

Banking Crisis, Sovereign Debt Crisis and Credit Rating Agencies

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Abstract

We propose a framework to analyze the interactions between the banking and sovereign debt crises in the aftermath of the 2007-2009 global financial crisis. We introduce government spending and public debt in an open economy banking crisis model built on Diamond and Dybvig (1983) and Chang and Velasco (2000, 2001). We examine in this framework how a banking crisis, and the associated requirement to implement costly bailout programs, can seriously aggravate public debt concerns. Similarly, we show how countries with a highly increasing public debt can seriously endanger the stability of the banking system by rendering banks who hold large amounts of government bonds more vulnerable to runs. We finally analyze in this context the role of credit rating agencies. We show that if investors give strong credence to agency ratings – as reflected by a strong sensibility of risk premia to rating changes – the decision to downgrade the rating of some countries can be sufficient to trigger a twin crisis, thus making the ‘prophecy’ of the agency self-fulfilling.

Keywords: Debt-elastic interest rate, banking crisis, sovereign debt crisis, bank run, credit rating agency, multiple equilibria.

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1 Introduction

During the period from 2007 to 2009, the economies of the United States and Western European countries were hardly struck by the subprime crisis. One remarkable unexpected consequence of this crisis is that many peripheral countries of the Eurozone are now confronted to a new kind of twin crisis, i.e. the simultaneous appearance of a banking crisis and a sovereign debt crisis. During the financial crisis, several member states had to implement massive bailout programs in order to save their domestic banks from bankruptcy. This, together with the negative effects of the crisis on tax revenues, has contributed to sharply increase the public-debt-to-GDP ratio of these countries. At the same time, the situation of many European banks, who were holding significant amounts of European sovereign debt, has been weakened by the increasing risk associated with many government bonds. This has generated a feedback loop between sovereign credit and bank funding conditions, aggravated by successive waves of downgrades by credit rating agencies.

The aim of this paper is to provide a framework to understand these issues and to analyze the conditions of emergence of a vicious cycle leading to a twin crisis, i.e., the simultaneous occurrence of a banking crisis and a sovereign debt crisis. We investigate these issues by adding several features to the traditional banking crisis model of Diamond and Dybvig (1983) and Chang and Velasco (2000, 2001): First, we introduce public debt and government budget constraint to capture the interactions between the banking sector and the fiscal authorities. Second, we assume that the government can intervene to prevent or stop a bank run at the cost of an increasing public debt. Third, we introduce a role for credit rating agencies through a debt-elastic interest rate. Finally, we consider the consequences of regulatory measures imposing to commercial banks to hold a certain quantity of government bonds as liquidity reserves, in the purpose of reinforcing the solvency of the banking system and the stability of the economy.

By incorporating government's budget constraint, public debt sustainability issue and imperfect international financial markets – represented by country specific risk premia correlated with sovereign debt credit ratings – our theoretical framework allows us to analyze the complex interactions between the fragility of the banking system and the over-indebtedness of the public sector. Our model leads to several conclusions:

First, we show that for governments who cannot rely on seigniorage revenues, the commitment to bail out banks during a crisis is credible only if the ratio of public debt to GDP *after* the implementation of the bailout program remains at a sufficiently low level. Furthermore, in a context where investors give strong credence to credit rating agencies to determine their investment decisions, the choice to downgrade or not those countries can become a self-fulfilling prophecy. For example, when the level of public debt is already high (but still sustainable) before the implementation of the package, the decision to downgrade the country's rating can generate an increase in risk premia applied on government bonds sufficient to make the government insolvent. In this context, credit rating agencies can play the crucial role of a selection device, influencing through their decisions the trigger (or not) of a twin crisis.

Second, we show that regulatory measures, such as the requirement to hold supposedly safe and liquid assets (such as AAA rated government bonds), may have perverse effects during periods of potential sovereign debt crisis. The reason is that the downgrade of the sovereign debt of several countries can be a source of contagion for domestic banks who hold a significant amount of these bonds for regulatory purposes.

The remainder of the paper is organized as follows. The next subsection relates our work to relevant literature. In the next section, we present the basic framework to explore

the relationship between the banking sector and government budget, the optimal state of the economy, the situation of a bank run and the role of government in bailing out the banking system. We further specify the role of credit rating agency and its impact on the banking and sovereign debt crises. In section 3, we enrich the framework in introducing the government bonds in bank's balance sheet under the implementation of the liquidity regulation. We then analyze the effect of contagion in the event where domestic banks hold the foreign bonds. In section 4, we present the case where the bank is downgraded and the final section concludes.

Relationship to the literature

The paper is related to a number of contributions. Most obviously, it brings together the literature on banking and financial crisis. Our model is built on the open economy banking crisis model of Chang and Velasco (2000, 2001) which is based on the traditional banking crisis model of Diamond and Dybvig (1983). We have ignored the maturity issue linked to bank's debt to focus our attention to the volatility of government bonds. The major contribution of this paper is that we bridge the theoretical gap between the sovereign debt and banking crises. The interactive relationship between the solvency of the government (hence the sustainability of the bailout package) and the banking crisis have been ignored in the theoretical literature on banking crisis. Most of the existing research emphasizes the role of the central bank as a lender of last resort in managing the banking crisis and puts accent on the adequacy of foreign currency reserves of the central bank in currency and banking crises (Rodrick and Velasco (1999), Radelet and Sachs (2000) and Domac et al.(2003)), or the link between the currency crisis and the banking crisis (Kaminsky (1998), Kaminsky and Reinhart (1999), Chang and Velasco (2000, 2001), Flood and Marion(2004) , Bauer et al.(2007), and Bleaney et al.(2008)). Gennaioli et al. (2010) have built a model where public default weakens the balance sheets of banks due to the holding of public bonds. They show complementarities between public debt and domestic credit markets, where the latter sustain the former by increasing the cost of default. Nevertheless, they do not make the link with the banking crisis literature.

Laeven and Valencia (2008) have shown that there was some kind of government interventions to rescue banks in thirty two among forty two systemic banking crises, through buying bad assets/loans, injecting cash in banks and/or providing credit lines to banks. Schneider and Tornell (2004) show positive effects of government bailout in managing the banking crisis. However, these papers do not take into account the solvency condition of the public sector. In other words, the government's ability to rescue the banking sector is treated as being infinite. Hasman et al. (2011) analyze the effectiveness and the impact on welfare of different government policies to prevent the emergence of banking crises. These policies include using taxpayers' money to recapitalize banks, government's credit lines to the banking system, the creation of a buffer and taxes on financial transactions (e.g., the Tobin tax). However, they have not paid attention to the role of public debt in the government's budget constraint.

