Essays on financial liberalization

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Financial Liberalization and Financial Instability

5.1 Introduction

In this chapter we study whether financial liberalization increases financial instability. We define financial instability as firms' inability to repay bank loans. We identify two channels through which financial liberalization may change financial instability, building on De Meza and Webb (1987). First, financial liberalization decreases the cost of borrowing, making it easier to repay loans and implying a reduction in financial instability. Second, financial liberalization leads to an entry of risky borrowers, increasing financial instability. Therefore, while the model helps us to identify the channels, the overall impact of financial liberalization on financial instability is theoretically ambiguous. Given this ambiguity, an empirical analysis in the second part of this chapter sheds further light on the liberalization-instability nexus. Specifically, we test if financial liberalization increases financial instability. In our analysis, we pay special attention to the 2008/09 global financial and economic crisis. The collapse of

Lehman Brothers in the U.S. in September 2008 caused a crisis in the global financial system. Through trade and financial channels this shock was transmitted to the real economy and worsened financial instability.

Our estimation results for a sample of 85 economies suggest that financial liberalization did not increase financial instability. But we do present evidence that in a country that exhibited a greater level of financial liberalization before the crisis, there was a sharper rise in impaired loans in the year 2009. The lesson appears to be that financial liberalization leads to financial instability during the crisis, but not outside the crisis period. Figure 5.1 illustrates this point.

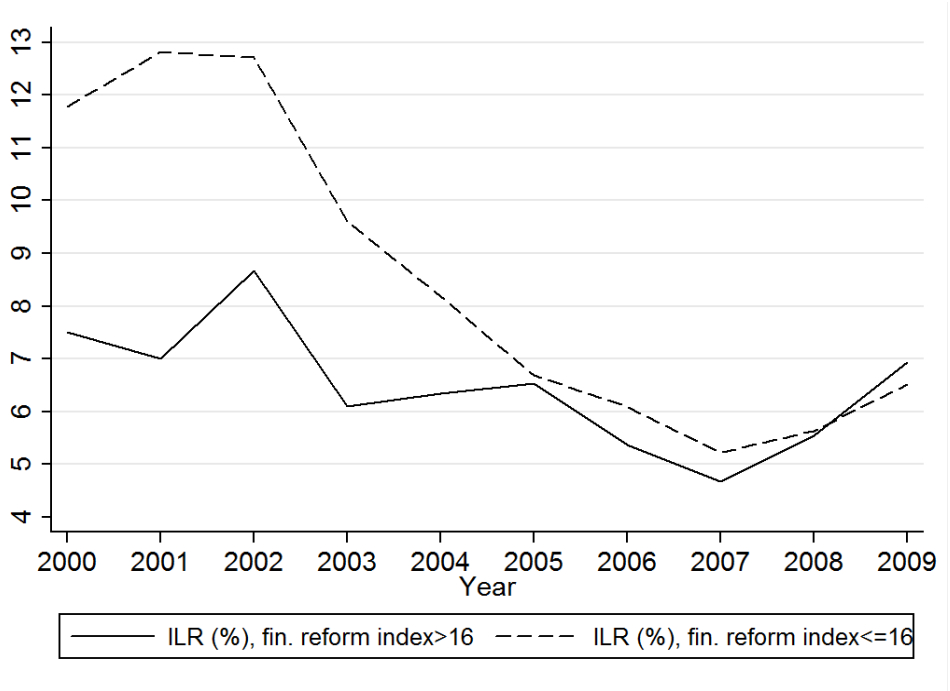

Figure 5.1: Impaired loans by level of financial liberalization

Notes: This figure displays the aggregate development of the impaired loans ratio (ILR) over time for a sample of 85 economies, distinguishing between more (solid line) and less (dotted line) financially liberalized countries. 'Aggregate' means that the arithmetic average over all countries has been computed. Financial liberalization is measured by the financial reform index due to Abiad et al. (2010) that takes on values between 0 and 21 (this variable is only observed until 2005). A country with a fully liberalized financial system has an index value of 21. After studying the distribution of index values, we chose a cut-off value of 16 (the sample mean) to distinguish between more and less financially reformed countries.

As shown in the figure, the financial crisis shock was followed by a sharp increase in the ratio of impaired loans in total loans in the years 2008 and 2009, respectively. This increase in impaired was greater in countries which had more liberalized financial sectors.

The remainder of this chapter is structured as follows. Section 5.2 provides a short review of the related literature. The Section 5.3 presents the theoretical model. The empirical analysis is carried out in section 5.4. Section 5.5 concludes.

5.2 Links to the Literature

We define financial instability as a decrease in the ability to repay bank loans. That financial liberalization leads to more financial instability can be motivated from the perspective of the financial restraint literature. Financial liberalization intensifies competition, leading to a decline in the franchise value of banks. Banks may respond by accepting risk exposure beyond usual standards to increase profits. For instance, reduced margins may encourage banks to economize on screening and monitoring efforts. Banks may also be more willing to opt for a gambling strategy in their loan allocation decisions, by downplaying risk relative to profit. Dell'Arricia and Marquez (2006) show that financial liberalization leads to reduced screening by banks, raising project riskiness. Having riskier projects makes firms more vulnerable to shocks to their conditions of financing.

Financial liberalization alleviates credit constraints that are due to capital market imperfections, but does so at the cost of increased financial instability. In Lorenzoni (2008), competitive financial contracts result in excessive borrowing ex ante and excessive volatility ex post. The conclusion from his theoretical model is that if firms borrow from banks, "[a]ggregate volatility and some degree of financial fragility are unavoidable … and over-borrowing is a possibility. Therefore, the presence and the severity of over-borrowing in specific episodes become an empirical issue." (Lorenzoni, 2008: 826).

An empirical reason to expect over-borrowing after financial liberalization is that financial liberalization often leads to an increase in capital inflows followed by a

domestic credit boom. While not all credit booms involve over-borrowing and financial instability, over-borrowing is more likely to occur during a credit boom. Of all liberalization episodes, the probability of crashes seems to be largest in emerging markets, if the capital account opens up first (Kaminsky and Schmukler, 2003). Mendoza and Quadrini (2009) develop an open-economy model to show that financial liberalization leads to a sharp rise in net credit (also, Mendoza and Terrones, 2008). The 2011 IMF World Economic Outlook surveyed 19 advanced and 28 emerging economies over the period 1960-2011 and finds that financial inflows systematically precede credit booms. Magud et al. (2012) examine 25 emerging economies and discover that large capital inflows and less flexible exchange rate regimes significantly increase domestic credit. Calderón and Kubota (2012) examine gross flows and find that gross private capital inflows significantly affect the probability of domestic credit booms. Furceri et al. (2012) estimate impulse response functions of domestic credit to net capital inflow surges. They report that shocks in net debt inflows have the largest positive effect on credit creation. Lane and McQuade (2014) establish that domestic credit growth is strongly related to net debt inflows, both in a sample of European countries and in an extended sample of 54 advanced and emerging economies over the period 1993-2008.

