University of Zurich

Department of Economics

Center for Institutions, Policy and Culture in the Development Process

Working Paper Series

Working Paper No. 103

Sovereign Defaults and Liquidity Crises

Filippo Brutti

February 2010

Sovereign Defaults and Liquidity Crises*

Filippo Brutti
University of Zurich and Study Center Gerzensee

First draft: October 2008
This draft: February 2010

Abstract

Sovereign debt crises in emerging markets are usually associated with liquidity and banking crises. The conventional view is that the domestic financial turmoil is the consequence of foreign retaliation, although there is no clear empirical evidence on "classic" default penalties. This paper emphasizes instead a direct link between sovereign defaults and liquidity crises, building on two natural assumptions: (i) government bonds represent a source of liquidity for the domestic private sector; (ii) the government cannot discriminate between domestic and foreign creditors in the event of default. In this context, external debt emerges even in absence of classic penalties and government default is countercyclical, triggers a liquidity crunch and amplifies output volatility. In addition, a financial reform that involves a substitution of government bonds with privately-sourced liquidity instruments could backfire by restricting government's access to foreign credit.

Keywords: Legal institutions, liquidity, sovereign risk, financial dependence.

JEL *Classification:* F34, O16.

*This paper previously circulated with the title "Legal Enforcement, Public Supply of Liquidity and Sovereign Risk". I am grateful to Jaume Ventura for his valuable guidance and countless suggestions, as well as Peter Benczur, Fernando Broner, Paula Bustos, Antonio Ciccone, Davide Debortoli, José Antonio Dorich, Nathan Foley-Fisher, Miklos Koren, Gino Gancia, Nicola Gennaioli, Dirk Niepelt, Silvana Tenreyro, Joachim Voth, Vivian Yue and Fabrizio Zilibotti for helpful comments. I am particularly indebted with Alberto Martin for discussing with me the idea of the paper since the very beginning. I also benefited from comments at the Bank of Hungary, Bank of Italy, EPFL Lausanne, Federal Reserve Board, Study Center Gerzensee, Universitat Pompeu Fabra, University of Warwick, University of Zurich and at the "Micro and Macroeconomic Effects of Financial Globalization" NBER conference. Financial support from the European Research Council (ERC Advanced Grant IPCDP-229883) is gratefully acknowledged. Any error is my own.

1 Introduction

Sovereign debt crises in emerging markets are usually associated with liquidity and banking crises. **?** show that sovereign default is in fact a good predictor of a banking crisis in many emerging countries over the period 1980-2000.[1] The conventional view interprets the domestic financial turmoil as an indirect consequence of foreign retaliation, e.g. trade sanctions or exclusion from international financial markets.[2] Yet, this interpretation is controversial. First, there is no clear-cut empirical evidence supporting the application of "classic" penalties.[3] Second, in recent sovereign crises (e.g. Argentina 2001 and Russia 1998) government default had a direct "balance-sheet" effect on domestic financial institutions, which were major holders of public debt (see **?**). In this paper, I then study the direct connection between sovereign defaults and liquidity crises abstracting from external penalties.

The model builds on two natural assumptions for emerging markets. First, public debt represents a source of liquidity for the private sector. Specifically, domestic firms need to refinance their projects in the future but are not able to access spot credit markets due to limited enforcement of creditors' rights. Firms then save in government bonds, either directly or indirectly through the banking sector, to hoard a reserve of liquidity. This aspect of the model is consistent with the negative correlation between creditor rights protection and banks' holdings of government debt observed in the data.[4] Second, the government cannot discriminate between domestic and foreign bond holders in the event of default. This assumption, which hinges on both the anonymity and the increasing integration of secondary markets for government bonds, is consistent with the large haircuts suffered by domestic financial institutions in recent debt crises.

The implications of these two assumptions are clear. Sovereign default has opposing effects on the domestic economy since, on one hand, it avoids a transfer of domestic resources to foreign creditors but, on the other, generates a liquidity crisis that disrupts private investment and lowers domestic production. The trade-off faced by the government then explains the emergence of sovereign debt even in absence of foreign penalties. Furthermore, default is triggered by a severe drop in aggregate productivity, which lowers the opportunity cost of a liquidity crisis, is countercyclical and amplifies output volatility through its effect on private investment.

Having established the link between sovereign defaults and liquidity crises, the paper then discusses a novel implication of financial reforms, namely that reforms do not necessarily raise domestic welfare and in some cases have a backfire effect on it. Suppose that suddenly domestic

[1] These authors apply a methodology similar to **?** and show that the probability of a banking crisis conditional on a sovereign default in the same year or in the year before is statistically larger than the unconditional probability, while this is not the case for the probability of a sovereign default conditional on a banking crisis.

[2] The nature of costs associated with default has been studied extensively since **?** and **?**. Scholars indeed agree on that debt repayment hinges on a sovereign's willingness to avoid the cost of a default given that existing legal arrangements do not provide sufficient protection of creditors' rights (due to the jurisprudential principle of "sovereign immunity"). See **?**, **?**, **?**, **?**, **?**, **?**, **?**, **?**, **?** and **?**, among others. **?**, **?** and **?** survey this literature.

[3] See **?**.

[4] See **?**.

firms can hedge their future refinancing needs through some type of contingent contracts rather than resorting to precautionary savings in non-contingent government bonds. Conventional wisdom suggests that this reform must have unambiguously positive welfare effects since it allows firms to reallocate efficiently liquidity across future states. However, this interpretation considers only one aspect of the reform. The reverse aspect of it is that the consequent decline in domestic demand for government bonds will reduce the direct cost of sovereign default on the economy and will restrict the government's access to foreign credit. In conclusion, an assessment that focuses exclusively on the efficiency gains for the private sector could overestimate the true effect of financial reforms, which might involve a reallocation of capital from the public to the private sector, particularly detrimental in countries with large returns on public infrastructures.