This paper has shed the light on the role of credit rating agency in the occurrence of twin crises by exploring the relationship between the level of public debt and the downgrade of sovereign creditworthiness through the elastic interest rate. Therefore, of great relevance to our paper is the literature on the debt elastic interest rate, i.e. the external position of an over-indebted country deteriorates its financial conditions in the international financial market. In the open-economy macroeconomics, the debt elastic interest rate provides a convenient and elegant way to close small open economy models. This notion appeared first in Bardhan (1967). Henceforth, it is adopted in several studies, for instance, Bhandari

et al. (1990), Schmitt-Grohe and Uribe (2003), Uribe (2007), and Corsetti et al. (2009). The risk premium in debt elastic interest rate could capture the fact that borrowers from highly indebted countries face less favorable financing conditions in international markets.

2 The Basic framework

Our model has some features similar to these adopted in the open economy banking crisis model of Chang and Velasco (2000, 2001). For simplicity, we abstract from the questions arising from debt maturity by assuming that banks use only short-term debt to finance investment. On the other hand, we introduce three kinds of investment vehicles, i.e., government bonds, short-term project versus long-term project. The banking crisis studied in our model is of the type specified by Diamond and Dybvig (1983). In incorporating a government budget constraint and an imperfect international financial market represented by a country specific risk premium which is correlated with the rating by credit rating agencies, we build a model which allows analyzing the highly complex interactions between the fragility of banking system and the over-indebtedness of the public sector observed in recent banking and sovereign debt crises in several developed European countries.

We first start with the simplest case without government bonds in bank's balance sheet. We assume that during most periods of time, the economy is in "normal times". Normal times mean that, in a situation where there exist ex-ante two equilibria (a no-run and a run equilibrium), agents do not panic and do not run. On the other hand, on rare occasions, the economy drops into a situation of "crisis". In a crisis situation, people panic. If a bank-run situation is an equilibrium outcome, people run.

2.1 Description

The small open economy is populated by a large number of agents, of measure one, called "depositors". Each depositor is endowed with an amount e of the tradable goods at the initial date (or the planning period). At the time t_0 , depositors are uncertain about their type, i.e., patient versus impatient. Information about types of depositors (or the time of consumption) is private and will be revealed at t_1 (i.e., short-term). However, there is no aggregate uncertainty in the economy. By the law of large numbers, the fraction of depositors who can derive the utility only from the consumption at t_1 is non-stochastic and denoted by λ . This type of consumer is called impatient. $1 - \lambda$ is the fraction of patient depositors who consume at t_2 (i.e., long-term) to maximize their utility. x stands for the consumption that each impatient depositor can derive from t_1 withdrawal, and y denotes the consumption of each patient depositor derived from t_2 withdrawal. The consumers' utility is measured by a CRRA function $U(c) = c^{1-\sigma}/(1-\sigma)$ with a positive coefficient of relative risk aversion, $\sigma > 0$. Thus, the expected utility of the representative depositor at t_0 is then

$$\lambda U(x) + (1 - \lambda)U(y).$$

Commercial banks

Bank works as the intermediary between depositors and firms. It takes advantage of the law of large numbers to predict more accurately its needs for costly liquidity. It pools the resources of the economy including depositors' endowments e and their capacity of borrowing in the international financial market. As in Chang and Velsaco (2000, 2001), the

bank can borrow from the international financial market a maximum amount $f > 0$ which is exogenous in our model. The credit ceiling, which is exogenous in this model, could be supported by many theoretic works on international borrowing under sovereign risk. The level of f can be treated here as imposed by the government's financial regulation which defers domestic banks from over-borrowing in the international financial market to avoid the banking crisis. There are two constant-return-to-scale technologies in this economy. The government starts at t_0 with an amount of debt which is financed by issuing long-term government bonds maturing at the end of period 2. Without seigniorage revenue, the government taxes entrepreneurs' projects with a rate τ to reimburse the mature bonds. For one unit of good invested at t_0 , long-term technology pays $(1 - \tau)R_h > 1$ units of goods in return after taxes, but only $(1 - \tau)r_l < 1$, if the project is restructured at t_1 . Short-term technology brings $(1 - \tau)R_s > 1$ units of goods in return after taxes at t_1 . It follows that

$$(1 - \tau)r_l < 1 < (1 - \tau)R_s < (1 - \tau)R_h, \quad (1)$$

On account of the high return of the long-term projects, the bank trends to invest as many resources as possible in this illiquid project.

To avoid the excessive complexity involved in examining all of the bank's options, we follow Chang and Velasco (2001) by applying the Revelation Principle which implies that attention can be restricted to feasible allocations. The latter give no agent an incentive to misrepresent her type. Therefore, the best allocation of resources attainable by the bank must solve a relatively simple social planning problem. To ensure an optimal allocation of resources, a bank has to satisfy the demand of liquidity in each period and avoid the liquidation of long-term projects. In doing so, the bank needs to respect resource constraints and informational constraints. The application of the Revelation Principle to the bank's problem ensures that the Bayesian Nash equilibria of any game played by depositors can be replicated by the truthful equilibria of a game in which each depositor is asked to report her type. Formally, the bank's problem is to maximize expected utility of depositors:

$$\max \lambda U(x) + (1 - \lambda)U(y), \quad (2)$$

subject to constraints:

$$f_1 \leq f, \quad f_2 \leq f, \quad (3)$$

$$A + K \leq e + f_1, \quad (4)$$

$$\lambda x + f_1 \leq (1 - \tau)AR_s + f_2 + (1 - \tau)r_l l, \quad (5)$$

$$(1 - \lambda)y + (1 + r_{12}^b)f_2 = (1 - \tau)R_h(K - l), \quad (6)$$

where A and K are the amount of goods invested respectively in the short-term project and illiquid long-term project. f_1 and f_2 are the bank's short-term foreign debt in the first and second period respectively. l is the amount of long-term projects restructured at t_1 . The interest rate in the first period is assumed to be zero for simplicity. r_{12}^b is the real interest rate on bank's borrowing in the second period.