Rancière et al. (2006) show that while financially liberalized economies grow faster than non-financially liberalized economies, they experience more crises and are exposed to more severe output contractions during financial crises. This may well be because higher debt levels relative to GDP, caused by financial liberalization and capital inflows, increase the probability of defaults as pointed out by Checchetti (2013).

Taken together, the surveyed empirical literature suggests that financial liberalization leads to more financial instability.

5.3 Model

We build on research by De Meza and Webb (1987) to provide a framework for assessing the link between financial liberalization and financial instability.

We propose a simple model in which entrepreneurs borrow money from banks in order to launch projects. Entrepreneurs differ by project success probability, but project return is the same for all entrepreneurs. Financial liberalization attracts riskier

entrepreneurs with low project success probabilities into the pool of borrowing entrepreneurs. As riskier entrepreneurs borrow, average project success probability declines. However, a decline in average project success probability need not be problematic, because financial liberalization also leads to a decline in borrowing cost such that more borrowing by risky entrepreneurs might be socially efficient. But if borrowing by risky entrepreneurs is not desirable from a social point of view, over-borrowing ensues. Such over-borrowing due to financial liberalization is interpreted as rising financial instability.

In line with chapters 3 and 4, we consider two types of financial liberalization, namely decreasing reserve requirements and reducing capital account restrictions.

We first describe the behavior of entrepreneurs and banks. Afterwards, we derive the equilibrium conditions and demonstrate the impact of financial liberalization.

Entrepreneurs

We consider a continuum of risk neutral entrepreneurs. Each entrepreneur carries out a risky project. A project requires one unit of labor and one unit of investment, respectively. Entrepreneurs do not possess own wealth which means that they need to borrow from banks in order to run a project. Each loan earns the bank interest at the lending rate r. Projects themselves yield a return R if successful and zero if not. Entrepreneurs differ in the probability of success p_i. We assume that p_i is uniformly distributed between zero and one. The higher p_i, the more safe the project is.

An entrepreneur will launch a project, if the returns on investment exceed the reservation payoff μ that equals the opportunity cost of labor. This means an entrepreneur is going to invest whenever:

$$p_i(R - r) \geq \mu. \tag{5.1}$$

For the *marginal* entrepreneur with $p_i \equiv p_t$, the above expression holds with equality:

$$p_t(R - r) = \mu. \tag{5.2}$$

Given equation 5.2, the success probability of the marginal entrepreneur equals $p_t = \frac{\mu}{R-r}$.

It is immediate that, in line with De Meza and Webb (1987), the *marginal* entrepreneur has the lowest p_i in the group of investing entrepreneurs. That is, for the group of investing entrepreneurs the following holds:

$$p_t \leq p_i \leq 1. \tag{5.3}$$

There is asymmetric information as banks are unable to observe the project success probabilities of entrepreneurs. However, banks are assumed to know the probability distribution and, therefore, know the average project success probability π of entrepreneurs launching investment projects. According to equation 5.2 all entrepreneurs with $p \geq \frac{\mu}{R-r}$ will launch a project. Thus, we can write π as a function of the lending rate r:

$$\pi(r) = E\left(p | p \geq \frac{\mu}{R-r}\right). \tag{5.4}$$

Since the p is uniformly distributed, $p \sim U[0,1]$, the conditional expectation in equation 5.4 can be written as:

$$\pi(r) = \frac{1}{2} + \frac{1}{2}\left(\frac{\mu}{R-r}\right) \text{ if } R > r. \tag{5.5}$$

Equation 5.5 determines how a change in the lending rate, r, affects the average project success probability π of entrepreneurs launching projects. [48] It is immediate that a rise in r increases π.

Banking sector

We assume that banks are risk neutral and optimize their profits in a competitive market. As mentioned above, banks lend to entrepreneurs at the market rate r and take deposits, paying a risk-free rate of interest ρ. In an economy with capital controls ρ is assumed to be larger than in an open economy with free capital flows (in the latter case ρ equals the foreign cost of borrowing). Furthermore, we assume that banks do not observe the success probability of entrepreneurs, p, they only know the underlying distribution. As a consequence, banks set a pooling lending rate r.

[48] If $R < r$ the average project success probability equals $\pi(r) = \frac{1}{2}\left(\frac{\mu}{R-r}\right)$. We do not consider this case here, since it implies that projects yield negative returns, which means that nobody is willing to invest.

Banks need to hold a fixed percentage, a, of deposits in the form of required reserves at the central bank. The central bank does not pay any interest on required reserves. Hence, required reserves operate as a tax on banks. Owing to required reserves, banks only grant a fraction $(1 - a)$ of loans for each unit of deposits. This implies that for a one unit increase in loans, deposits need to rise by $\frac{1}{(1-a)} \equiv \beta$, where $1 \leq \beta < \infty$. Note that an increase in β is associated with an increase in required reserves. By contrast, financial liberalization implies a fall in β. Due to required reserves, the effective opportunity cost of capital becomes $\beta\rho$ (with ρ denoting the risk-free rate of interest). In a country without reserve requirements $\beta = 1$ and, hence, the opportunity cost of capital will simply be ρ.

Since banks operate in a competitive environment, they set the lending rate such that profits are zero. This implies that banks grant loans, if their expected payment on a project loan, πr, equals the risk-free payment $\beta\rho$:

$$\pi r = \beta\rho. \tag{5.6}$$

Equation 5.6 specifies the locus of project success probabilities and lending rates that make the bank earn the required rate of return.

Market equilibrium

Equations 5.5 and 5.6 determine the equilibrium lending rate r^*. Given the lending rate, investors decide whether to borrow from banks (i.e all individuals with $p_i \geq \frac{\mu}{R-r}$ will borrow). On the basis of individuals' choices, it is possible to determine the equilibrium average project success probability π^*. A detailed calculation of the equilibrium values of $r^*$and π^* will be provided in section 5.A.2 of the appendix. Here, we restrict ourselves to a graphical analysis depicted in figure 5.2.

According to equation 5.5, which we name BB curve in figure 5.2, an increase in r is associated with a rise in π. As r approaches R, π becomes very large. Here, we will only study situations with $\pi < 1$.[49] Also note that there is a lower bound on average project

[49] Note that if $\pi>1$ no entrepreneurs who will borrow and launch an investment projects. Under such circumstances there will be a market breakdown. Cases with $r > R$ are not of interest either, because

success probability: π can never be below $1/2$, since this involves a situation in which everybody borrows and launches projects (see equation 5.5).

The shape of equation 5.6, which we name *LL* curve in figure 5.2, is more straightforward. It is monotonically decreasing in the lending rate r, with the risk-free payment $\beta\rho$ determining a lower bound on r. Below this threshold banks do not lend any money. If r was lower than $\beta\rho$, banks' expected payment would be smaller than πr, implying that banks would be making losses. Moreover, there exists an upper bound on r: we already know that $\pi \geq 1/2$, which implies that $r \leq 2\beta\rho$. This also implies that any equilibrium should satisfy $\beta\rho \leq r \leq 2\beta\rho$.