Two strands of the literature are brought together in this paper. First, the motivation for holding government bonds is based on the corporate finance approach to liquidity hoarding, e.g. **?**, and is extended to the case of open economies. The view of these authors is that corporations need to hoard liquidity to cope with future refinancing needs and they do so using government bonds since private markets cannot provide alternative saving instruments due to financial frictions. Yet, it could be argued that integration with a mature market, having a virtually infinite financial capacity, could alleviate the need for government bonds in the economy: indeed, the private sector could save in foreign saving instruments (e.g. US T-bills). In this paper, however, I show that this is not true in general. Indeed, a slight and realistic modification of **?**'s framework, i.e. the inclusion of sovereign risk, implies that government bonds in emerging markets cannot be substituted perfectly, as a source of liquidity, with foreign bonds. The intuition is that governments can manipulate domestic bond returns and make them procyclical, allowing domestic bondholders to reallocate efficiently resources across states of nature.

The second strand of the literature closely related to this paper includes a number of recent papers that focus on the consequences of sovereign default on the domestic private sector, e.g. **??**, **?**, **?**.[5] These papers have in common with mine the assumption about the imperfect discrimination among creditors, but address different implications: respectively, the welfare and distributional effects of default, the political process governing sovereign repayment and the interaction between private and public capital flows. My paper instead concentrates on the emergence of a liquidity crisis in the event of default and on the disruption of private investment.

As regards the empirical evidence, the paper documents that sovereign debt crises are associated with domestic liquidity crises. Using sectoral data for a panel of 59 emerging countries over the period 1980-2000, the evidence shows that sovereign defaults exert a differential effect across manufacturing sectors, which is both statistically and economically relevant, with financially dependent industries experiencing sharper contractions. Furthermore, the evidence shows that the domestic liquidity crisis is not fully explained by the contraction in foreign credit to the private sector.

[5] See also **?** and **?**.

The rest of the paper is organized as follows. Section 2 and section 3 discuss respectively the model features and the implications of financial reforms. Section 4 presents the empirical evidence and section 5 concludes.

2 A model of sovereign risk and liquidity crises

This section first characterizes a stylized economy where government debt represents a source of liquidity due to frictions in private credit markets. Then, it analyzes the implications of sovereign risk on private investment and aggregate output.

2.1 Technology

Consider a small open economy that lasts for three periods: $t = 0, 1, 2$. There is a single homogenous good which is produced by a continuum of risky investment projects. Investment in each project j costs one unit of the good in $t = 0$ and returns θA_j in $t = 2$, where θ and A_j denote two independent shocks realized in $t = 1$. θ captures an *aggregate* shock, which affects all projects equally and takes values $\theta_H > 1$ with probability $\pi_H \equiv \pi(\theta_H)$ (good state of the economy) and $\theta_L < 1$ with probability $\pi_L \equiv \pi(\theta_L) = 1 - \pi_H$ (bad state of the economy). Let's normalize the expected value of the shock to one, i.e. $\pi_H \theta_H + \pi_L \theta_L = 1$. A_j captures an *idiosyncratic* shock, which affects each project individually and takes values $A > 0$ if the project is lucky and zero if the project is unlucky. Each project has an equal probability of being lucky or unlucky. In the latter case, the project admits an additional investment with variable size, i, which returns $\theta \rho i$ in $t = 2$. Setting $\frac{A}{2} > 1$ and $\theta_L \rho > 1$, both date 0 and date 1 investments are profitable. Figure 1 describes the timing of investment projects.

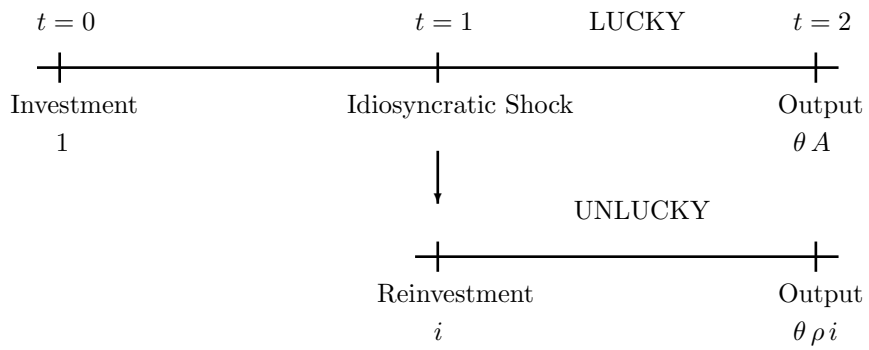

Figure 1: Timing of investment projects

2.2 Agents and Preferences

The economy is populated by a continuum of individuals with mass one, who have zero initial endowment, consume only at date 2 and are risk neutral. There are two types of individuals: *entrepreneurs* (firms) and *workers*, both with mass one half. Entrepreneurs have access to the investment technology and each one can start a single project. Workers, on the other hand, have no access to the investment technology, but get income w at date 1. There is also a benevolent *government* which maximizes the average welfare of domestic individuals. At date 0, the government has access to a public investment project with rate of return $\phi > 1$ and maximum size $\bar{g}$.

2.3 Financial Frictions

The economy is financially integrated with an international financial market (IFM), which is risk neutral, has deep pockets and can lend/borrow at the normalized interest rate $r^* = 1$. Hence, both the entrepreneurs and the government borrow from the IFM to finance their projects. Let's now discuss the type of financial frictions existing in this economy. First, entrepreneurs have a limited access to credit due to weak enforcement of creditors' rights, reflecting the inability of courts of law to seize the entire value of a debtor's assets.

Assumption 1 *Entrepreneurs can pledge only a fraction γ of expected revenues, while workers cannot commit future income.*

It is well known that financial frictions influence financial decisions in many ways.[6] Here, I focus on the demand for liquidity assuming (i) $\gamma \frac{A}{2} > 1$ and (ii) $\gamma\, \theta_H \rho < 1$. These two conditions imply, respectively, that date 0 investment is profitable for the IFM but date 1 investment is not. Hence, unlucky entrepreneurs cannot borrow on the spot market to finance additional investment.