The constraint (3) show that, to respect the credit ceiling f , the bank has to choose a level of borrowing at the initial date which could be refinanced at t_1 . The constraint (4) represents the resource constraint of the bank at t_0 . It shows that bank's investments in short term, long-term projects cannot exceed the amount of resources collected at t_0 . Constraints (5) and (6) are bank's feasibility conditions at t_1 and t_2 respectively.

2.2 The optimum

In "normal times", agents do not panic, thus the long-term projects are fulfilled. In normal times, the domestic economy faces favorable conditions. The real interest rate on bank's borrowing is equal to the world interest rate r^* . It is also assumed that, if the economy is in a situations of "normal times" in period 0, they expect this situation to prevail up to period 2 (as in Diamond and Dybvig and Chang and Velasco). This means that crises situations occur sufficiently rarely that they are not taken into consideration when forming expectations.

The no-run equilibrium implies that all inequality constraints bind and no project is restructured prematurely i.e., $l = 0$. As long as long-term projects are highly profitable, it is optimal for the bank, maximizing the utility of representative agent to borrow as much as it can at the initial date so as to invest more in long-term projects and roll over the debt at the intermediate date. Thus the credit ceilings (3), the resource constraint (4) and the feasible condition (5) are binding at the optimum. The optimal solutions are identified with a tilde above the variables. We thus obtain:

$$\tilde{f}_1 = \tilde{f}_2 = f, \quad (7)$$

$$\tilde{A} + \tilde{K} = e + f, \quad (8)$$

$$\lambda \tilde{x} = (1 - \tau) \tilde{A} R_s, \quad (9)$$

$$(1 - \lambda) \tilde{y} + (1 + r^*) f = (1 - \tau) R_h \tilde{K}. \quad (10)$$

Given the optimal conditions (7), (8), (9) and (10), we can examine now the bank's best remuneration for patient and impatient depositors respectively. The optimal allocation between x and y should satisfy the social transformation curve:

$$\begin{aligned} \frac{R_h}{R_s} \lambda \tilde{x} + (1 - \lambda) \tilde{y} &= (1 - \tau) R_h (\tilde{A} + \tilde{K}) - (1 + r^*) f \\ &= (1 - \tau) R_h (e + f) - (1 + r^*) f \\ &\equiv v. \end{aligned} \quad (11)$$

The left-hand side of equation (11) denotes the expected value of total withdrawal at t_2 , and the right hand side of this equation stands for the net wealth of the bank in terms of the value at t_2 . Impatient depositors withdraw and consume a total quantity equal to $\lambda \tilde{x}$ at t_1 . If they renounce to consume at the intermediate date, they can obtain $\frac{R_h}{R_s}$ unities of goods at date t_2 .

Given the CRRA utility function, the maximization of (2) subject to the condition (11) leads to

$$\frac{\tilde{x}}{\tilde{y}} = \left(\frac{R_h}{R_s} \right)^{-\frac{1}{\sigma}}.$$

Hence, we can write the best plan of resource distribution between patient and impatient depositors as:

$$\lambda \tilde{x} = \theta \nu \frac{R_s}{R_h}, \quad (12)$$

$$(1 - \lambda) \tilde{y} = (1 - \theta) \nu, \quad (13)$$

where $\theta \equiv \lambda \{ \lambda + (1 - \lambda) \left[\frac{R_h}{R_s} \right]^{\frac{1-\sigma}{\sigma}} \}^{-1}$ is a coefficient in the unit interval. Substituting the solutions of \tilde{x} and \tilde{y} given by conditions (12) and (13) into resource constraints, we

obtain the bank's optimal investment plan which gives the best distribution to depositors as follows:

$$\tilde{A} = \frac{\theta v}{(1 - \tau)R_h}, \quad (14)$$

$$\tilde{K} = e + f - \frac{\theta v}{(1 - \tau)R_h}. \quad (15)$$

2.3 Demand deposit system and equilibria

The optimum can be obtained as the good Nash equilibrium of a demand deposit system. This system is a contract that stipulates that, in period 0, each agent must surrender to the bank his endowment and his capacity to borrow abroad. The bank invests \tilde{K} in the long-term technology and \tilde{A} in the short-term technology and borrows up to the credit ceiling at t_0 and t_1 in the international market. In return, the agent is given the right to withdraw, at his discretion, either \tilde{x} units of consumption in period 1 or \tilde{y} units in period 2. An agent of type 2 who withdraws \tilde{x} can store it between period 1 and period 2 and thus consume \tilde{x} in period 2.

As in Diamond and Dybvig (1983) and Chang and Velasco (2001), it is easy to show that, according to the parameters' value, there may be two situations: either the optimum is the unique Nash equilibrium, or the optimum is one of two possible equilibria; i.e., the "good" equilibrium in which agents do not run, and the bad equilibrium in which agents run.

2.3.1 No-run equilibrium: debt is rolled over

In the no-run equilibrium, agents of type 1 withdraw \tilde{x} in period 1, and agents of type 2 withdraw \tilde{y} in period 2. The fact that $\tilde{y} > \tilde{x}$, ensured by $\frac{R_h}{R_s} \gg 1$, implies that no agent has an interest to misrepresent his type. Thus, the no-run equilibrium implements the best welfare allocation through the demand deposit system.

In this benchmark case, it is assumed that the banks can credibly commit to repay their external debt $f(1 + r_{12}^b)$ under any circumstances. Thus, there is no concern about the solvency of the bank with respect to their external liabilities,¹ and the domestic interest rate paid by banks is always equal to the international interest rate: $r_{12}^b = r^*$. The maximum amount of liquidation consistent with repayment of international debt is

$$\begin{aligned} l^+ &= \tilde{K} - \frac{(1 + r^*)f}{(1 - \tau)R_h} \\ &= \frac{(1 - \lambda)\tilde{y}}{(1 - \tau)R_h} \\ &= \frac{(1 - \theta)v}{(1 - \tau)R_h}. \end{aligned} \quad (16)$$

In this case, a run can occur if the short-term obligations of the bank exceed its available liquidation, or

$$z^+ \equiv \tilde{x} - (1 - \tau) \left(R_s \tilde{A} + r_l l_1^+ \right) > 0, \quad (17)$$

¹Of course, domestic depositors are still potentially subject to a default of the bank on deposits.

where z^+ is a measure of the bank's illiquidity when interest rate applied to banks' borrowings is equal to the international rate r^* . We can describe condition (17) in terms of fundamental parameters using (12), (??), (14) and (15) the definition of θ and l^+ as follows

$$r_l < r_1^+ \equiv (R_h)^{\frac{\sigma-1}{\sigma}} (R_s)^{\frac{1}{\sigma}}.$$

2.4 The economy in "normal times"

"Normal times" means that if there are two equilibria (a no-run equilibrium in which the second-best is decentralized, and a run equilibrium in which all agents attempt to withdraw their deposit), coordination is ensured on the no-run equilibrium.