The intersection of the two curves in equations 5.5. and 5.6 determines the equilibrium values of $r^*$and π^*.

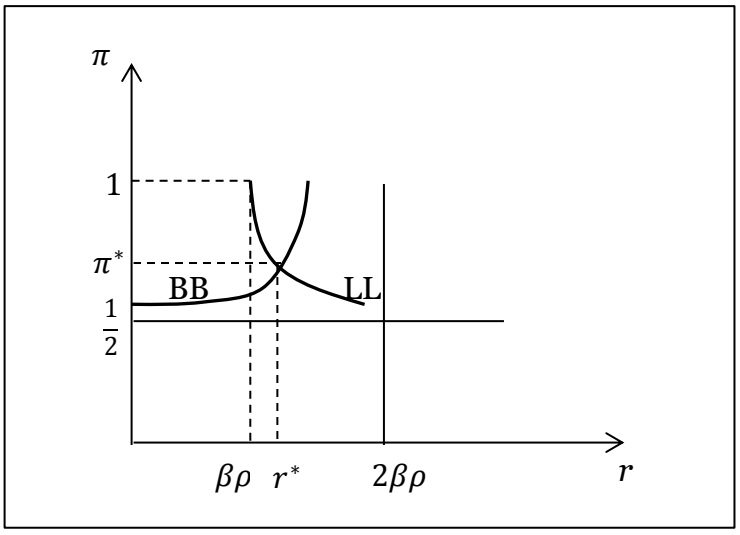

Figure 5.2: Market equilibrium

Notes: The intersection of the *BB* and *LL* curves determines the equilibrium values of $r^*$and $\boldsymbol{\pi}^*$. The solid horizontal is the lower bound on π^*, and the solid vertical line is the upper bound on r^*.

Over-borrowing

We proceed by showing that the market equilibrium is characterized by over-borrowing. Afterwards, we want to analyze how financial liberalization affects over-borrowing.

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nobody will undertake projects with negative returns. Moreover, in the feasible area the BB curve can only take positive values.

To gauge over-borrowing we compare the market equilibrium with the socially efficient equilibrium, in which all projects with a positive net present value are undertaken. Socially efficient projects have an expected return above the opportunity cost of labor μ plus the effective opportunity cost of capital $\beta\rho$. Thus, in the socially efficient equilibrium, only projects with $p_i R \geq \beta\rho + \mu$ are undertaken. This means, the condition for social efficiency is $p_i > p_e = \frac{\beta\rho+\mu}{R}$. If there is over-borrowing, the marginal borrower has success probability $p_t < p_e$. In other words, there are some entrepreneurs borrowing and investing who should not.

In order to prove that the market equilibrium is characterized by over-borrowing, assume that there is no over-borrowing such that $p_t \geq p_e$. The marginal investor then needs to satisfy the social optimality condition:

$$p_t R \geq \beta\rho + \mu, \tag{5.7}$$

We substitute the participation constraint $p_t(R - r) = \mu$ (equation 5.2) to obtain:

$$p_t R \geq \beta\rho + p_t(R - r), \tag{5.8}$$

implying $p_t r \geq \beta\rho$. In other words, banks would make profits on loans to the marginal investor. Since the marginal entrepreneur is the most risky entrepreneur in the pool of entrepreneurs who launch investment projects, this outcome is incompatible with the zero-profit condition of banks (equation 5.6). Hence, as in De Meza and Webb (1987), the market equilibrium is characterized by over-borrowing: too many risky entrepreneurs borrow and launch investment projects. Over-borrowing implies that the average project success probability π $\left(\pi(r) = \frac{1}{2} + \frac{1}{2}p_t\right)$ is too low compared to the average project success probability according to the socially optimal equilibrium π^e $\left(= \frac{1}{2} + \frac{1}{2}p_e\right)$ since $p_t < p_e$. Precisely, over-borrowing means that the difference $\pi^e - \pi > 0$, we show this in figure 5.3.

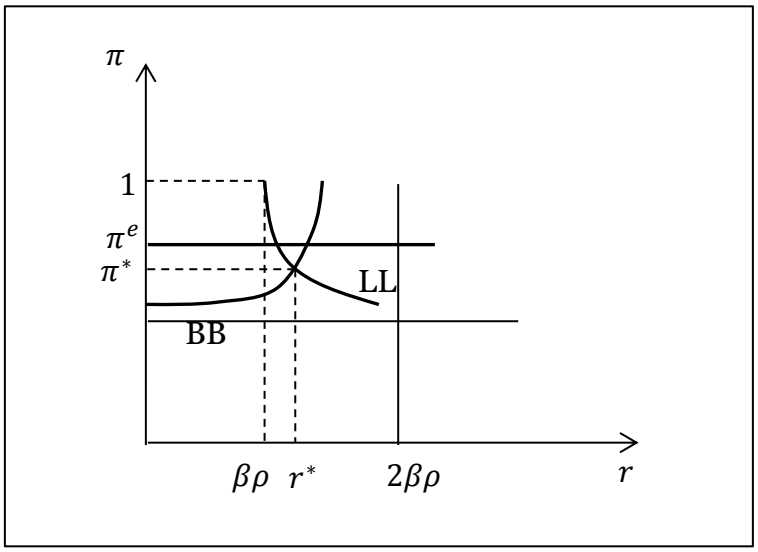

Figure 5.3: Market equilibrium and over-borrowing

Notes: $r^*$and π^* denote equilibrium borrowing cost and average project success probability, respectively. π^e stands for the socially optimal average project success probability. The difference between π^* and π^e indicates over-borrowing.

Impact of financial liberalization on the equilibrium and over-borrowing

As noted earlier, we consider two types of financial liberalization: a decrease in reserve requirements and a reduction in capital controls. Liberalizing reserve requirements means that banks need to hold a smaller fraction of deposits in the form of required reserves at the central bank. In the model, this is captured by a fall in β. Capital account liberalization enables entrepreneurs to obtain cheaper foreign funds, leading to a decrease in ρ. Both a fall in β and/or ρ imply a lowering of the required return of banks. In the following analysis, we focus on the effect of ρ. An analysis of a change in β is similar.

As shown in figure 5.4, financial liberalization entails a downward shift of the *LL* curve. This leads to a decrease in the equilibrium cost of borrowing from r^* to $r^{*\prime}$. As a consequence, riskier entrepreneurs will be borrowing and launching projects. If riskier entrepreneurs borrow from banks, the equilibrium project success probability will decline from π^* to $\pi^{*\prime}$.