Firms could meet their refinancing needs by negotiating a contingent contract with the IFM, which promises a positive transfer in case of adverse expenditure shock and a negative one in the alternative case. However, for the time being, I restrict this possibility.

Assumption 2 *Entrepreneurs cannot enter into contingent contracts with the IFM.*

Assumption 1 and 2 together imply that firms need to save for future investment and they can do so only purchasing non-contingent bonds. In this integrated economy, entrepreneurs can choose between a foreign bond issued by the IFM and a public bond issued by the domestic government. The government, indeed, issues a one-period bond in $t = 0$ to finance the investment in the public

[6] Since the seminal contribution of **?**, financial frictions and their consequences have attracted a growing literature. **?** and **?** provide two excellent surveys. A necessarily incomplete list of past contributions include: **?** and **?** on the link between credit cycles and business cycles; **?**, **?** on international capital flows and global imbalances; **?**, **?**, **?** on emerging market crises and sudden stops.

project and repays it by collecting lump-sum taxes at date 1. Sovereign risk arises whenever the government cannot commit to repay in the future.

Assumption 3 *The government commits to repay its debt with probability π_G.*

If $\pi_G = 1$, there is full commitment and the government always repays. If $\pi_G = 0$, there is full discretion and the government can choose whether to repay or not to maximize the welfare of domestic individuals. Following **?**, I consider that in the event of a default the government cannot discriminate between domestic and foreign creditors.

Assumption 4 *The government cannot discriminate between domestic and foreign creditors.*

Assumption **??** is consistent with the large haircuts suffered by domestic financial institutions on government bonds during recent debt crises (e.g. Russia 1998 and Argentina 2001). It also reflects the recent development of liquid secondary markets for sovereign bonds, which makes the gathering of informations on individual bondholders both unfeasible and inefficient for the government.[7]

3 Equilibrium

This section solves for the competitive equilibrium of the model under two opposite regimes: the case of full commitment by the government, i.e. $\pi_G = 1$, and the case of full discretion, i.e. $\pi_G = 0$. The comparison between the two cases helps to explain why domestic agents buy government bonds rather than foreign bonds and the connection between sovereign defaults and liquidity crises.

3.1 Equilibrium with government commitment

At date 0 the representative entrepreneur borrows d from the IFM and saves in government and foreign bonds up to a face value b and f to maximize the expected profit from the project,

$$\sum_{\theta} \pi(\theta) \left(\frac{y_l(\theta) + y_u(\theta)}{2} \right) - d \tag{1}$$

[7]Suppose the government could discriminate among domestic and foreign bondholders. Expecting a default on their bond holdings, foreigners would always unfold their positions before maturity by selling bonds on the secondary market to domestics, which have the incentive to buy the bond at any non-negative discount since they know the government has no incentive to default on domestic debt. This way, foreigners receive *de facto* their payment. Hence, if the government wants to avoid the repayment of foreigners, it must commit to default on all bond holders indiscriminately, for instance by not gathering information on secondary market transactions. By doing so, the government gains an additional degree of freedom and, as shown in the next section, can implement a contingent repayment policy which benefits domestic agents. The following quote from **?** is enlightening: *"the view that external debt is completely separable from domestically issued debt is dead wrong"*

where $y_l(\theta) = \theta\, A + (b + f - \tau)$ and $y_u(\theta) = \theta\, \rho(b + f - \tau)$ denote respectively the output from a lucky and an unlucky project. Notice that unlucky entrepreneurs fully reinvest in the project, i.e. $i = b + f - \tau$, since additional investment has strictly positive net returns. The budget constraint of the entrepreneur is

$$1 + b + f \;=\; d, \tag{2}$$

where government bonds have unit price as foreign bonds and the cost of initial investment is one. Limited contract enforcement restrains date 0 borrowing by imposing,

$$d \;\leq\; \gamma \sum_{\theta} \pi(\theta) \left(\frac{y_l(\theta) + y_u(\theta)}{2} \right). \tag{3}$$

Maximization of (**??**) subject to (**??**)-(**??**) features a corner solution where the borrowing constraint is binding and government and foreign bonds are perfect substitutes. This result hinges on that the expected (gross) return on both bonds for domestic entrepreneurs is higher than the borrowing rate, i.e. $\bar{\rho} \equiv \frac{(1+\rho)}{2} > 1$. In particular, the level of saving in government and foreign bonds by each entrepreneur is

$$b + f = \gamma\, \frac{\frac{A}{2} - \bar{\rho}\,\tau - 1}{1 - \gamma\,\bar{\rho}}. \tag{4}$$

Aggregation across individuals implies that the average income of entrepreneurs is $Y_E(\theta) = \frac{y_l(\theta)+y_u(\theta)}{2} - d$ and the average income of workers is $Y_W = w - \tau$. Social welfare is given by the sum of entrepreneurs' and workers' income plus the output of the public project,

$$W(\theta) = \frac{1}{2} Y_E(\theta) + \frac{1}{2} Y_W + \phi\; g. \tag{5}$$

The problem of the government then consists in choosing date 0 public investment and debt issuance, g and B, and date 1 taxation, τ, to maximize the expected value of social welfare, i.e. $\sum_\theta \pi(\theta)\; W(\theta)$, subject to the budget constraints $B = g$ and $\tau = B$. Maximization implies the following condition:

$$g = \begin{cases} \bar{g} & \text{if} \quad \phi \;\geq\; \frac{1}{2}\left(1 + \frac{\bar{\rho}-\gamma\bar{\rho}}{1-\gamma\bar{\rho}}\right) \\ 0 & \text{if} \quad \phi \;<\; \frac{1}{2}\left(1 + \frac{\bar{\rho}-\gamma\bar{\rho}}{1-\gamma\bar{\rho}}\right) \end{cases}. \tag{6}$$

Hence, the government undertakes the public investment only if its future return exceeds the cost of taxation required to pay for it. Suppose now that the government invests in the public project. Then, public debt at date 0 must equal the size of public investment, i.e. $B = \bar{g}$, and, by imposing market clearing, the level of external debt is $b^* = B - \frac{1}{2} b$. Thus, if public investment

$\bar{g}$ is greater or equal than aggregate domestic savings, given by the right hand side of (**??**) times the number of entrepreneurs, there exists one equilibrium in which the government doesn't need to borrow from the IFM. As sovereign risk emerges only when the government is borrowing from abroad, henceforth I focus on the alternative case.

