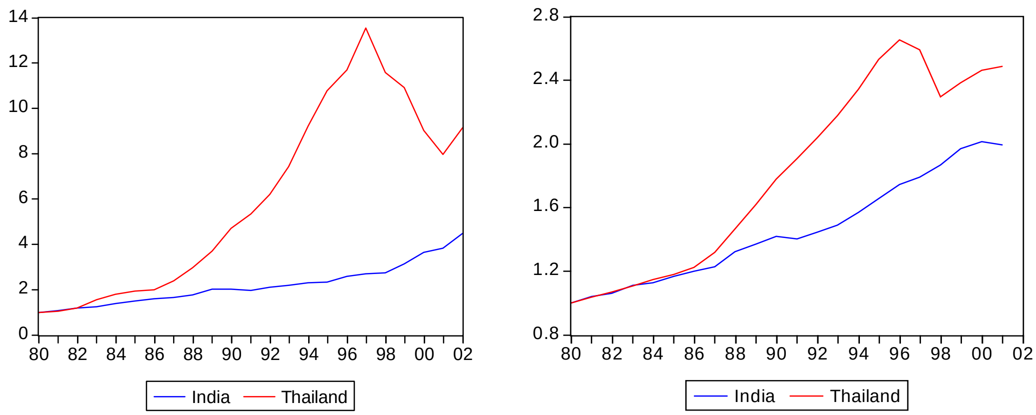
[27] As Levine et.al.(2000) mention, the assumption of weak exogeneity does not imply that expectations of future growth do not have an effect on current moments of credit expansion, but only that unanticipated future shocks to economic growth do not influence financial development.

$$
\begin{aligned}
E[(y_{i,t-1} - y_{i,t-2}) \cdot (\eta_i + \varepsilon_{i,t})] &= 0 & (3.27)\\
E[(X_{i,t-1} - X_{i,t-2}) \cdot (\eta_i + \varepsilon_{i,t})] &= 0 & (3.28)
\end{aligned}
$$

The consistency of the GMM estimators depends on whether lagged values of the explanatory variables are valid instruments in the growth regression. The Sargan test of over-identifying restrictions, which tests the overall validity of the instruments. Failure to reject the null hypothesis gives support to the model.

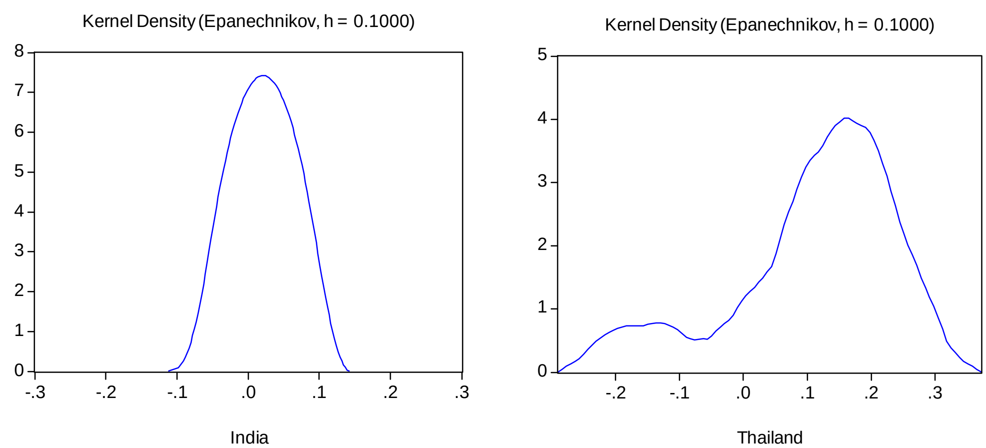
Figure 1: Safe vs. risky growth path: a comparison of India and Thailand

Real Credit: GDP per capita:



Note: The values for 1980 are normalized to one.

Figure 2: Distributions and Kernel Densities of Real Credit Growth



	India	Thailand
Mean	0.021	0.109
Std. Dev.	0.014	0.125
Skewness	-0.370	-1.108

Note: the moments of real credit growth are computed using the quarterly data from 1980:1 to 2002:1.