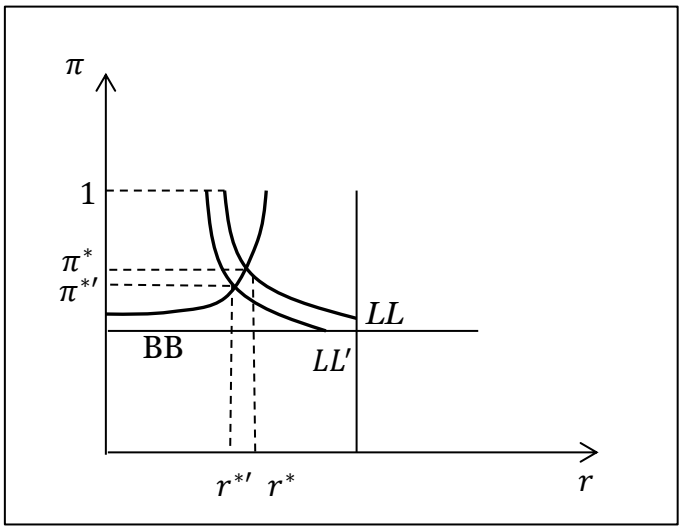

Figure 5.4: Impact of financial liberalization on the equilibrium

Notes: π^* and $\pi^{*\prime}$ refer to the equilibrium average project success probabilities before and after financial liberalization respectively. r^* and $r^{*\prime}$ denote the equilibrium interest rates before and after financial liberalization, respectively.

Next, we intend to determine whether financial liberalization increases over-borrowing. Over-borrowing is characterized by the difference between the socially optimal average project success probability, π^e, and average project success probability of the pool of borrowing entrepreneurs, π. In order to assess whether over-borrowing rises due to financial liberalization, we need to examine how the difference $\pi^e - \pi$ is affected by financial liberalization, that is we need to assess the derivative $\frac{d(\pi^e-\pi)}{d\rho}$. In section 5.A.3 of the appendix we formally derive $\frac{d(\pi^e-\pi)}{d\rho}$, in the main text we concentrate on a graphical analysis. We illustrate this in figure 5.5. The figure shows that financial liberalization, in addition to the shift in *LL* curve, also entails a shift in the horizontal line π^e, indicating the socially optimal average project success probability. Our main interest lies in assessing whether over-borrowing has increased, that is whether $\pi^{e\prime} - \pi' > \pi^e - \pi$. This is difficult to predict and depends on the shape of the curves. In the appendix we show that the sign of the derivative $\frac{d(\pi^e-\pi)}{d\rho}$ is indeed ambiguous.

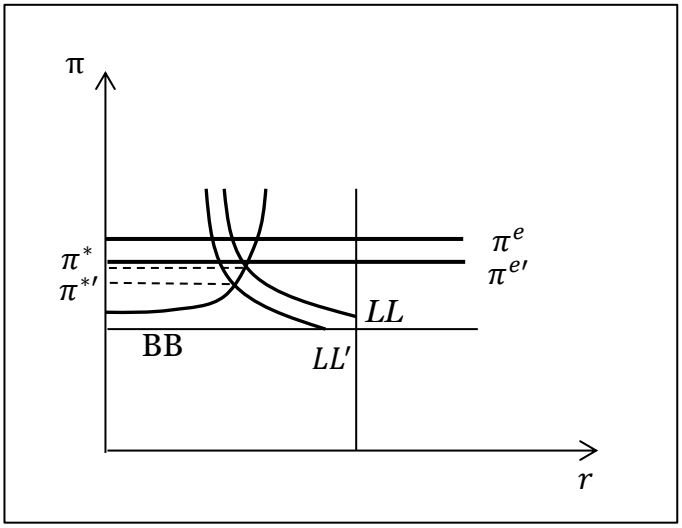

Figure 5.5: Impact of financial liberalization on over-borrowing

Notes: The dashed lines refer to the equilibrium average project success probabilities before and after financial liberalization, π^* and $\pi^{*\prime}$, respectively. The horizontal solid lines refer to the socially optimal average project success probabilities before and after financial liberalization, π^e and $\pi^{e\prime}$, respectively.

From the model to empirical testing

The analysis of the previous paragraph suggests that the impact of financial liberalization on financial instability is an empirical matter. The fact that borrowing by entrepreneurs with lower success probabilities can be socially desirable implies that financial instability need not rise with financial liberalization.

In the light of our theory, we would expect an insignificant coefficient on financial liberalization in reduced-form regressions of financial instability. However, we conjecture that the negative economic shock in the year 2009 tightened the link between financial liberalization and instability. It is well documented that the global financial and economic crisis hit the real economy through trade and financial channels during 2008-2009. In our model, this is represented by low project returns, R, as firms were suddenly faced with lower profits. Intuitively, if project returns are low, it is less desirable from a social point of view to lend money to risky entrepreneurs. Yet, financial liberalization enables riskier entrepreneurs to borrow due to the availability of cheaper funds. As a

consequence, over-borrowing is more likely to ensue. Thus, while more borrowing in the wake of financial liberalization is desirable during economically prosperous years, an economic downturn might lead to financial instability.

5.4 Data and Analysis

5.4.1 Data

We use a newly constructed bank-level data set on financial instability for 85 countries over 2000-2009. We aggregate bank-level data into country-level data by computing the average impaired loans ratio weighted by total assets over banks in a country. We refer the reader to appendix 5.A.4 for a description of this data. We measure financial instability as the share of loans past due by 90 days or more (called impaired loans) in gross loans.[50] We call this measure impaired loans ratio, or short ILR. The ILR measure of financial instability is usually considered by regulatory authorities as an indicator of financial soundness. As shown in figure 5.1, the impaired loans ratio declines steadily until 2008 and it sharply rises thereafter.

For financial liberalization we will rely on the financial liberalization index due to Abiad et al. (2010). Moreover, we will control for inflation, the size of the financial sector (credit to the private sector as a percentage of GDP), constant-Dollar GDP per capita levels as well as the size of the government. More detailed information about the sources and definitions of our variables can be found in table 5.A.1 of the appendix for. Table 5.1 presents descriptive statistics of our data.

[50] The value of gross loan equals the loan portfolio plus loss reserves. The total loan portfolio is the sum of all loan types including residential and other mortgage loans, retail loans, corporate loans and commercial loans.

Table 5.1: Descriptive statistics

variable	obs.	mean	s.d.	min. value	max. value
ILR (%)	815	6.5	6.7	0.13	44.1
Finreform (values between 0 and 21)	815	15.6	3.8	3.8	21
Private credit (%)	791	62	52.6	3.8	235.5
Per capita GDP (in 2005 $)	791	13552	13038	525	49942
Inflation (%)	797	6.8	8.4	-18.8	80.8
Government consumption (%)	793	15.2	5.1	4.5	29.8

Notes: Data definitions and sources can be found in table 5.A.1 of the appendix.