2.4.1 Budget Constraint of the government

The government starts with an amount of debt D . This debt is financed by issuing at $t = 0$ a quantity B_{02} of "long-term" government bond maturing at the end of period 2. They are sold at a discount of the par value. Then, taxes are raised and there are government spending. At the end of period 2, the debt D_2 is refinanced by issuing new bonds on international markets. However, international investors agrees to refinance the debt up to a certain degree. More precisely, we assume that there exist a threshold g_f of the ratio of debt over GDP above which the government will become unable to honor its debt in the future. Thus, refinancing arises provided that the ratio of debt over GDP does not exceed the exogenous ceiling g_f , i.e. the constraint

$$\frac{D_2}{Y_2} \leq g_f$$

is satisfied. Otherwise, the government is considered insolvent.

2.4.2 Stationary state in normal times

If, in period 0, investors do not expect the possibility of a crisis affecting the domestic country, the discount rate applied on long term government bonds is equal to the international real interest rate r^* . Thus the issue price of bonds consistent with the initial level of debt is

$$\frac{B_{02}}{1+r^*} = \tilde{D}.$$

During the period, the government collects taxes T raised on short-term and long terms projects, and has government spending G . The amount of debt left at the end of period 2 is thus

$$D_2 = B_{02} + (G - T).$$

We assume that in "normal times", the level of taxes collected and of government spending is such that the level of debt (and the ratio of debt over GDP) remains constant, i.e. $D_2 = D$, and that the debt left in period 2 is financed by issuing the same quantity B_{24} of "long-term" government bond maturing at the end of period 4. In "normal times", all projects mature and the amount of taxes collected is

$$\tilde{T} = \tau(R_s \tilde{A} + R_h \tilde{K}).$$

The amount of government spending consistent with a constant level of debt is thus

$$\bar{G} = \tilde{T} - r^* \tilde{D},$$

i.e. the amount of taxes collected in the stationary state, $\tilde{T} = \tau(R_s \tilde{A} + R_h \tilde{K}) = \tau \tilde{Y}$, where \tilde{Y} is total production in normal times, is just sufficient to pay interest charges without aggravating the level of public debt \tilde{D} . The debt/GDP ratio remains constant and equal to

$$\tilde{g} \equiv \frac{\tilde{D}}{\tilde{Y}} < g_f.$$

2.5 Crisis times

"Crisis times" means that if there are two equilibria (a no-run and the run equilibria), agents panic and coordinate on the run equilibrium. The issue for the government is then to design policies that make the run equilibrium unsustainable.

2.5.1 Existence of a credible bailout program

Assume for now that $r < r_1^+$, i.e. banks are potentially subject to runs. We consider the possibility of ruling out the run equilibrium by introducing a bailout program provided by the government. Without government intervention, a bank run is possible if $r_l < r_1^+$ or

$$z^+ \equiv \tilde{x} - (1 - \tau) (R_s \tilde{A} + r_l l_1^+) > 0.$$

A government can try to rule out this run equilibrium by deciding, in period 1, to bail out the bank by injecting the required cash amount G_1^b missing to the bank to honor deposits. In order to do so, the government must issue a quantity B_{12} of new (short-term) bonds sold at a discount of the par value. In this benchmark situation in which there is no concern on government's solvency, the interest rate applied to these bond is $r_{12}^g = r^*$, so that $G_1^b = B_{12}/(1 + r^*)$. The required amount of cash G_1^b preventing the run-equilibrium to occur must satisfy

$$\tilde{x} - (1 - \tau) (R_s \tilde{A} + r_l l_1^+) \leq G_1^b \quad (18)$$

We then obtain the following proposition:

Proposition 1: *Assume that, in the "crisis state", the government is able to commit to bailout banks in case of a run. Then if the condition*

$$g^{br}(r^*) \equiv \frac{D_2^{br}(r^*)}{Y_2^{br}} = \frac{\tilde{D} + \frac{(1-\theta)v}{R_h} \left[(1 + r^*) (r_1^+ - r_l) + \frac{\tau}{1-\tau} (R_h - r_l) \right]}{\tilde{Y} - \frac{(1-\theta)v}{R_h} \left(\frac{R_h - r_l}{1-\tau} \right)} < g^f \quad (19)$$

is satisfied, the commitment to implement a bailout program is credible (in the sense that it does not endanger the solvency of the country) and is sufficient to prevent the occurrence of the run equilibrium.

Proof

If external debt is rolled-over in crisis time, the minimal amount of government money injection consistent with (18) is

$$G_1^b = \frac{(1 - \theta) v}{R_h} (r_1^+ - r_l).$$

We need to show that the government would remain solvent after raising the required amount of liquidities G_1^b even if the run occurred and the bailout package was implemented. Raising G_1^b requires to issue new bonds B_{12} at the price $1/(1+r_{12}^g)$, i.e. such that

$$\frac{B_{12}}{1+r_{12}^g} = \frac{(1-\theta)v}{R_h} (r_1^+ - r_l).$$

The amount of taxes collected in case of a run is

$$\begin{aligned} T_1^+ &= \tau(R_s \tilde{A} + r_l l^+ + R_h(\tilde{K} - l^+)) \\ &= \tilde{T} - \tau(R_h - r_l)l^+. \end{aligned}$$

Thus, the level of debt at the end of period 2 after the implementation of the bailout package is

$$\begin{aligned} D_2^{br}(r_{12}^g) &= D_0(1+r^*) + (\bar{G} + B_{12} - T_1^+) \\ &= \tilde{D} + B_{12} + (\tilde{T} - T_1^+). \end{aligned}$$

Given the two expressions above, and using the expression for l^+ , we obtain

$$D_2^{br}(r_{12}^g) = \tilde{D} + \frac{(1-\theta)v}{R_h} \left[(1+r_{12}^g)(r_1^+ - r_l) + \frac{\tau}{1-\tau}(R_h - r_l) \right]. \quad (20)$$

On the other hand, output in case of bank runs is

$$\begin{aligned} Y_2^{br} &= R_s \tilde{A} + r_l l^+ + R_h(\tilde{K} - l^+) \\ &= \tilde{Y} - (R_h - r_l)l^+ \\ &= \tilde{Y} - \frac{(1-\theta)v}{R_h} \left(\frac{R_h - r_l}{1-\tau} \right). \end{aligned} \quad (21)$$

Thus, the ratio of debt over GDP after the bank run and the implementation of the bailout package is represented by the condition (6) in proposition 1. As shown by equations (20) and (21), the financial situation of the government is now deteriorated with the reduction in the tax revenue and the rise in the level of public debt.