3.2 Equilibrium with sovereign risk

Consider now that the government cannot commit and chooses whether to repay or not its debt to maximize the welfare of domestic individuals. In the absence of discrimination between domestic and foreign creditors, the government faces a clear trade-off: on one hand, debt repayment involves an efficient reallocation from workers to entrepreneurs which raises aggregate investment, but, on the other hand, it requires a transfer to the IFM, which reduces the resources available for domestic consumption. Let $e \in \{0, 1\}$ denote the repayment choice of the government, where $e = 1$ indicates repayment and $e = 0$ indicates default. Repayment occurs only if the average income gain of entrepreneurs (LHS) compensates the income loss of workers (RHS), or

$$Y_E(\theta, e = 1) - Y_E(\theta, e = 0) \;\geq\; Y_W(e = 0) - Y_W(e = 1), \tag{7}$$

where the policy e affects the average income of entrepreneurs $Y_E(\theta, e) = \frac{y_l(\theta,e)+y_u(\theta,e)}{2} - d$ through the face value of government bonds and taxation, as in

$$y_l(\theta, e) = \theta\, A + f + e\,(b - \tau) \quad \text{and} \quad y_u(\theta, e) = \theta\, \rho\big(f + e(b - \tau)\big), \tag{8}$$

while it affects the average income of workers only through taxation, as in $Y_W(e) = w - e\ \tau$.[8] Substituting for the budget balance condition $\tau = \frac{1}{2}b + b^*$ in (**??**), it is clear that government repayment involves a transfer to entrepreneurs when $b^* < \frac{1}{2}b$. Notice now that the LHS of (**??**) is increasing in the return from unlucky entrepreneurs' additional investment and, therefore, in the aggregate productivity θ, while the RHS is constant. Therefore, there might be an equilibrium where (**??**) is satisfied for $\theta = \theta_H$ but not for $\theta = \theta_L$. In such a case, the government's repayment policy is procyclical. Let's now show that this case results to be the unique equilibrium of the model.

At date 0, the representative entrepreneur decides how much to save in public and foreign bonds taking into account the risk of opportunistic behavior by the government. In particular, the entrepreneur chooses $\{d, b, f\}$ to maximize

$$\sum_{\theta} \pi(\theta) \left(\frac{y_l(\theta, e) + y_u(\theta, e)}{2} \right) - d, \tag{9}$$

[8] Condition (**??**) is expressed in terms of average income rather than total income since entrepreneurs and workers have equal mass.

once again subject to both a budget constraint and a borrowing constraint. The budget constraint is given by

$$1 + f + \pi_H \, b = d, \tag{10}$$

where the price of government bonds reflects the market expectations about future repayment and equals the actuarial fair price $\pi(\theta_H)$ required to compensate risk neutral agents for default in the bad state. The borrowing constraint instead is

$$d \leq \gamma \sum_{\theta} \pi(\theta) \left(\frac{y_l(\theta, e) + y_u(\theta, e)}{2} \right). \tag{11}$$

Revenue maximization now implies that domestic entrepreneurs save just in government bonds. Intuitively, government bonds are made contingent on the state of the economy by the government default choice, allowing domestic firms to reallocate liquidity to the state in which the productivity of additional investment is higher. A simple rearrangement of (**??**) shows indeed that the expected (gross) return on government bonds, $\bar{\rho}_H \equiv \frac{1+\theta_H \rho}{2}$, is greater than the expected return (gross) on foreign bonds, $\rho = \frac{1+\rho}{2}$, since $\theta_H > 1$. Given that both returns exceed the borrowing rate, the borrowing constraint must be binding and the following condition holds:

$$b = \gamma \, \frac{\frac{A}{2} - \pi_H \bar{\rho}_H \, \tau - 1}{\pi_H \left(1 - \gamma \bar{\rho}_H\right)} \qquad \text{and} \qquad f = 0. \tag{12}$$

As in the previous section, the government chooses $\{g, B, \tau\}$ to maximize the expected value of social welfare, i.e. $\sum_{\theta} \pi(\theta) \; W(\theta, e)$, where

$$W(\theta, e) = \frac{1}{2} Y_E(\theta, e) + \frac{1}{2} Y_W(e) + \phi \; g, \tag{13}$$

subject to the budget constraints $\pi_H B = g$ and $\tau = B$. In the absence of commitment, however, future repayment must be incentive compatible at least when $\theta = \theta_H$ to induce individuals to buy government bonds,

$$Y_E(\theta_H, e = 1) - Y_E(\theta_H, e = 0) \;\geq\; Y_W(e = 0) - Y_W(e = 1). \tag{14}$$

Maximization of social welfare finally implies that the incentive compatibility constraint is binding, the repayment policy of the government is procyclical, i.e. $e = 1$ if $\theta = \theta_H$ and $e = 0$ if $\theta = \theta_L$, and that the level of external debt equals a fraction of domestic debt,

$$b^* = \frac{1}{2} \left(\frac{\theta_H \rho - 1}{\theta_H \rho + 3} \right) b, \tag{15}$$

where the above condition is obtained by substituting for $Y_E(\theta_H, e)$ and $Y_W(e)$ and $\tau = B = \frac{1}{2}b + b^*$ in (**??**). The explanation for this result is quite intuitive. The government increases its external debt to maximize public investment.[9] At some point, the ex-post incentive compatibility constraint is satisfied only in the good state and the probability of future default becomes positive, the relative price of government bonds drops to compensate bondholders for the risk assumed and domestic firms start reallocating their savings from foreign to government bonds to increase the additional investment in the good state. As domestic holdings of government debt expand, the ex-post cost of default increases, the government borrowing constraint is relaxed and public investment can be further expanded.