5.4.2 Specifications, Estimator, and Results

In this section, we treat the global financial crisis as an external shock, and test whether the effect of financial liberalization on financial instability depends on this shock. The first model we estimate is:

$$ILR_{i,t} = \alpha_0 + \gamma_1 finreform_{i,t-4} + \gamma_2\left(dT_{2009} \times finreform_{i,t-4}\right) + \boldsymbol{x}'_{i,t}\boldsymbol{\beta} + \eta_i + \delta_2 d2_t + \cdots + \delta_T dT_t + u_{i,t}, \quad \text{with } t = 1, \ldots, 9. \tag{5.9}$$

where t and i index time and country, respectively. The dependent variable is the logarithm of the impaired loans ratio. The variable $finreform_{i,t-4}$ denotes the level of financial liberalization lagged by four periods, to allow for a lagged response of impaired loans to financial liberalization.[51] Variables $d2_t,\ldots,dT_t$ represent time dummy variables where $ds_t = 1$ if $s = t$, and zero otherwise. Note that we exclude the first year (2001) from the set of time dummy variables to avoid multicollinearity. The regressor vector $\boldsymbol{x}'_{it}$ includes the set of control variables, η_i are time invariant country dummy variables and u_{it} are identically and independently distributed disturbances. We use GDP per capita, government consumption, private credit and inflation as control variables as these potentially explain some of the variation in our dependent variable.

[51] We lag this variable by four years since observations for financial liberalization end in 2005.

Parameter γ_1 captures the main or direct effect of financial liberalization on financial instability. The parameter of main interest is γ_2, measuring the extent to which the relationship between financial liberalization and financial instability is modified in the year 2009 due to the shock.

Our next specification includes a lag of the dependent variable. Plausibly, financial liberalization causes gradual adjustments of bank balance sheets and, hence, of financial instability. Moreover, we want to account for serial correlation in the disturbances. Using the same notation as above, our second empirical model is given by:

$$ILR_{i,t} = \alpha_0 + \alpha_1 ILR_{i,t-1} + \gamma_1 finreform_{i,t-4} + \gamma_2 \left(dT_{2009} \times finreform_{i,t-4}\right) + \boldsymbol{x}'_{i,t}\boldsymbol{\beta} + \eta_i + \delta_2 d2_t + \cdots + \delta_T dT_t + u_{i,t}, \quad \text{with } t = 1, \ldots, 9. \tag{5.10}$$

Whereas the interpretation of the main parameters of the model, γ_1 and γ_2 is the same as in equation 5.9, the dynamic specification in 5.10 produces unbiased standard errors.

Assuming that the decision to liberalize the financial sector is exogenous to the impaired loans ratio, equation 5.9 can be estimated by using the within estimator. By contrast, the within estimator no longer yields unbiased coefficient estimates in the case of the dynamic specification in equation 5.10, because the means of $ILR_{i,t}$ and u_{it} contain their past, present and future values. As a result, the average values of the impaired loans ratio, $\overline{ILR}$, and the error term, $\bar{u}$, are correlated with u_{it}, and $ILR_{i,t-1}$, respectively (Nickell, 1981). On account of these problems, we employ the Anderson and Hsiao (1982) estimator. The idea of this estimator is to take first differences of the original model. As a result, the individual effect η_i is removed. However, the differenced lagged dependent variable and the disturbance term are still correlated: whereas the latter contains $u_{i,t}$,the former contains $ILR_{i,t-1}$. However, a simple IV estimator is at hand. More precisely, Anderson and Hsiao (1982) propose to use either the lagged difference or the lagged level as an instrument for the differenced lagged endogenous regressor. Both types of instruments would be uncorrelated with the differenced disturbance term. Arellano (1989) points out that the estimator based on the level instrument is superior. Moreover, it has the advantage that fewer observations will be lost. Thus, we will employ level instruments in the following analysis.

Table 5.2 presents estimation results for equation 5.9. We do not report coefficients of year dummy variables (with 2001 as base year). These are generally significantly negative, capturing the downward trend in the impaired loans ratio that was observed in figure 5.1. We find that the coefficient on the financial reform index is statistically insignificant in all specifications. In other words, financial liberalization does not correlate significantly with the impaired loans ratio. The coefficient on the interaction term between the financial reform index and the year 2009 is significantly positive in columns 2 to 4. The interpretation is that banks in more financially liberalized countries are less stable in the 2009 crisis year.

Table 5.2: Impact of financial liberalization on the ILR

	(1) FE	(2) FE	(3) FE	(4) FE
Finreform(t-4)	0.12	0.28	-0.20	-0.01
	(0.57)	(0.56)	(0.54)	(0.55)
Finreform(t-4) x year 2009		1.53***	1.46***	1.03***
		(0.42)	(0.41)	(0.39)
Private credit			0.35**	0.51***
			(0.17)	(0.16)
Per capita GDP				-1.05**
				(0.48)
Inflation				-0.01
				(0.04)
Gov. consumption				-0.28
				(0.40)
Constant	1.36	0.95	0.96	9.88**
	(1.50)	(1.48)	(1.38)	(4.31)
Year effects	Yes	Yes	Yes	Yes
Observations	815	815	791	712
R-sqr.	0.15	0.18	0.19	0.20
Groups	91	91	89	85

Notes: The dependent variable is the logarithm of the impaired loans ratio (share of loans past due by 90 days or more in gross loans). A higher value of this variable means more financial instability. All other variables have been log-transformed. Cluster-robust standard errors are reported in brackets. Stars indicate significance at the 1%-, 5%-, and the 10%-level, respectively.

Table 5.3 reports estimation results for equation 5.10. The lagged coefficient on the impaired loans ratio is significantly positive throughout, implying that persistence in this variable should be controlled for. As noted, the estimates in Table 5.3 are subject to the Nickell bias. In table 5.4 we therefore show the results using the Anderson and Hsiao (1981) IV estimator.

Table 5.3: Regressions with lagged dependent variable

	(1) FE	(2) FE	(3) FE	(4) FE
L.ILR	0.53***	0.52***	0.49***	0.47***
	(0.05)	(0.04)	(0.05)	(0.04)
Finreform(t-4)	0.20	0.36	0.11	0.46
	(0.40)	(0.38)	(0.36)	(0.36)
Finreform(t-4) x year 2009		1.25***	1.15***	0.95***
		(0.31)	(0.32)	(0.35)
Private credit			0.36**	0.60***
			(0.17)	(0.09)
Per capita GDP				-0.82**
				(0.35)
Inflation				-0.05
				(0.04)
Gov. consumption				-0.42
				(0.25)
Constant	0.37	-3.60**	-4.02***	3.31
	(1.03)	(1.46)	(1.36)	(3.11)
Year effects	Yes	Yes	Yes	Yes
Observations	712	712	691	626
R-sqr.	0.69	0.66	0.44	0.49
Groups	89	89	87	83

Notes: The dependent variable is the logarithm of the impaired loans ratio (share of loans past due by 90 days or more in gross loans). A higher value of this variable means more financial instability. All other variables have been log-transformed. Cluster-robust standard errors are reported in brackets. Stars indicate significance at the 1%-, 5%-, and the 10%-level, respectively.