Figure 3a: Growth residuals vs. mean of credit growth

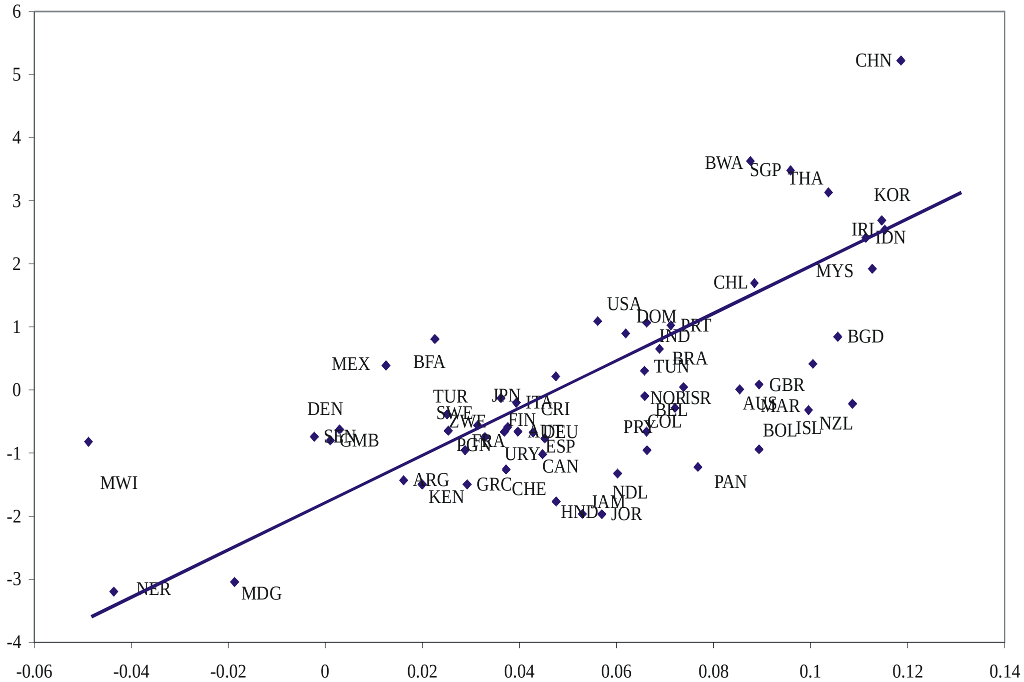