3.3 Discussion

The previous model justifies the emergence of sovereign debt in absence of classic penalties and the connection between default and a liquidity crisis that disrupts private investment and amplifies output volatility when economic conditions worsen. Both results arise as a direct consequence of the liquidity role of public debt. Given that generality has been sacrificed in favor of analytical simplicity, a detailed discussion of the main aspects of the model is required.

- The model extends **?** argument that government debt represents a source of liquidity to the case of open economies. The perfect commitment case, indeed, shows that the existence of a market for government bonds does not improve domestic liquidity when the economy is financially integrated with a large financial market. Indeed, foreign bonds represent a perfect substitute for public bonds. Yet, the two assets become imperfectly substitutable when we consider sovereign risk, since government bonds guarantee an efficient reallocation of domestic liquidity across states of nature. Admittedly, risk aversion plays a crucial role here and, in fact, domestic agents would not hold domestic government bonds if they were sufficiently averse to risk.[10] The nature of liquidity needs then becomes crucial. Indeed, if agents need to save to invest in the future, intuition suggests they will prefer portfolios which perform better when the economic outlook is good and good investment opportunities are likely to arise. In such a case, government bonds constitute a better investment strategy. If they save to finance future consumption, they will prefer portfolios with countercyclical returns to hedge against adverse income shocks (e.g. wage cuts, unemployment). Nevertheless, it could be argued that governments often resort to financial repression to place their debt to domestic financial institutions. When this is the case, the consequence of a sovereign default so far described will be at play, notwithstanding the actual willingness of domestic agents to hold government bonds.

[9] Notice that I am still assuming that the return on public investment exceeds the implied cost of taxation in order to make the government willing to borrow, i.e. $\phi \geq \pi_H \frac{1}{2}\left(1 + \frac{1+\theta_H \rho}{2}\right)$.

[10] However, the preference for government bonds is robust to low level of risk aversion.

- Arguably, government bonds are held by financial institutions while firms rely on banks to manage their liquidity needs (e.g. through cash deposits or credit lines). Empirical evidence shows indeed that government bonds typically constitute a large fraction of domestic banks assets, with higher figures corresponding to developing countries and, among this group, to countries with weak creditor rights protection (see **?** and **?**). This observation, however, is not inconsistent with the model. Consider a slightly modified framework including a competitive banking sector, which borrows from the IFM and lend to domestic firms. This setup, suggested by **?**, is clearly equivalent to the previous one whenever there is no commitment problem between banks and firms (i.e. banks can monitor projects), but there is a commitment problem between banks and the IFM (e.g. banks can pledge only a fraction of their assets).[11] Hence, the two frameworks have no major differences in terms of the government's repayment policy, although the second interpretation certainly provides a more compelling description of the transmission of the liquidity crisis to the economy. In particular, the inclusion of a banking sector that holds government bonds and grants loans to firms, can justify the observation of interest rate spikes in the event of default: indeed, exactly as in the above model unlucky entrepreneurs could not refinance their project, banks will be forced to reduce the volume of credit to the private sector. This credit crunch will ultimately cause tighter competition for funds by firms and, in presence of decreasing returns, mounting interest rates.

- In the model, government debt enhances private liquidity because it involves a redistribution of resources from taxpayers to entrepreneurs that cannot be accomplished by private financial markets. An implicit assumption is therefore the inability of the government to redistribute resources within the economy, or equivalently that taxation is non-discriminatory. In its absence, the government would always default and just redistribute resources from workers to entrepreneurs. This type of redistribution, however, is arguably unfeasible due to either political costs or the reluctance of distressed agents to accede publicly-sponsored financing which could reveal information to the market (see for instance the scarce success to the Fed discounted window facility during the recent US crisis). Furthermore, the assumption of non-discrimination in taxation is a common assumption in the literature (see **?**, **?**, **?**).

- The need for public supply of liquidity hinges on the absence of private contingent assets. This assumption, which is taken as given in the model, can be easily justified by considering that the idiosyncratic expenditure shock is private information. In such a case, spot credit markets are still inaccessible to unlucky entrepreneurs, since a demand for additional funds in $t = 1$ immediately reveals the entrepreneur's type causing lenders to refuse further credit (recall that additional investment is not profitable for the IFM). Furthermore, if the shock is unobservable, agents cannot write contracts contingent on it.

[11] The equivalence between the two frameworks is trivial when we consider that each bank lends to just one firm.

4 Financial reforms

In the late 90's, the US federal debt paydown, mirrored in many OECD countries, and the disappearance of government bonds raised practitioners worries about liquidity provision to the private sector and spurred the development of alternative liquidity-enhancing instruments as over-the-counter derivatives (see **?**, **?**, **?**). Twisting this argument, one could argue that the recent expansion of over-the-counter markets in emerging economies, fostered by new market infrastructures, regulations and higher financial integration (see **?**), raises a specular problem. In particular, the possibility to hedge future refinancing risks through a wide and highly flexible range of instruments (like fixed-income, currency or equity derivatives) could dampen domestic appetite for public bonds and, ultimately, the government's access to credit. This section discusses the welfare implications that arise from this type of financial reforms.

Assumption 2 imposed that entrepreneurs could not enter in contracts contingent on the expenditure shock and could refinance their investment only through their previous savings in non-contingent bonds. Relax now this assumption and suppose that there are two types of domestic firms: good firms, which can trade contingent contracts with the IFM, and bad firms, which cannot.[12] The expansion of derivative markets can then be mimicked by an exogenous increase in the number of good firms in the economy.