As can be seen in table 5.4, the coefficient on the lagged impaired loans ratio is now greater, suggesting that the coefficients on this variable in the previous tables suffered from a downward bias.

The coefficient on the interaction term between the financial liberalization index and the year 2009 is significantly positive in all specifications. The estimate in column 4 implies that a ten percent increase in the financial liberalization index (in the year 2005) is associated with a rise in the impaired loans ratio by eight percent in the year 2009.[52] For the average country in the dataset this means that an increase in the financial reform index from 15.5 to 17 leads to a rise in the impaired loans ratio by 0.56 percentage points.[53] Comparing the average country in the dataset that scores 15.5 on the financial reform index with a country that is fully liberalized (the financial reform index equals 21), the latter is characterized by an impaired loans ratio that is 24 percent greater.[54]

In sum, we find some evidence that financial liberalization leads to a rise in impaired loans upon the crisis shock. This outcome is robust to the inclusion of private credit and further controls in columns 3 and 4 of table 5.4. In line with the literature reviewed in section 5.2, we find that a larger credit-to-GDP ratio is also correlated with a higher impaired loans ratio, independently of the financial liberalization effect.[55] But this effect vanishes once we include the lagged dependent variable.

[52] We expect an eight percent rise in the impaired loans ratio for a ten percent increase in the financial reform index because $1.1^{\gamma_2}=1.1^{0.84}=1.08$.

[53] For the average country in the dataset, the impaired loans ratio equals seven percent and the financial reform index is 15.6. Thus, a ten percent increase in the index means that the impaired loans ratio increases by 0.56 percentage points since 7%*1.08=7.56%, taking the difference between 7.56% and 7% implies a change of 0.56 percentage points.

[54] We calculate $1.3^{\gamma_2}=1.3^{0.84}$ since the financial reform index of a fully liberalized countries is 30 percent greater, compared with that of the average country.

[55] Similar findings have been made in Mendoza and Terrones (2008), Schularick and Taylor (2012), Gourinchas and Obstfeld (2012) and Checchetti (2013).

Table 5.4: Regressions with lagged dependent variable using the IV estimator

	(1) IV	(2) IV	(3) IV	(4) IV
L.ILR	0.87***	0.83***	0.85***	0.72***
	(0.09)	(0.09)	(0.12)	(0.12)
Finreform(t-4)	0.65*	0.60	0.73	0.46
	(0.39)	(0.39)	(0.48)	(0.45)
Finreform(t-4) x year 2009		0.68**	0.65**	0.84**
		(0.28)	(0.32)	(0.36)
Private credit			-0.29	0.37
			(0.51)	(0.26)
Per capita GDP				-1.36**
				(0.67)
Inflation				0.03
				(0.06)
Gov. consumption				-0.33
				(0.55)
Constant	0.13*	-1.75**	-1.63*	-2.15**
	(0.07)	(0.78)	(0.90)	(1.00)
Year effects	Yes	Yes	Yes	Yes
Observations	619	619	600	536
Groups	88	88	86	82
Underidentification test statistic	44.52	44.05	41.05	36.55
F-statistic	25.36	26.32	25.91	17.63

Notes: The estimates are based on Anderson-Hsiao first-difference estimator, where the second lag of the dependent variable has been chosen as instrument for the lagged dependent variable. The dependent variable is the logarithm of the impaired loans ratio (share of loans past due by 90 days or more in gross loans). A higher value of this variable means more financial instability. All other variables have been log-transformed. Cluster-robust standard errors are reported in brackets. Stars indicate significance at the 1%-, 5%-, and the 10%-level, respectively.

5.5 Conclusion

In this chapter we asked if financial liberalization is one of the drivers of financial instability. One strand in the literature suggests that financial liberalization, especially

capital account liberalization leading to an increase in capital inflows, causes increased leverage (credit-to-GDP ratios). Another literature strand discusses how increased leverage causes increased risk of financial crisis and, thus, larger financial instability. Taken together, this has motivated our research question.

We have developed a simple model, which allowed us to identify two channels through which financial liberalization affects financial instability: an entry of risky entrepreneurs and decreased borrowing cost. We have associated financial instability with an increase in borrowing away from the social optimum. Depending on which of the channels dominates, more risky borrowing may or may not be socially optimal. While the theoretical model helped us identify relevant channels, it gave no conclusive indication of the effect of financial liberalization on financial instability

We therefore complemented the theoretical analysis with an empirical assessment of the impact of financial liberalization on financial instability. To this end, we have used new data on impaired loans for 85 countries over the time period 2000-2009. The data indicated that more financially liberalized countries experienced a stronger positive response in impaired loans to the 2009 shock.

Subsequently, we have tested the liberalization-instability nexus in panel estimations. We have regressed the impaired loans ratio on its own lag and four-year lagged values of the Abiad et al (2010) financial reform index and further control variables. We found that the coefficient for the level of financial reform is statistically insignificant in general. In other words, financial liberalization did not correlate with the impaired loans ratio. We have also interacted the four-year lagged financial reform index with a year 2009 dummy variable. The coefficient on this interaction term was found to be consistently and significantly positive. Thus, our results indicate that banks in more financially liberalized countries are less stable during a crisis period, but not outside the crisis period. Our results are broadly in line with those of, e.g., Rancière et al. (2006) as we have found that financial liberalization may lead to more financial instability.

Future empirical research could further delve into the transmission channels of financial liberalization that we have identified theoretically, namely decreasing cost of borrowing and entry of riskier borrowers. To this end, bank-level analyses could be particularly useful. The theoretical model could be extended by modeling loan defaults explicitly.

5.A Appendix

5.A.1 Variable Sources and Definitions

Table 5.A.1: Variable sources and definitions

Variable	Variable Definition	Source
ILR	Share of loans past due by 90 days or more (impaired loans) in gross loans; gross loan equals the loan portfolio plus loss reserves	DFID project
Finreform	index based on seven dimensions of financial liberalization, ranging between 0 and 21; a country with a fully liberalized financial system has an index value of 21	Abiad et al. (2010)
Private credit	private credit to the domestic sector as a percentage of gross domestic product (GDP).	World Development Indicators
Per capita GDP	real GDP per capita	World Development Indicators
Inflation	annual growth rate of the GDP deflator	World Development Indicators
Government consumption	government current expenditures for purchases of goods and services (including compensation of employees)	World Development Indicators