Figure 3b: Growth residuals vs. variance of credit growth

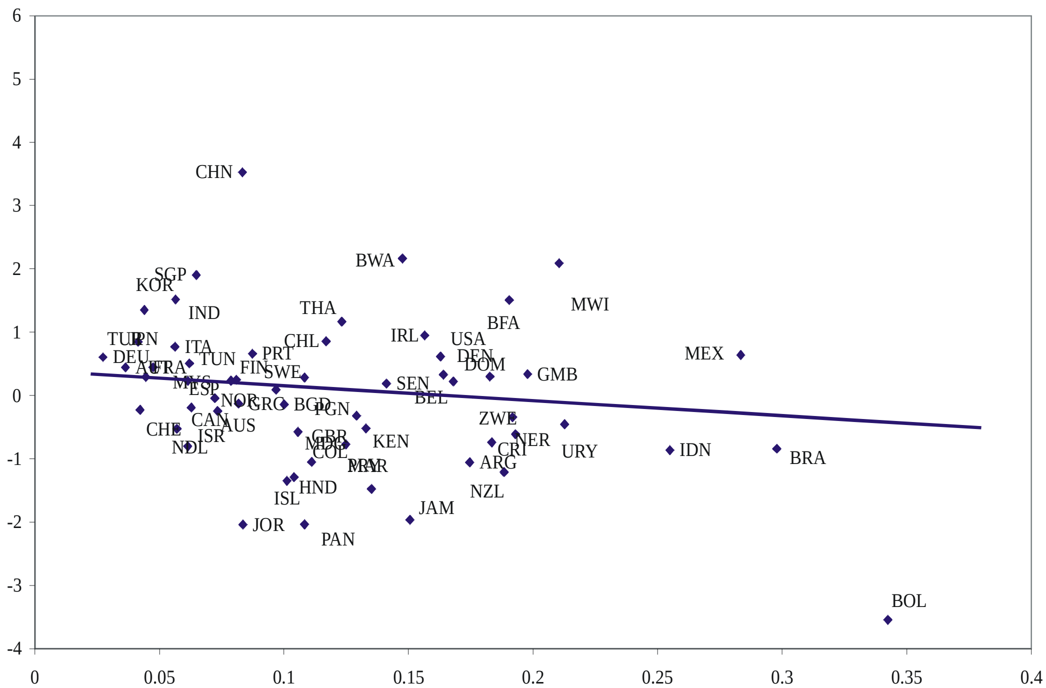