Assumption 2' *Let $\lambda \in \left(0, \frac{1}{2}\right)$ denote the number of good firms, i.e. firms that can enter into a contract contingent on the expenditure shock.*

Let's now analyze the effects of a change in λ. Results from the previous section imply that bad firms save in government bonds up to $b = \gamma \frac{\frac{A}{2} - 1 - \pi_H \frac{1+\theta_H \rho}{2} \tau}{\pi_H \left(1 - \gamma \frac{1+\theta_H \rho}{2}\right)}$ and get average revenues

$$Y_{Eb}(\theta, e) = \begin{cases} \theta_L \frac{A}{2} - 1 - \pi_H \ b & \text{if } \theta = \theta_L \\ \theta_H \frac{A}{2} - 1 - \pi_H \ b + \frac{1+\theta_H \rho}{2} \ b - \frac{1+\theta_H \rho}{2} \tau & \text{if } \theta = \theta_H \end{cases}, \tag{16}$$

where I implicitly substituted for $e = 1$ if $\theta = \theta_H$ and $e = 0$ if $\theta = \theta_L$. Good firms, instead, can save in a foreign security that is contingent on the aggregate productivity shock, as government bonds, but also on the idiosyncratic expenditure shock.[13] Let x denote the amount of foreign securities purchased by each good firm and $q = \frac{1}{2}\pi_H$ be the actuarial fair price of each foreign security. Good firms then purchase the foreign security up to $x = \frac{\gamma \frac{A}{2} - 1 - \pi_H \frac{1+\theta_H \rho}{2} \tau}{\frac{1}{2}\pi_H (1 - \gamma \theta_H \rho)}$ and get

[12] One interpretation for good and bad firms is that the former are well regulated and transparent firms with foreseeable cash-flows from their assets, while the latter are badly regulated and opaque firms holding assets with uncertain values. The analogy with the distinction between good and bad banks in the recent US crisis seems therefore appropriate.

[13] Given that terms of private contingent contracts are determined in equilibrium, domestic agents will choose contracts that are contingent on the aggregate productivity shock for the same token discussed in the previous section.

average revenues

$$Y_{Eg}(\theta, e) = \begin{cases} \theta_L \frac{A}{2} - 1 - \frac{1}{2}\pi_H \; x & \text{if } \theta = \theta_L \\ \theta_H \frac{A}{2} - 1 - \frac{1}{2}\pi_H \; x + \frac{\theta_H \rho}{2} \; x - \frac{1+\theta_H \rho}{2}\tau & \text{if } \theta = \theta_H \end{cases} . \tag{17}$$

Given that $\rho > 1$, substitution of b and x into (**??**) and (**??**) implies that the expected revenue of good firms, $\sum_\theta \pi(\theta) Y_{Eg}(\theta, e)$, is higher than the expected revenue of bad firms, $\sum_\theta \pi(\theta) Y_{Eb}(\theta, e)$. Not surprisingly, therefore, a financial reform that introduces a market for contingent securities improves the efficiency of capital allocation across states of nature and raises the aggregate output of the private sector.

Let's now analyze the implications of the reform on the government policy. To see this, consider the problem of the government which chooses the investment g to maximize the expected social welfare $\sum_\theta \pi(\theta) \; W(\theta, e)$, where

$$W(\theta, e) = \lambda \, Y_{Eg}(\theta, e) + \left(\frac{1}{2} - \lambda\right) Y_{Eb}(\theta, e) \; + \; Y_W(e) + \phi \; g, \tag{18}$$

subject to the budget balance conditions $\left(\frac{1}{2} - \lambda\right) b + b^* = g$ and $\tau = \left(\frac{1}{2} - \lambda\right) b + b^*$ and the incentive compatibility constraint, i.e.

$$\begin{aligned} \left(\frac{1}{2} - \lambda\right) \Big(Y_{Eb}(\theta, e = 1) - Y_{Eb}(\theta, e = 0)\Big) \; \geq \; \lambda \Big(Y_{Eg}(\theta, e = 1) - Y_{Eg}(\theta, e = 0)\Big) + \\ + \Big(Y_W(e = 1) - Y_W(e = 0)\Big). \end{aligned} \tag{19}$$

Consider once again that the government wants to borrow to start the public project.[14] As discussed before, the government will borrow up to the point in which the incentive compatibility constraint is binding in order to maximize public investment and therefore

$$b^* = \left(\frac{1}{2} - \lambda\right) \left(\frac{\theta_H \rho - 1}{\theta_H \rho + 3}\right) b. \tag{20}$$

Comparative statics then show that an increase in the number of good firms λ restrains the government's access to foreign credit and therefore the size of public investment. The welfare consequences of the reform, hence, are ambiguous: indeed, substitution of (**??**) into (**??**) implies that social welfare increases only if the efficiency gain in the private sector is greater than the expected net return on public investment, i.e. $\sum_\theta \pi(\theta)(Y_{Eg}(\theta, e) - Y_{Eb}(\theta, e)) \geq \Big(\phi - \pi_H \frac{1}{2}\left(1 + \frac{1+\rho}{2}\right)\Big)\left(1 + \frac{\theta_H \rho - 1}{\theta_H \rho + 3}\right) b$.

[14] This requires $\phi \geq \pi_H \frac{1}{2}\left(1 + \frac{1+\rho}{2}\right)$, i.e. the return on public investment exceeds the implied cost of taxation.

4.1 Discussion

The previous section delivers a simple but powerful result. The common presumption that a complete market for private claims necessarily raises welfare might not be robust to the inclusion of an interaction between private and public debt markets. In particular, the efficiency gains in the allocation of capital across private agents might overestimate the real effect of the reform, which can involve a reallocation of capital from the public to the private sector, particularly detrimental in poor countries with large returns on public infrastructures. Strong policy prescriptions, however, are undoubtedly misplaced in this simple environment. For instance, a relaxation of the benevolent government assumption yields diametrically opposite implications. In such a case, welfare increases when the government borrows less and therefore the improvement in domestic financial markets will have a beneficial disciplining effect on public expenditure.[15] Far from making normative statements, this paper suggests that financial reforms deliver novel implications on the composition of capital flows.

An alternative interpretation of the model suggests that governments might oppose financial liberalization and resort to form of financial repression to sustain domestic holdings of government debt. **?** reports the case of Argentina, where bank reserve requirements clearly privileged government bonds by classifying them as *"being the least risky of all assets that a bank could hold"* and by successively raising the share of government bonds in total reserves to allow the central government to collocate additional debt. This example suggests that inefficient institutions tend to be particularly persistent in time for reasons that differ from the ones already discussed in the literature, which stress the role of initial conditions extremely costly to revert or political economy reasons to maintain the *status quo*.