If $r_{12}^g = r^*$, the solvency of the government if the bailout program was implemented requires $g^{br}(r^*) \leq g^f$. In this case, the commitment is credible and condition (6) is satisfied, which is sufficient to destroy the run equilibrium and to prevent the implementation of the bailout program. ■

2.5.2 Role of credit rating agencies

We now assume that there exists a credit rating agency whose role is to evaluate the solvency of the government. For simplicity, we assume that the agency attributes only two ratings: “A” stands for “no risk on solvency”, which is a better rating than “B” standing for “risk on solvency”.

We also assume that when $g < g^f$, the government is always able to honor its debt, while when $g > g^f$, the government always defaults.

Thus, in order to be consistent, the credit rating agency sets the rating according to the following rule

$$\begin{aligned} \text{rating} &= \mathbb{A}, & \text{if } g^a \leq g^f; \\ &= \mathbb{B} & \text{if } g^a > g^f, \end{aligned} \quad (22)$$

where g^a is the expected level of public debt ratio by the credit rating agency.

We also assume that the interest rate on government bonds includes a risk premium which is decreasing in the rating of the credit rating agency

$$r_{12}^g = r^* + \rho(\text{rating}). \quad (23)$$

Note that, since the main criterion underlying the rating is the ratio of public debt over GDP, this makes the domestic interest rate elastic to public debt.

The government bonds are assumed to be riskless in the initial period, so this ratio will not affect the portfolio of banks' bond holding. If the government is downgraded at the intermediate date, the values of government bonds will decrease with the rise of the risk ratio.

We can then establish the following proposition:

Proposition 2. *Assume that $z_1^+(r^*) > 0$ and that condition (6) is satisfied, the credit rating agency determines its rating according to (22) and the interest rate on domestic bonds is given by (23). We then have the following situations:*

Case 1. *the credit rating agency maintains its rating \mathbb{A} after the announcement of the bailout package. Then $r_{12}^g = r^*$, and we are in the situation of proposition 4. The bailout package is credible, and its mere announcement is sufficient to prevent the occurrence of a run. In addition, because the run equilibrium never takes place, the ratio g remains ex-post equal to its long-run level \tilde{g} . Thus, there is no sovereign debt crisis, and the expectation $g^a \leq g^f$ of the credit rating agency is fulfilled.*

Case 2. *the credit rating agency downgrades its rating to \mathbb{B} after the announcement of the bailout package. Then, $r_{12}^g = r^* + \rho(\mathbb{B}) > r_{12}^*$, and we have two situations:*

2a. *$g^{br}(r^* + \rho(\mathbb{B})) < g^f$, i.e., the ratio of public debt over GDP after implementation of the bailout package remains smaller than the threshold above which the solvency of the government is not ensured. In this case, the bailout package is credible and the run equilibrium does not take place. Thus, the ratio of debt over GDP remains equal to \bar{g} , and the expectation $g^a > g^f$, implying that the rating of the credit rating agency is not fulfilled.*

2b. *$g^{br}(r^* + \rho(\mathbb{B})) > g^f$, in this case, the implementation of the bailout package seriously endangers the ability of the government to honor its debt, validating ex-post the credit rating agency decision.*

Thus, if $g^{br}(r^*) < g^f < g^{br}(r^* + \rho(\mathbb{B}))$ both situations of case 1 and (2b) are sustainable as equilibrium. The decision by the credit agency to downgrade or not the rating of the domestic country appears as a self-fulfilling prophecy. The credit rating agency plays the role of a selection device.

Note that when the situation (2b) is realized, the bailout program is considered to be infeasible by investors. As the case stands, not just the cost of new government borrowing rises, the present value of long-term bonds issued at t_0 decreases, so as the assets available to the bank at t_1 . The liquidity gap of the bank is enlarged. The government will not bailout the banking sector in the cost of sovereign debt crisis, since the bailout package G_1^b is no longer enough to safeguard the solvency of the banking system. The bank now needs more liquidity injection to compensate the loss from holding depreciated government bonds. In other words, if the government is rational, it will not insist on carrying out the bailout program in situation (2b), because the bank will be closed down sooner or later.

3 Enlarged framework – Regulatory measures and contagion

3.1 New framework

We are now analyzing how the situation of a relatively "healthy" country in the Euro area can be seriously affected by the degradation of the economic situation of other member states. In order to do so, we now assume that the government requires banks to hold a percentage α of its debt principal in the form of A-rated assets, and that most of these assets consist in government bonds of the various countries of the Euro area. The reason for this is that holding a certain level of highly liquid assets makes the bank less vulnerable to the liquidity crisis.²

It is assumed that the bank commits to hold bonds purchased in 0 until period 2 unless a bank run occur in period 1. Formally, the bank's maximization problem in consistent with the liquidity regulation is under the new set of constraints as follows:

$$\begin{aligned}
 A + K + \left(\frac{B^d}{1 + r_{02}^d} + \frac{B^f}{1 + r_{02}^f} \right) &= e + f_1, \\
 f_1 &\leq f, & f_2 &\leq f, \\
 \frac{B^d}{1 + r_{02}^d} + \frac{B^f}{1 + r_{02}^f} &\geq \alpha(e + f_1), \\
 \lambda x + f_1 &\geq (1 - \tau)R_s A + f_2 + (1 - \tau)r_l l + \phi \left(\frac{B^d}{1 + r_{12}^d} + \frac{B^f}{1 + r_{12}^f} \right), \\
 (1 - \lambda)y + (1 + r_{12}^b)d_2 &= (1 - \tau)R_h(K - l) + (1 - \phi)(B^d + B^f)
 \end{aligned}$$

where B^d is the face value of domestic governments bonds, and r_{02}^b and r_{12}^b are the long-term and short term interest rates on these bonds, respectively. Similarly, B^f is the face value of foreign governments bonds, r_{02}^f and r_{12}^f are the long-term and short term interest rates on these bonds. l is the amount of liquidated long-run projects, and r_{12}^b is the interest rate on corporate loans. As the holding of the government bonds is for the purpose of providing more liquid in the case of bank run. ϕ is thus a dummy variable which is equal to 1 when the run occurs and to 0 otherwise.