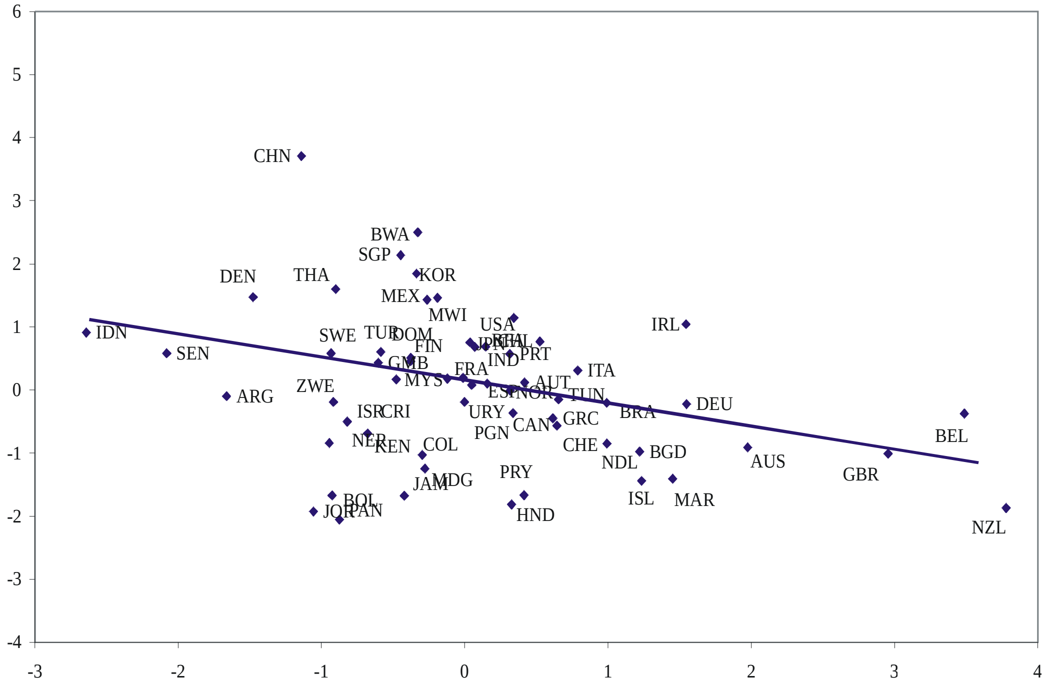
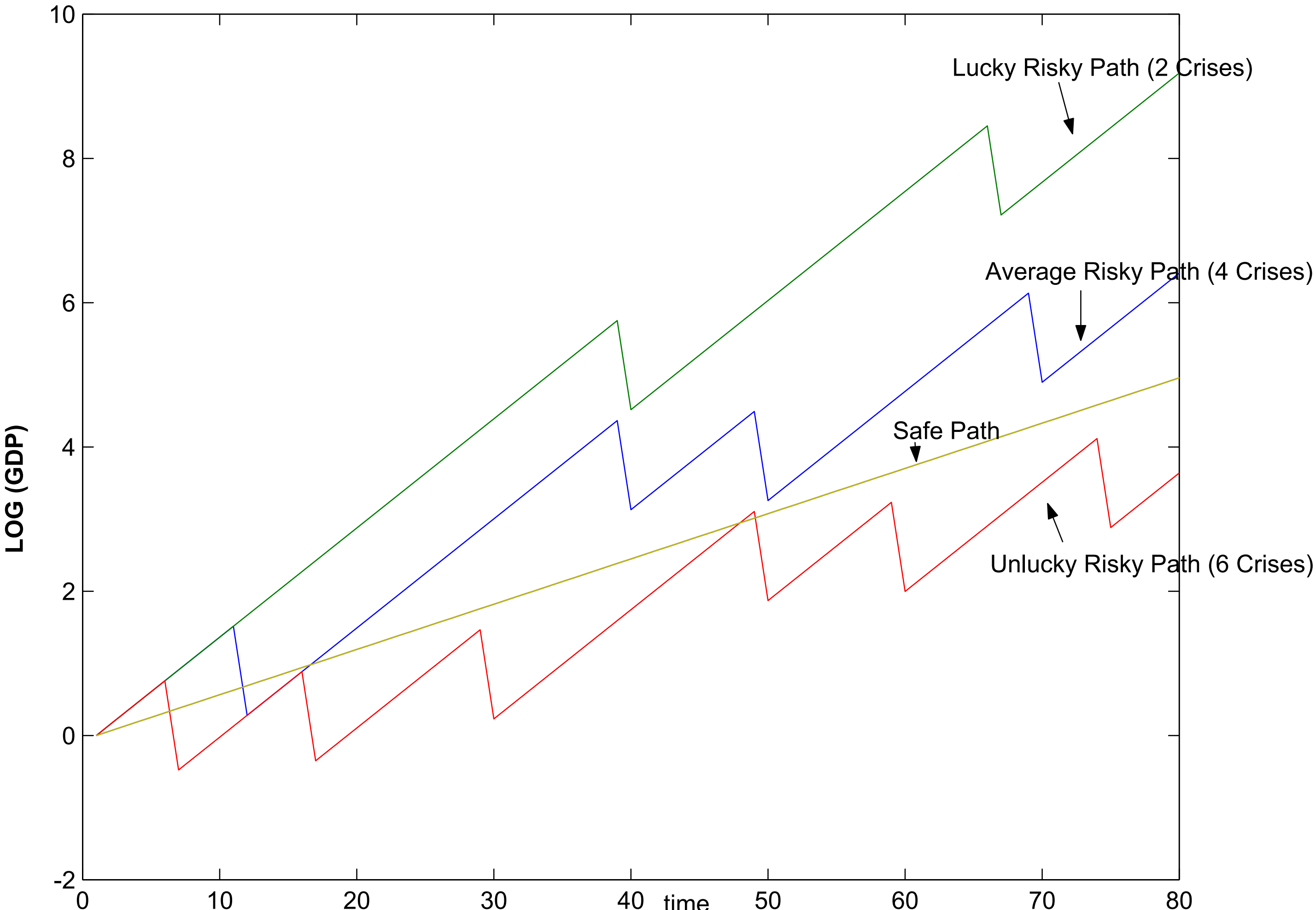