5 Sovereign defaults and liquidity crises: empirical evidence

This section documents that sovereign debt crises are associated with liquidity crises. The empirical evidence indeed shows that sovereign defaults prompt sharper contractions in industries that depends on external sources of finance. The evidence also shows that the domestic liquidity crisis in the event of default cannot be fully ascribed to the decline in foreign credit, in line with the previous model.

I test the distinct impact of sovereign default across manufacturing industries using the following empirical model,

$$g_{i,c,t} \;=\; \alpha_{i,c} \;+\; \lambda_{i,t} \;+\; \mu_{c,t} \;+\; \Big(\beta_F\, FinDep_i \;+\; \beta_X\, X_i\Big) \cdot DEF_{c,t} \;+\; \epsilon_{i,c,t}, \tag{21}$$

[15] I am grateful to an anonymous referee who suggested this interpretation.

where $g_{i,c,t}$ denotes the value-added growth in industry i of country c in time t, $\alpha_{i,c}$ is a industry-country fixed effect that captures the growth trend along the time sample in each industry and country pair, $\lambda_{i,t}$ is a sector-time fixed effect that captures global sector-specific shocks in each period and $\mu_{c,t}$ is a country-time fixed effects that captures country-specific macroeconomic shocks, and therefore includes the average effect of sovereign default on manufacturing growth.

The main focus is on the growth response of industries with different external dependence, as captured by the interaction between the default indicator $DEF_{c,t}$ and a measure of sectoral external dependence $FinDep_i$. Given that $FinDep_i$ takes higher values when an industry shows greater financial dependence, a negative coefficient on this interaction term, i.e. $\beta_F < 0$, suggests that financial dependent industries experience sharper contractions in the event of default. Spurious correlation in the estimation of β_F is reduced by including alternative industry characteristics, that might be partially related with financial dependence but capture different aspects of each industry: namely, capital intensity, skill intensity and export orientation.

The interaction coefficients β_F and β_X are estimated using a fixed-effect estimator, after eliminating the industry-time effects, $\lambda_{i,t}$ and country-time effects, $\mu_{c,t}$, by taking out the industry-time average and the country-time average from all variables prior to estimation. Notice that the fixed-effect estimate of β_F will be independent on both within-country convergence dynamics across industries, as imposed in other studies focusing on sectoral growth,[16] and on each country's degree of financial integration, partially controlling for the foreign retaliation argument.

5.1 Data

Data on value added at the industry level are obtained from the UNIDO INDSTAT3 2005 database and includes 28 sectors defined according a 3-digit ISIC classification for a wide range of countries and time. Original data in current US dollars are first converted in constant prices using the US GDP deflator, sourced from the World Bank's *World Development Indicators 2006*, and then log differenced to obtain the growth rate. The large amount of noise, due to misreporting and sporadic observations, is filtered using common procedures for these data.[17] First, I drop those observations for which the growth rate of value added fall in the top and bottom 2.5 percent of the distribution. Second, I remove time spells with less than 5 consecutive observations for each industry-country pair. Third, I exclude all country-year pairs reporting data for less than 10 sectors.

Financial dependence is measured as the median share of investment not financed with internal cash flow in industry i. Data on this index is sourced from **?**, who report the original **?** index at the 3-digit ISIC level, and is based on US public companies balance sheet information. As

[16] See the seminal paper by **?**, among others.
[17] See **?**.

argued by **?**, the focus on US data permits to isolate technological differences across sectors that are invariant across countries.

Capital intensity and skill intensity are measured respectively as the ratio of real capital stock on value added in industry i and the ratio of nonproduction worker wages to total wages in industry i, averaged over the time sample. These data are taken from the NBER manufacturing productivity database and converted to match the ISIC classification scheme by mean of a concordance table. Export orientation is measured as the average ratio of exports on output in industry i over the time sample. The source for these data is **?**. To ease interpretation, all industry indexes are normalized such that they have mean zero and standard deviation one.

Default episodes are indicated by a dummy variable that takes value one in the first year after government announcement.[18] As in most of the empirical sovereign debt literature, the source of data used to define default episodes is the Standard and Poor's database. A list of default episodes included in the sample is provided in the appendix.

To guarantee parameter stability within the sample, I focus only on developing countries, using the World Bank classification of low, lower middle and upper middle income countries. The final dataset includes 28 manufacturing sectors in a cross-section of 59 developing countries over the period 1980-2000.

5.2 Results

Table **??** reports fixed-effect estimates relative to the 1980-1990 and the 1990-2000 samples (columns 1-4). The interaction between the default dummy and the financial dependence index enters with a negative sign in all specifications but is statistically significant only in the sub-period 1990-2000. Arguably, this result does not reject the theoretical model. Indeed, a key assumption of the model, namely the non-discrimination between foreign and domestic bond holders, suits more realistically the institutional set-up of sovereign debt markets in the 1990s. Indeed, it is only during the 1990s, as a consequence of the Brady plan, that the share of debt issued in anonymous bond markets started to soar in emerging countries, whilst before most of sovereign borrowing was granted in the form of syndicated bank loans.

As regards the 1990s, the point estimate of coefficient β_4 is also economically significant. In fact, industries that are one standard deviation more financial dependent than the median industry experience a four percentage points decline in their relative growth rate. The last column of table **??** also shows that this effect is robust to the inclusion of additional industry characteristics.

[18] Since the exact time of default is difficult to identify, I extend the definition of default to the first two year after the government announcement and to the first three years. In both cases, the estimate of coefficient β_F remains negative and statistically significant, albeit it moves towards zero as the default window expands.