5.A.2 Calculation of Equilibrium π and r

We continue by deriving formal expressions of the equilibrium lending rate and average project success probability, r^* and π^*, respectively. Therefore, we use equations 5.5 and 5.6 from the main text. For reasons of convenience, we show them here again:

$$BB\ curve: \quad \pi(r) = \frac{1}{2} + \frac{1}{2}\left(\frac{\mu}{R-r}\right)\ if\ R > r, \tag{5.A.1}$$

$$LL\ curve: \quad \pi = \frac{\beta\rho}{r}. \tag{5.A.2}$$

Setting the two equations equal and solving for r yields two solutions:

$$r_1^* = \frac{1}{2}R + \frac{1}{2}\mu + \beta\rho - \frac{1}{2}\sqrt{2R\mu + \mu^2 + 4\beta^2\rho^2 + R^2 - 4R\beta\rho + 4\beta\mu\rho}, \quad (5.A.3)$$

$$r_2^* = \frac{1}{2}R + \frac{1}{2}\mu + \beta\rho + \frac{1}{2}\sqrt{2R\mu + \mu^2 + 4\beta^2\rho^2 + R^2 - 4R\beta\rho + 4\beta\mu\rho}. \quad (5.A.4)$$

The corresponding equilibrium values for the success probability are:

$$\pi_1^* = \frac{\mu}{R-\mu-\beta\rho+0.5\sqrt{2R\mu+\mu^2+4\beta^2\rho^2+R^2-4R\beta\rho+4\beta\mu\rho}} + \frac{1}{2}, \quad (5.A.5)$$

$$\pi_2^* = -\frac{\mu}{\mu-R+\beta\rho+0.5\sqrt{2R\mu+\mu^2+4\beta^2\rho^2+R^2-4R\beta\rho+4\beta\mu\rho}} + \frac{1}{2}. \quad (5.A.6)$$

There are two equilibria. Whereas the first equilibrium (r_1^*, π_1^*) suggests a relatively low lending rate and relatively high success probability, the second equilibrium consists of a relatively high lending rate combined with a relatively low success probability (r_2^*, π_2^*). The second equilibrium is not feasible though as $R < r_2^*$. Therefore, we will disregard it in the following analysis.

Proposition: **The second equilibrium is not feasible, since $R < r_2^*$.**

Proof: Rewrite r_2^* in equation 5.A.4 as $2r_2^* - R = \mu + 2\beta\rho + \sqrt{\Theta}$ with $\Theta = \sqrt{2R\mu + \mu^2 + 4\beta^2\rho^2 + R^2 - 4R\beta\rho + 4\beta\mu\rho}$. The right-hand side has to be positive since the term under the square root cannot be negative. It, thus, follows that $R < 2r$. In this case R can be smaller than r and the right-hand side is still positive. But in the model it generally holds that $\mu + 2\beta\rho > r$ (see figure 5.2). Now write $2r_2^* - R = \mu + 2\beta\rho + \sqrt{\Theta}$ as $r_2^* - R + r_2^* - (\mu + 2\beta\rho) = \sqrt{\Theta}$. On the left-hand side $r_2^* - (\mu + 2\beta\rho)$ is negative. Thus, R has to be less than r, otherwise the right-hand side can never be positive. But an equilibrium with $R < r$ is not feasible since no entrepreneur is willing to invest.

5.A.3 Impact of Financial Liberalization on the Equilibrium

First, we show how financial liberalization affects the equilibrium cost of borrowing. Second, we assess the impact of financial liberalization on overborrowing.

Recall that financial liberalization is reflected by a decrease in β, capturing lower reserve requirements, or a decrease in ρ, capturing capital account liberalization. In the following analysis, we focus on the effect of ρ. An analysis of a change in β is similar.

For the sake of convenience, we will employ implicit differentiation methods. To this end, we write the functions that describe borrowing (BB curve) and lending (LL curve) behavior as $\pi^B = B(r)$ and $\pi^L = L(r, \rho)$, respectively. Derivatives are denoted by subscripts. To save notation, we will write derivatives $B_r(r)$ and $L_r(r, \rho)$ as B_r and L_r, respectively.

The equilibrium requires that $B(r) = \pi = L(r, \rho)$. We are interested in solving this system for the equilibrium interest rate and success probability in terms of the parameter ρ with $\pi = \pi^*(\rho)$ and $r = r^*(\rho)$ or:

$$B(r^*(\rho)) = L(r^*(\rho), \rho). \tag{5.A.7}$$

Then, the comparative statics derivative is obtained by totally differentiating expression 5.A.7 to ρ:

$$\frac{dB}{dr^*}\frac{dr^*}{d\rho} = \frac{dL}{dr^*}\frac{dr^*}{d\rho} + \frac{dL}{d\rho}. \tag{5.A.8}$$

This can be rearranged for $\frac{dr^*}{d\rho}$ to obtain:

$$\frac{dr^*}{d\rho} = \frac{L_\rho}{B_r - L_r} > 0 \; since \; L_\rho > 0, B_r > 0 \; and \; L_r < 0. \tag{5.A.9}$$

The result in expression 5.A.9 implies that an increase in financial repression will cause the equilibrium interest rate to rise.

In order to evaluate the impact of financial liberalization on overborrowing, we need to calculate the derivative:

$$\frac{d(\pi^e - \pi)}{d\rho} = \frac{d\pi^e}{d\rho} - \frac{d\pi}{d\rho}, \tag{5.A.10}$$

with π^e and π denoting the socially optimal and average project success probability, respectively. The derivative $\frac{d\pi^e}{d\rho}$ simply equals:

$$\frac{d\pi^e}{d\rho} = \frac{\beta}{2R} > 0. \tag{5.A.11}$$

Since $B(r^*(\rho)) = \pi^*$ the change in the equilibrium average project success probability π^* can be found by using the chain-rule as:

$$\frac{d\pi^*}{d\rho} = \frac{dB}{dr^*}\frac{dr^*}{d\rho}. \tag{5.A.12}$$

Combining 5.A.9 and 5.A.12 yields:

$$\frac{d\pi^*}{d\rho} = \frac{B_r \cdot L_\rho}{B_r - L_r} > 0 \; since \; L_\rho > 0, B_r > 0 \; and \; L_r < 0. \tag{5.A.13}$$

Next, using the results in equations 5.A.11 and 5.A.13, we can evaluate the expression in 5.A.10:

$$\frac{d(\pi^e - \pi)}{d\rho} = \underbrace{\frac{d\pi^e}{d\rho}}_{+} - \underbrace{\frac{d\pi}{d\rho}}_{+} \gtrless 0. \tag{5.A.14}$$

Expression 5.A.14 suggests that the overall impact of financial liberalization on overborrowing is ambiguous.

5.A.4 Description of the Financial Instability Dataset

A complete description can be found in DFID (2015). Here, we focus on aspects of the data that are most relevant from the perspective of this chapter. The dataset covers 23,287 banks over the period 2000-2009. It includes retail banks, investment banks, Islamic banks, cooperative banks, real estate and mortgage institutions, and savings banks. It excludes those types of banks which are rare in most countries, such as securities firms and microfinance institutions. While this makes the sample composition more comparable across countries, we note that it significantly reduces the number of banks in those few countries where the excluded bank types dominate the banking system. Figure 5.A.1 shows that the total number of banks reporting on the impaired loans ratio varies substantially across the 84 countries in the dataset. In case of 40 countries information on the impaired loan ratio is based on 41 or more banks. 28

countries have information from fewer than 30 banks. In addition, there are a few countries for which the total number of banks ranges between 31 and 49. Figure 5.A.2 illustrates that the number of banks in the sample declines year-on-year over the sample period (except for 2003), presumably due to insolvencies and non-reporting.