Figure 3c: Growth residuals vs. skewness of credit growth



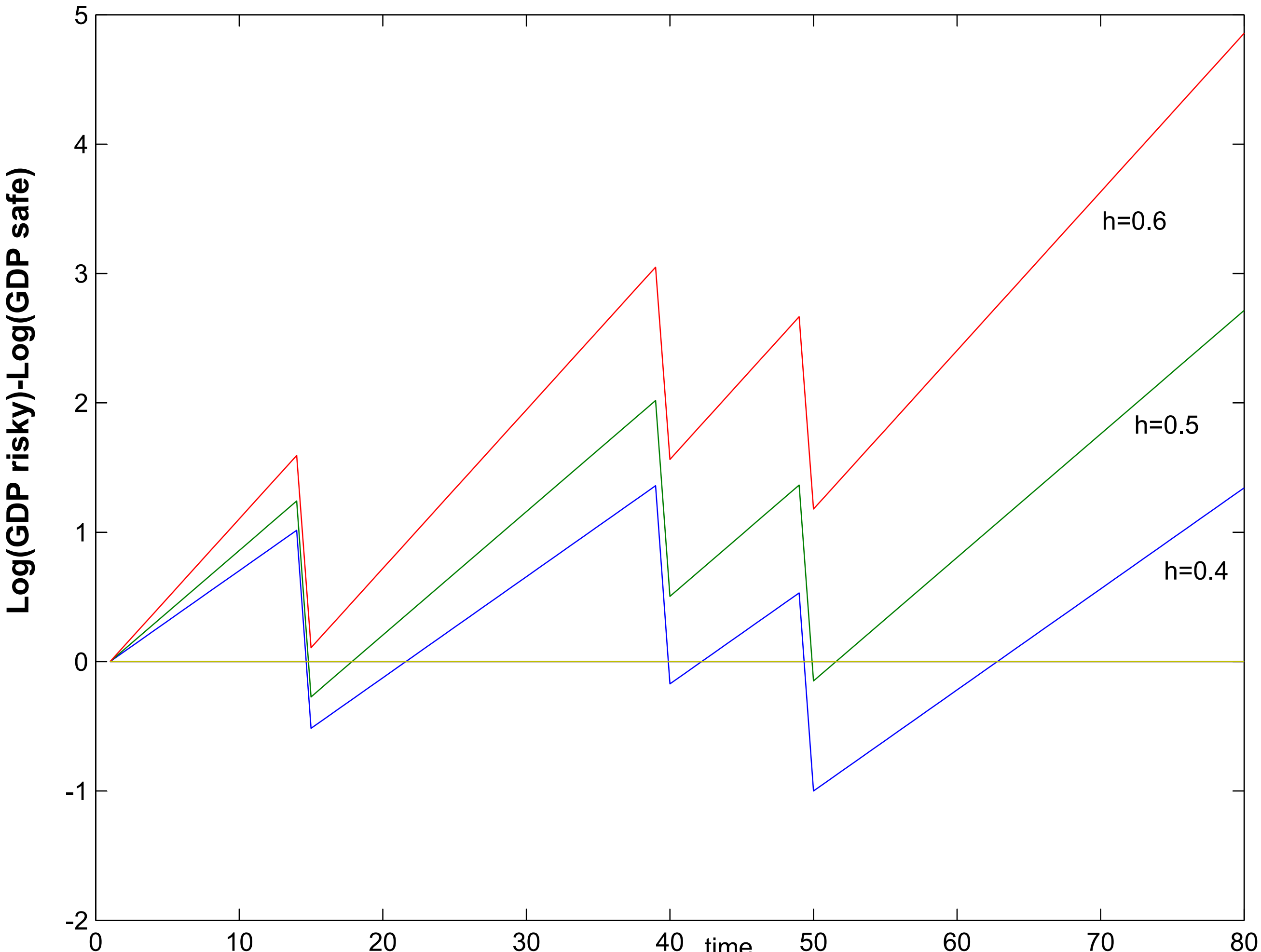
Note: The vertical axis in each graph shows the residuals of the cross section regression, given in Table 3, leaving out the mean, variance and skewness of real credit growth, respectively. The horizontal axis shows the three moments of real credit growth.

Figure 4:GDP Limit Distribution



parameters: theta=1.25 (Risky High Return), sigma=1.2 (Safe Return), h=0.55 (contract enforceability)
1-u=0.05 (Crisis Probability), d=0.2 (Dividend Rate), 1-alpha=75% (Financial Distress Costs), r =0.075 (world risk-free rate)

Figure 5 :Risky GDP Growth v.s. Safe GDP Growth: the Role of Contract Enforceability



parameters: theta=1.25 (Risky High Return), sigma=1.2 (Safe Return), 1-u=0.05 (Crisis Probability) d=0.2 (Dividend Rate)
1-alpha=75% (Financial Distress Costs) r=0.075 (Word Risk Free Rate)

Table 1: Skewness and Growth

Dependent variable: Real per capita GDP growth

	(1) [a]	(2) [b]	(3) [c]
	Cross section (Least Squares)	Panel (Least Squares)	Panel (GMM)
Initial per capita GDP	-0.463	-0.263**	-0.157
	(0.356)	(0.122)	(0.172)
Secondary schooling	0.020	0.020**	0.139**
	(0.020)	(0.006)	(0.274)
Credit growth, mean	0.161**	0.178**	0.147**
	(0.049)	(0.010)	(0.017)
Credit growth, variance	-0.045**	-0.044**	-0.064**
	(0.023)	(0.0089	(0.007)
Credit growth, skewness	-0.406**	-0.302**	-0.204**
	(0.194)	(0.052)	(0.084)
# of observations	57	114	114

a) Regression 1 is estimated by OLS. Standard errors are reported in parentheses (in all regressions in this table)
b) Regression 2 is estimated by GLS from a panel of non-overlapping 10 year windows.
c) Regression 3 is a panel regression with non-overlapping 10 year windows using the GMM System Estimator
** denotes significance at 5% level

Table 2: Moments of Credit Growth for different country groups:

	HECs	MECs	LECs
Mean	0.031	0.077	0.042
Std. Dev.	0.091	0.145	0.174
Skewness	0.526	-1.441	-0.677

Note: HEC's, MEC's and LEC's denote high, low and middle enforceability of contracts, respectively. The entries in the table are computed using country-years within each group.