Table 1: **Estimation Results**

	(1) 1980-1990	(2) 1980-1990	(3) 1990-2000	(4) 1990-2000	(5) 1990-2000
$DEF_{c,t} \cdot FinDep_s$	-0.002	-0.001	-0.042**	-0.043**	-0.043**
	(0.011)	(0.011)	(0.018)	(0.021)	(0.021)
$DEF_{c,t} \cdot Kint_s$		0.022*		-0.003	
		(0.011)		(0.019)	
$DEF_{c,t} \cdot Hint_s$		-0.002		-0.009	
		(0.010)		(0.016)	
$DEF_{c,t} \cdot ExpOr_{s,c}$		0.105		-0.459	
		(0.391)		(0.730)	
$SS_{c,t} \cdot FinDep_s$					-0.023**
					(0.010)
Sector-country effects	Yes	Yes	Yes	Yes	Yes
Obs.	9332	7913	7988	7239	7701

***,**,* represent significance at 1%, 5%, and 10%, respectively. Heteroskedasticity-consistent standard errors are reported within parenthesis. Sector-time and country-time fixed effects were removed prior to estimation by mean differencing.

During the 1990s, however, the importance of foreign credit to the private sector has also increased. One might then argue that the trigger of the liquidity crisis lies in the halt in foreign private lending rather than in the default on domestically held bonds. In fact, **?** show a significant decline in foreign credit to the private sector during default episodes. In order to control for this alternative explanation, I include in the baseline regression an interaction term between the financial dependence index and a dummy capturing sudden stop episodes. Sudden stop episodes are defined as a five percent decline in net financial inflows relative to GDP, as in **?**, and mainly reflect reversion in bank loans and trade credit. Nonetheless, column 5 in table **??** shows that sovereign default still exerts a significant stronger effect on financial dependent industry, which exceeds the average relative contraction experienced by these industries in concomitance with a sudden stop in foreign lending. Hence, this evidence shows that the domestic liquidity crisis is not fully explained by the contraction in foreign credit to the private sector.

6 Conclusion

Sovereign debt crises in emerging markets are usually associated with financial turmoil and liquidity crises throughout the economy. This connection is suggested by both anecdotical and empirical evidence. In particular, defaults episodes appear to lead banking crises. However, there is no clear evidence supporting the application of foreign penalties when default occurs.

This paper then proposes a novel mechanism linking sovereign defaults with liquidity and banking

crises without any intervention of foreign creditors. The model considers a standard unwillingness-to-pay problem assuming that: (i) the enforcement of private contracts is limited and, as a result, public debt represents a source of liquidity; (ii) the government cannot discriminate between domestic and foreign agents. The model shows that external debt might emerge even in absence of classic penalties imposed by foreign creditors. Indeed, the prospect of triggering a liquidity crisis throughout the economy restores the ex-post incentive to pay of the government. Nonetheless, liquidity crises might arise when economic conditions deteriorate and the government chooses opportunistically to default in order to avoid the repayment of foreign agents. Empirical evidence consistent with the connection between sovereign defaults and liquidity crises is also provided.

This paper also suggests novel implications arising from financial reforms in the economy. The common presumption that a complete market for private claims necessarily raises welfare might not be robust to the inclusion of an interaction between private and public debt markets. In particular, the efficiency gains in the allocation of capital across private agents might overestimate the real effect of the reform, which can involve a reallocation of capital from the public to the private sector, particularly detrimental in poor countries with large returns on public infrastructures. In particular, the model provides implications on the composition of capital flows whose analysis constitutes a fruitful area of future research.

A A snapshot of the Argentine crisis

After being almost fatally wounded by the shock wave of the Mexican Tequila Crisis in 1994-1995, the Argentinean banking system was deeply reformed by the introduction of a new regulatory regime, called BASIC, designed following the international standards in the Basel Accord. As reported by **?** in his recent book *The Next Great Globalization*, the reform was instigated by concerns raised by depositors' run on domestic banks and the consequent decline in bank lending to non-financial companies which drove the Argentine economy into a recession. The new regime had *"strict liquidity requirements, which required banks to hold* 20% *of short-term deposits in safe and liquid assets"*. Though, from the Basel Accord it inherited *"a weighting scheme for measuring bank risk according to which government bonds were classified as being the least risky of all assets that a bank could hold"* designed to fit advanced countries better than emerging markets. Thus, at the outset of the 2001 crisis Argentine banks were already major holders of government debt and the banks' exposure grew further when the limits on the share of government bonds in bank reserves were lifted to allow the central government to collocate additional debt: *"the banks went along because, with their high interest rates, the bonds would be very profitable if the government avoided default"*. By then, the stability of the banking system was compromised. When the government announced a temporary suspension of debt payments and, soon after, abandoned the currency board, most firms were declared insolvent on their dollar-denominated debts and the strength of bank balance sheets was seriously undermined by large losses in both the defaulted government debt and private loans. That precarious situation was further exacerbated by the subsequent asymmetric *pesofication* of bank loans and deposits. With banks not granting new loans, businesses dramatically cut back on their spending, aggravating further the economic downturn. While the trigger of the Argentine debt crisis is arguably in four external shocks (namely, the appreciation of the US dollar, the decline in the terms of trade, the Russian crisis and the Brazilian exchange rate crisis), **?**'s analysis shows that the cost of the government's default was substantially magnified by the destabilization of the internal credit market.

Table 2: **Default episodes in the sample**

Country	Default year	Country	Default year
ARG	1989	PAN	1983
BOL	1986	PAN	1987
BOL	1989	PER	1983
CHL	1983	PHL	1983
CRI	1981	POL	1981
CRI	1984	RUS	1998
ECU	1982	SEN	1990
ECU	1999	SEN	1992
EGY	1984	SLV	1981
ETH	1991	TUR	1982
GTM	1986	TZA	1984
HRV	1992	URY	1983
JAM	1987	URY	1987
JOR	1989	URY	1990
KEN	1994	VEN	1983
LKA	1996	VEN	1990
MAR	1986	VEN	1995
MDG	1981	ZAF	1985
MDG	1986	ZAF	1989
MEX	1982	ZAF	1993
MKD	1992		