In normal times, domestic and foreign government bonds are considered as perfect substitutes, and we have $r_{12}^d = r_{12}^f = r_{12}^b = r^*$. The no-run equilibrium implies that all inequality constraints bind and $\tilde{l}^1 = 0$. The constraint of the liquidity regulation is always satisfied with equality. Since the bank has no interest in holding more bonds than the quantity demanded by the authority. This is natural consequence of that the return of bonds is dominated by which of entrepreneurs's projects. Finally, as in the benchmark case, all the constraints are always satisfied with equality in optimal. We thus obtain:

²The prudential regulatory measure in this paper has been mentioned by a number of economists to explain the close connection between the financial situation of commercial banks and the government budget, see for instance, Hanson (2007), Brutti (2010), Reinhard & Belen Sbrancia (2011), and Bolton & Jeanne (2011). The introduction of the liquidity regulation is inspired by the liquidity coverage ratio in Basel III. In fact, both in Basel II and Basel III, the AAA-rated government bonds are considered to be the risk-free and highly liquid assets. Thus, holding liquid and (supposedly) safe government bonds is a natural way to comply more easily with the Basel regulation.

$$\begin{aligned} \tilde{f}_1 &= \tilde{f}_2 = f \\ \tilde{A}_1 + \tilde{K}_1 + \frac{\tilde{B}^*}{1+r^*} &= e + f \end{aligned} \quad (24)$$

$$\tilde{B}^* = \alpha(e+f)(1+r^*) \equiv \tilde{B}^*(\alpha) \quad (25)$$

$$\lambda\tilde{x}_1 = (1-\tau)R_s\tilde{A}_1 \quad (26)$$

$$(1-\lambda)\tilde{y}_1 = (1-\tau)R_h\tilde{K}_1 + \tilde{B}^* - (1+r^*)f \quad (27)$$

where $\tilde{B}^* \equiv \tilde{B}^d + \tilde{B}^f$. Obviously, if foreign and domestic government bonds have the same risk and the same rate of return, the composition of the portfolio of bonds is indifferent to the bank. We thus denote by $\gamma \in (0, 1)$ the share of foreign bonds in total bonds holdings:

$$\begin{aligned} \tilde{B}^d &= (1-\gamma)\tilde{B}^*, \\ \tilde{B}^f &= \gamma\tilde{B}^*. \end{aligned}$$

Given the optimal conditions (24)~(27), we can examine now the bank's best remuneration for patient and impatient depositors respectively. The optimal allocation between x and y should satisfy the social transformation curve:

$$\frac{R_h}{R_s}\lambda\tilde{x}_1 + (1-\lambda)\tilde{y}_1 = v - \alpha(e+f)[(1-\tau)R_h - (1+r^*)] \equiv v_1 \quad (28)$$

Provided $(1-\tau)R_h > (1+r^*)$, we have $v_1 < v$. Thus, regulation is costly in terms of welfare during normal times. This is a natural consequence of the fact that the return on government bonds is dominated by the return on long-term projects.

The maximization of (2) subject to (28) leads to

$$\lambda\tilde{x}_1 = \frac{R_s}{R_h}\theta v_1 \quad (29)$$

$$(1-\lambda)\tilde{y}_1 = (1-\theta)v_1 \quad (30)$$

with $\theta \equiv \lambda\{\lambda + (1-\lambda)[\frac{R_h}{R_s}]^{\frac{1-\sigma}{\sigma}}\}^{-1}$. Substituting the solutions of \tilde{x} and \tilde{y} given by conditions (29) and (30) into resource constraints, we can then deduce the optimal quantity invested respectively in short-term and long-term projects:

$$\begin{aligned} \tilde{A}_1 &= \frac{\theta v_1}{(1-\tau)R_h} \\ \tilde{K}_1 &= (1-\alpha)(e+f) - \frac{\theta v_1}{(1-\tau)R_h} \end{aligned}$$

This optimum can be obtained as the good equilibria of a demand deposit system as described above.

3.2 Effectiveness of the regulatory measure when there is no sovereign debt crisis

As in the former section, we assume that the bank can credibly commit to repay its external debt, so that debt is rolled-over. In normal times, the maximum amount of liquidated long-term projects in consistence with the liquidity regulation is now:

$$\begin{aligned}
l_1^+(\alpha) &= \tilde{K}_1 - \frac{(1+r^*)f}{(1-\tau)R_h} \\
&= \frac{(1-\theta)v_1 - \alpha(1+r^*)(e+f)}{(1-\tau)R_h}.
\end{aligned}$$

Note that $l_1^{+'}(\alpha) < 0$. Other things being equal, this tends to make the bank more vulnerable to runs. On the other hand, the holding of government bonds enables banks to get extra liquidity to pay depositors in the event of a run. Indeed, the condition for existence of a bank run equilibrium, when there is no concern on sovereign debts, is now:

$$\bar{z}_1^+(\alpha) \equiv \tilde{x}_1 - (1-\tau) \left(R_s \tilde{A}_1 + r l_2^+(\alpha) \right) - \frac{\tilde{B}^*(\alpha)}{1+r^*} > 0$$

Using the fact that, at equilibrium, $(1-\tau)R_s \tilde{A}_1 = \lambda \tilde{x}_1$, and substituting for the values of \tilde{x}_1 , $\tilde{B}^*(\alpha)$ and $l_1^+(\alpha)$, we easily obtain that the condition $\bar{z}_1^+(\alpha) > 0$ is equivalent to:

$$r_l < r_2^+(\alpha) \equiv \frac{r_1^+ - \frac{\alpha(e+f)R_h}{(1-\theta)v_1}}{1 - \frac{\alpha(e+f)(1+r^*)}{(1-\theta)v_1}}$$

It is easy to verify that

$$\text{sign}(r_2^{+'}(\alpha)) = \text{sign}\left(r_1^+ - \frac{R_h}{1+r^*}\right)$$

so that $r_2^{+'}(\alpha) < 0$ if the condition $(1+r^*) < (R_h/R_s)^{(1/\sigma)}$ is satisfied. We can then establish the following proposition:

Proposition 3. Effectiveness of regulation

Assume $(1+r^) < (R_h/R_s)^{(1/\sigma)}$. Then an increase in regulation (i.e., an increase in α) shrinks the range of values consistent with existence of a run equilibrium.*

Assume that the additional condition $r_1^+ - \frac{(e+f)R_h}{(1-\theta)v} < r_l < r_1^+$ holds., Then there exists an $\bar{\alpha} \in (0, 1)$ such that the run equilibrium is destroyed for any $\alpha > \bar{\alpha}$.