Table 3: Different Country Groups

Dependent variable: Real per capita GDP growth

	(1) MEC vs. HEC and LEC (Definition 1)	(2) MEC vs. HEC and LEC (Definition 2)	(3) MEC only	(4) All (including WAR/TOT)	(5) All (including WAR/TOT)	(6) Lib. vs. No Lib
Initial per capita GDP	0.031	0.005	-0.550**	-0.191**	-0.395**	-0.625**
	(0.118)	(0.114)	(0.330)	(0.081)	(0.088)	(0.100)
Secondary schooling	0.012**	0.013**	0.012**	0.029**	0.036**	0.040**
	(0.005)	(0.005)	(0.001)	(0.004)	(0.005)	(0.006)
Credit growth, mean	0.090**	0.093**	0.243**	0.135**	0.209**	0.141**
	(0.013)	(0.014)	(0.036)	(0.009)	(0.012)	(0.035)
Credit growth, variance	-0.029**	-0.026**	-0.041**	-0.009**	-0.014**	-0.030**
	(0.011)	(0.011)	(0.024)	(0.001)	(0.006)	(0.008)
Credit growth, skewness	-0.136**	-0.148**	-0.410**	-0.216**	-0.416**	0.071
	(0.058)	(0.058)	(0.183)	(0.041)	(0.059)	(0.213)
Credit growth, mean *MEC	0.178**	0.184**				
	(0.025)	(0.025)				
Credit growth, variance *MEC	-0.008	-0.010				
	(0.010)	(0.011)				
Credit growth, skewness *MEC	-0.336**	-0.413**				
	(0.134)	(0.140)				
Credit growth, mean *WAR/TOT					-0.122**	
					(0.022)	
Credit growth, variance * WAR/TOT					0.004	
					(0.006)	
Credit growth, skewness * WAR/TOT					0.684**	
					(0.133)	
Credit growth, mean *Liberalized						0.030
						(0.039)
Credit growth, variance * Liberalized						0.016
						(0.011)
Credit growth, skewness *Liberalized						-0.489**
						(0.228)
# of observations	114	114	46	166	166	101

Note: This table reports the results of the benchmark regression – regression [2] in table 3- for different country groups.

Regression (1) includes an interaction dummy that takes a value of 1 if a country is an MEC according to the income criterion and zero otherwise. Regression (2) has a similar interaction dummy that takes a value of 1 if the country is an MEC according the "Rule of Law" index of Kaufman and Kraay, and zero otherwise. Regression (3) includes the middle enforceability countries only. Regression (4) includes all 83 countries in the samlple, including countries that experienced wars and severe terms of trade deteriorations. In regression (5) we include an interaction dummy for countries with wars and large term of trade shocks. Finally. regression (6) includes an interaction dummy that takes a value of 1 if a country has liberalized and zero otherwise. The dates and a description of the construction of the liberalization index is given in the appendix. Wald tests for the three moments of credit in regressions (4) and (5) are given below.

Wald Tests 1: War/TOT countries vs non VAR/TOT countries

	F-statistic	(p-value)
Credit-mean	20.69**	0.000
Credit-variance	181.05**	0.000
Credit skewness	4.44**	0.037

Wald Tests 2: Liberalized vs. Not Liberalized

	F-statistic	(p-value)
Credit-mean	126.62**	0.000
Credit-variance	2.80*	0.097
Credit skewness	40.23**	0.000

Table 4: Moments of Credit Growth Before and After Financial Liberalization

	Country-years that are liberalized	Country-years that are closed
Mean	0.067	0.034
Std. Dev.	0.130	0.170
Skewness	-0.707	0.049

Note: The sample is partitioned into two country-year groups: liberalized and nonliberalized