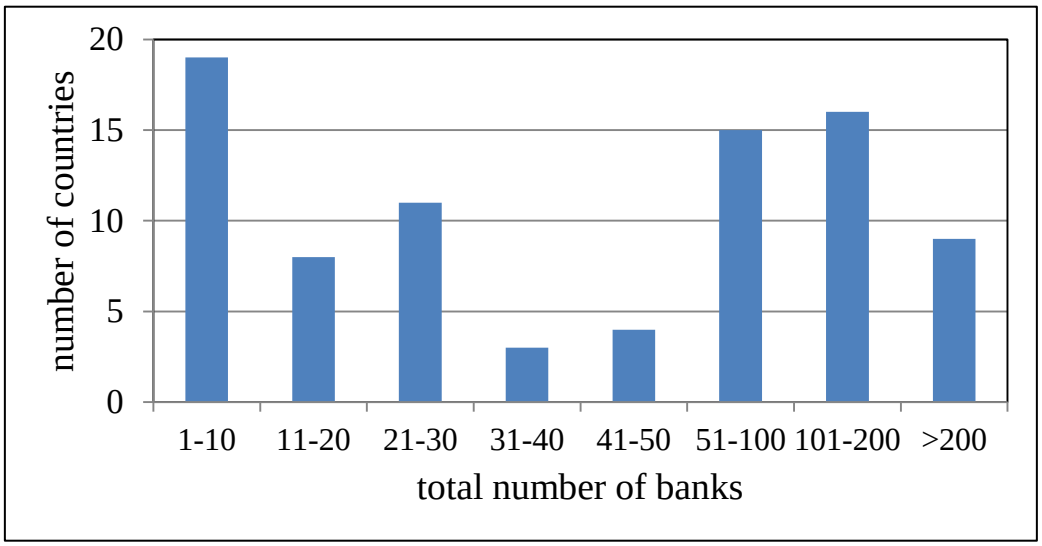

Figure 5.A.1: Distribution of bank-year observations

Notes: The figure shows the distribution of the number of observations on the impaired loans ratio. For example, the first bar means that in case of 19 countries in the dataset, observations on the impaired loans ratio come from between one to ten banks. Due to restricted availability of the bank-level dataset, the data in the graph refer to the sample in which banks report 66 percent of the time on all five measures of financial instability.

The bank-level data has been aggregated into country-level data by computing the average impaired loans ratio weighted by total assets over banks in a country. This can be done in different ways, each with its advantages and drawbacks.

In particular, we focus on a sample that has no restrictions on bank entry into or exit from the database, nor on the number of reporting periods. This approach maximizes the number of observations. Though, a shortcoming is that the sample composition changes over time.[56]

[56] Alternatively, one could construct a sample that includes only those banks that report in all ten years from 2000 to 2009. Such a sample is balanced over time but the number of observations is smaller and banks with more impaired loans are more likely to drop out. Moreover, such a sample could suffer from a bias since banks with more bad loans are more likely to stop reporting or to go insolvent, leaving the

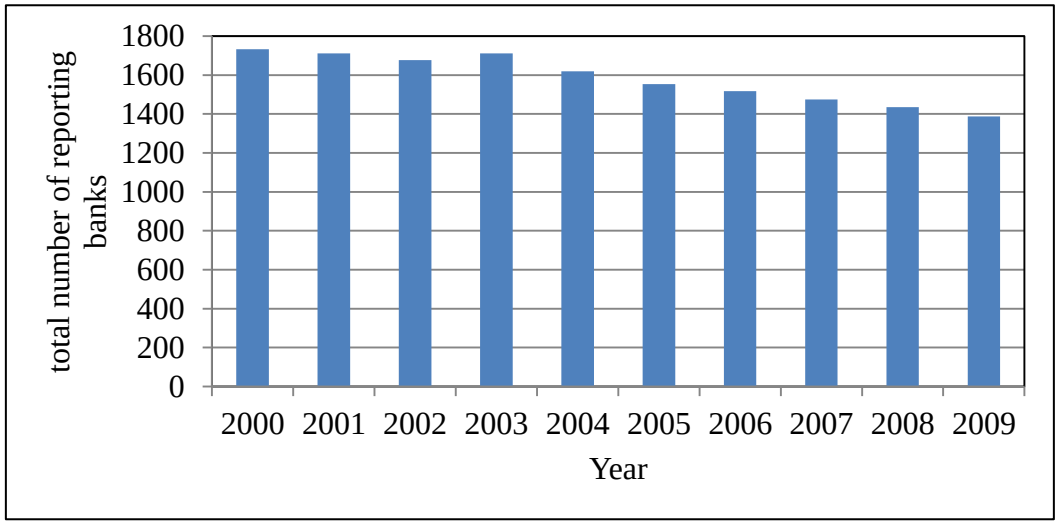

Figure 5.A.2: Number of observations per year

Notes: This figure shows the total number of reporting banks in each year of the sample period, 2000 to 2009. For example, the first bar means that the total number of observations in the year 2000 was 1733. Due to restricted availability of the bank - level data, the data in the graph refer to sample in which banks report 66 percent of the time on all five measures of financial instability.

sample. Excluding those banks in all years yields a balanced sample, but precisely in a study of financial instability, it would exclude those banks which are likely to be more instable.

5.A.5 Countries Included in the Dataset

Table 5.A.2: Country list

Albania	France	Norway
Algeria	Georgia	Pakistan
Argentina	Germany	Paraguay
Australia	Ghana	Peru
Austria	Greece	Philippines
Azerbaijan	Guatemala	Poland
Bangladesh	Hong kong	Romania
Belarus	Hungary	Russia
Belgium	India	Senegal
Bolivia	Indonesia	Singapore
Brazil	Ireland	South Africa
Bulgaria	Israel	Spain
Cameroon	Italy	Sri lanka
Canada	Jordan	Sweden
Chile	Kazakhstan	Switzerland
China	Kenya	Tanzania
Colombia	Korea	Thailand
Costa Rica	Kyrgyzstan	Tunisia
Cote d'Ivoire	Lithuania	Turkey
Czech Republic	Madagascar	Uganda
Denmark	Malaysia	Ukraine
Dominican Republic	Mexico	United Kingdom
Ecuador	Morocco	United States
Egypt	Mozambique	Uruguay
El salvador	Nepal	Venezuela
Estonia	Netherlands	Vietnam
Ethiopia	New Zealand	
Finland	Nicaragua	