Proof

The threshold $\bar{\alpha}$ is obtained by solving $r_l = r_2^+(\bar{\alpha})$ and, if $r_1^+ - \frac{(e+f)R_h}{(1-\theta)v} < r < r_1^+$, the solution is in $(0, 1)$. As $r_2^{+'}(\bar{\alpha}) < 0$ when $(1+r^*) < (R_h/R_s)^{(1/\sigma)}$, for any $\alpha > \bar{\alpha}$, we have $r_l > r_2^+(\bar{\alpha})$ and the run equilibrium is eliminated by the implementation of liquidity regulation. ■

3.3 Potentially perverse effect of regulation under sovereign debt crisis – Contagion

In previous sections, we have assumed that foreign government bonds have the same risk (thus the same rate of return) than the domestic ones initially and in “normal times”. The composition of the portfolio of bonds is indifferent to the bank at t_0 , the moment the bank makes the investment planning. In this section, we focus our attention on the the situation of a relatively "healthy" country in the Euro area affected by the degradation of the economic situation of other member states (in particular, through the emergence

of solvency concerns). Specifically, we shall assume that government bonds of the foreign country are affected by a ratings downgrade, so that $r_{12}^f = r^* + \rho(B) > r^*$.

Even if the domestic country is not affected by the downgrade (at least in a first round), the downgrade of the rating of foreign government bonds hits the balance sheet of domestic banks who hold such bonds. For these domestic banks, the maximum amount of liquidated long-term projects remains equal to l_1^+ , but the condition for existence of a bank run equilibrium is now:

$$\bar{z}_2^+(\alpha) > 0$$

with

$$\begin{aligned}\bar{z}_2^+(\alpha) &\equiv \tilde{x}_1 - (1 - \tau) \left(R_s \tilde{A}_1 + r l_2^+(\alpha) \right) - \frac{\tilde{B}^d}{1 + r^*} - \frac{\tilde{B}^f}{1 + r_{12}^f} \\ &= \bar{z}_1^+(\alpha) + \frac{(r_{12}^f - r^*) \gamma \tilde{B}^*(\alpha)}{(1 + r^*) (1 + r_{12}^f)},\end{aligned}$$

with $\frac{(r_{12}^f - r^*) \gamma \tilde{B}^*(\alpha)}{(1 + r^*) (1 + r_{12}^f)} > 0$. Clearly, for any level of regulation (as measured by α), the illiquidity measure of banks is worsened by the degradation of the rating of foreign government bonds. The reason is that, in the event of a run, the price at which banks would sell these bonds in the secondary market, $\tilde{B}^f / (1 + r_{12}^f)$, is substantially reduced after the downgrade by the credit rating agency.

Using the fact that, at equilibrium, $(1 - \tau) R_s \tilde{A}_1 = \lambda \tilde{x}_1$, and substituting for the values of \tilde{x}_1 and $l_2^+(\alpha)$, we easily obtain that the condition $\bar{z}_2^+(\alpha)$ is equivalent to

$$r_l < \bar{r}_3^+(\alpha) \equiv \frac{r_1^+ - \frac{\alpha(e+f)R_h}{(1-\theta)\bar{v}} \left(1 - \gamma + \gamma \frac{1+r^*}{1+r_{12}^f} \right)}{1 - \frac{\alpha(e+f)(1+r^*)}{(1-\theta)\bar{v}}}$$

It can be verified that

$$\begin{aligned}\text{sign} \{ \bar{r}_2^{+'}(\alpha) \} &= \text{sign} \left\{ r_1^+ - R_h \left(\frac{1 - \gamma}{1 + r^*} + \frac{\gamma}{1 + r_{12}^f} \right) \right\} \\ &= \text{sign} \left\{ r_1^+ - \frac{R_h}{1 + r^H} \right\}\end{aligned}$$

where

$$1 + r^H \equiv \left(\frac{1 - \gamma}{1 + r^*} + \frac{\gamma}{1 + r_{12}^f} \right)^{-1}$$

is the weighted harmonic mean of $(1 + r^*)$ and $(1 + r_{12}^f)$.

Thus, if there is a sharp increase in the interest rate r_{12}^f on foreign bonds following the downgrade by the credit rating agency, we may have that $1 + r^H > (R_h / R_s)^{(1/\sigma)}$, implying $\bar{r}_3^{+'}(\alpha) > 0$. In this case, regulation actually *worsens* the situation of domestic banks. This situation is most likely if the risk premium on foreign bonds increases sharply after the downgrade of the rating on these bonds, and if γ is large, i.e. if domestic banks hold a significant share of depreciated foreign government bonds. Summarizing:

Proposition 4 *Assume that the risk premium on foreign government bonds after the downgrade by the credit rating agency is such that $\rho(B) > (R_h / R_s)^{(1/\sigma)} - (1 + r^*)$. Then,*

there exists a $\bar{\gamma} \in (0, 1)$ such that if $\gamma > \bar{\gamma}$, the regulatory measure $\alpha > 0$ aggravates the exposition of banks to runs in a healthy domestic country compared to a situation without regulation.