Table 5: Endogeneity

Second stage	(1)	(2)	First stage	(3)	(4)
	Panel IV	Panel GMM		Panel IV	Panel GMM
Dependent variable: Real per capita GDP growth	(Lib)	(Lib)	Dependent variable: Skewness	(Lib)	(Lib)
Initial per capita GDP	-0.393	-0.393	Initial per capita GDP	0.119	0.119
	(0.286)	(0.304)		(0.156)	(0.164)
Secondary schooling	0.034**	0.034**	Secondary schooling	0.010	0.010
	(0.015)	(0.017)		(0.008)	(0.009)
Credit growth, mean	0.250**	0.250**	Credit growth, mean	0.078**	0.078**
	(0.053)	(0.060)		(0.019)	(0.021)
Credit growth, variance	-0.021	-0.021	Credit growth, variance	0.010	0.010
	(0.024)	(0.033)		(0.013)	(0.012)
Credit growth, skewness	-1.330**	-1.330**	Liberalization	-1.020**	-1.020**
	(0.626)	(0.666)		(0.345)	(0.331)
Hausman Test P-value	O.107		F-statistic	5.03	
# of observations	99	99		99	99

Note: The instrument for skewness is the liberalization index. Regressions (1) and (2) show the second stage of the regression, regressions (3) and (4) the first stage, estimated with OLS and GMM, respectively. We performed a regression based Hausman test, where we include the residual of the 1st stage regression in the main regression equation. As the coefficient on this residual is not significant (with a p-value of 0.107), we conclude that OLS is indeed a consistent estimator for skewness.

Table 6: Outliers

Dependent variable: Real per capita GDP growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Excluded Countries	Jordan	Niger	Papua-NG	Botswana	Korea	China	All Outliers
Initial per capita GDP	-0.338**	-0.276**	-0.174	-0.421**	-0.158	-0.068	-0.148
	(0.117)	(0.114)	(0.122)	(0.114)	(0.122)	(0.122)	(0.116)
Secondary schooling	0.024**	0.019**	0.016**	0.029**	0.015**	0.012**	0.015**
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)
Credit growth, mean	0.174**	0.172**	0.174**	0.178**	0.170**	0.168**	0.144**
	(0.010)	(0.010)	(0.013)	(0.010)	(0.011)	(0.012)	(0.013)
Credit growth, variance	-0.045**	-0.047**	-0.043**	-0.040**	-0.043**	-0.037**	-0.041**
	(0.008)	(0.006)	(0.009)	(0.008)	(0.008)	(0.007)	(0.007)
Credit growth, skewness	-0.320**	-0.288**	-0.342**	-0.292**	-0.274**	-0.248**	-0.244**
	(0.050)	(0.037)	(0.058)	(0.055)	(0.050)	(0.049)	(0.047)
# of observations	112	112	113	112	112	112	103

Note: There are no statistical outliers in our benchmark regression (regression 2, Table 4), in the sense that one of the residuals is more that 2 standard deviations away from the mean. In regressions (1)-(3), we individually exclude the countries with the larges country-decade residuals from the regression. In regression (4)-(6), the countries with the lowest country-decade residuals. In regression (7), we exclude all countries with extreme observations at the same time.

Table 7: extended set of control variables

Dependent variable: Real per capita GDP growth

	(1)	(2)	(3)	(4)
Initial per capita GDP	-0.173	-0.191	0.145	-0.011
	(0.117)	(0.116)	(0.128)	(0.143)
Secondary schooling	0.017**	0.018**	0.003**	0.009
	(0.005)	(0.005)	(0.006)	(0.006)
Government share	-0.034**	-0.034**	-0.037**	0.037**
	(0.013)	(0.013)	(0.012)	(0.012)
Life Expectancy		0.005	-0.021	0.003
		(0.072)	(0.065)	(0.007)
Inflation			-0.017**	0.016**
			(0.003)	(0.002)
Terms of trade growth				0.064
				(0.052)
Credit growth, mean	0.139**	0.138**	0.139**	0.162**
	(0.012)	(0.012)	(0.013)	(0.013)
Credit growth, variance	-0.050**	-0.050**	-0.023**	-0.088**
	(0.008)	(0.007)	(0.006)	(0.017)
Credit growth, skewness	-0.203**	-0.204**	-0.161**	-0.245**
	(0.051)	(0.052)	(0.049)	(0.066)
# of observations	114	114	114	114

Note: In regressions (1) to (4) we add standard control variables used in the empirical growth literature to our benchmark regression (regression 2, Table 1).