Proposition 4 illustrates the case of France and other similar countries in which private banks hold a significant amount of depreciated foreign government bonds. While these bonds were considered as safe, their holding now aggravates the exposition to runs of domestic banks. Banks who were solvent in the event of a run before the downgrade can become insolvent after the downgrade. If banks were not solvent in case of a run but that a bailout program was announced, and that this bailout plan was credible enough to prevent the occurrence of the run (case 1 of proposition 2), the increase in the illiquidity measure of domestic banks after the downgrade of the rating of foreign bonds makes larger the amount of resources required to bailout banks. This can put in turn the domestic country in a difficult financial situation if it were to implement the bailout package. The domestic country may now fall in case (2b) of proposition 2 in which it would become unable to implement the bailout package after a downgrade of its own rating by the credit rating agency, etc.

4 Downgrading the rating of commercial banks

In previous sections, we consider only the case where the government is downgraded by the credit rating agency after the announcement of bailout package. In this section, we assume that the rating agency, in expecting the occurrence of bank run, downgrades the rating of the bank instead of that of government. As before, there are two equilibria (a run and a no run). The credit rating agency sets the rating according to the value of z , i.e., the difference between short-run obligations and liquidity at t_1 and its expectation on the stability of banking sector:

$$\begin{array}{ll} \text{if } z < 0, & \text{rating} = \mathbb{A}; \\ \text{if } z > 0, & \text{rating} \begin{cases} \nearrow \mathbb{A} & \text{if agency expects no run,} \\ \searrow \mathbb{B} & \text{if agency expects a run.} \end{cases} \end{array}$$

As in the case of the government, the interest rate on banks' borrowings includes a risk premium ρ^b which is inversely related to the rating of the credit rating agency

$$r_{12}^b = r^* + \rho^b(\text{rating}).$$

Proposition 5. *In the case where z is negative, the bank always have enough liquidity to honor its debt. Thus the credit rating agency will not expect the bank run and will not downgrade the rating of the bank. If z is positive, the banking sector is submitted to two equilibria. The credit rating agency will maintain the \mathbb{A} rating of the bank, if it expects no run, otherwise, it will downgrade the rating of the bank to \mathbb{B} . The bank run can be self-fulfilling with the liquidity gap of the banking sector being deteriorated by the downgrade.*

We assume that z_1^+ is positive and the credit rating agency downgrades the rating of the bank in observing this. The interest rate on bank's new borrowing rises, such that $r_{12}^b = r^* + \rho^b(\mathbb{B})$. The increase in the cost of new borrowing affects negatively the balance sheet of the bank. For the same quantity of debt borrowed at t_1 , the repayment now is

higher at t_2 . Consequently, the maximum amount of liquidation consistent with repayment of new debt is reduced, such that

$$\begin{aligned} l_3^+ &= \tilde{K} - \frac{(1 + r_{12}^b)f}{(1 - \tau)R_h} \\ &= l_1^+ - \frac{(r_{12}^b - r^*)f}{(1 - \tau)R_h} < l_1^+. \end{aligned}$$

With the reduction of the liquidity obtained from the liquidation of long-term project, the liquidity gap is thus widened at the same scale, i.e.,

$$z_3^+ \equiv \tilde{x} - (1 - \tau)(r_l l_3^+ + \tilde{A}R_s) - \frac{\tilde{B}}{1 + r^*} \equiv z_1^+(r^*) + \frac{r_l}{R_h}(r_{12}^b - r^*)f > 0, \quad (31)$$

Note that the bank run is always socially inefficient in terms of the welfare of the country. However, when the agents panic, the run can be self-fulfilled. The decision of agents depends on the information revealed at t_1 . If the agents have a steady confidence in its banking sector and do not run after the downgrading of the bank. The rating by credit rating agency is untenable and the interest rate expectations on banks' borrowing $r_{12}^b = r^* + \rho^b(\mathbb{B})$ are not fulfilled. Consequently, the economy is in the "good equilibria". However, the possibility of bank run is now increased, not only because of the widening of liquidity gap, which reduces the probability of agents to be paid, but also of the pessimistic expectation of credit rating agency, which spreads the panic among the agents and impels them to run.

Proposition 6. *When $z_3^+(r^*) > 0$, the credit rating agency will not downgrade the domestic banking sector if it expects that a necessary bailout program will not induce a downgrade of government bonds and hence be credible. Contrarily, if the initial ratio of public debt to GDP is sufficiently high, a downgrade of banks' rating could lead to a twin-crisis.*

The government can intervene to avoid the bank run by a bailout package $G_3^b = z_3^+$, which is bigger than the package without the downgrade G_1^b . Obviously, the debt to GDP ratio is now at a level higher than $g^{br}(r^*)$. If the debt/GDP ratio surpasses the threshold g^f , the bailout program is incredible and thus will not be implemented. Contrariwise, when the bailout package is considered to be credible, the depositors will stop running at the announcement of bailing out. Nevertheless, if the bailout program is taken as unfeasible, banks will be closed down and all the long-term projects will be restructured prematurely. The tax revenue of the government is then reduced considerably, and consequently, the debt/GDP ratio will rise even without the bail-out package. Finally, the banking crisis contaminates the government budget and the creditworthiness of the government is submitted to the risks of downgrading.

5 Conclusion

In this paper, we have developed a simple open-economy banking crisis model to examine the interaction between bank and public crises. In the context of global financial integration, a stable level of foreign capital inflow is crucial not only for domestic banks, but also for the public sector of the small open economy. In a period of crisis, an increase in risks perceived by international investors will reduce substantially the amount of foreign financial investments in small counties. The model allows us to show the interaction between

the banking and sovereign debt crises.

We show that the difficulty in one sector can easily induce the trouble in another sector. The banking system and the government will survive a negative financial shock (bank-run) due to auto-realized expectations or fail together. Therefore, the downgrade of credit rating could play the role of a catalyst in the twin crisis affecting both public and banking sectors by reinforcing pessimistic expectations in the financial market and thus augmenting the risk premium, which accelerates the transmission of the crisis from one sector to another and provokes their mutual reinforcement, and finally leads the economy into a deep recession.

The government regulation which imposes the banking system to detain a fraction of their short-term liability has stabilizing effect of the government has not a debt problem. On the contrary, when the public debt is too high, this regulation will have a detrimental effect on the banking sector and constitutes a channel of transmission of sovereign debt crisis to the banking sector, leading to a banking crisis.

In a model where the special structure of banks resource composition determines that the sequential order of depositor service is the key element which affects the stability of the banking sector, our analysis suggests that, in the case of a banking crisis, the bailout of banking sector is a rational choice of the government because the banking crisis will significantly reduce its future fiscal revenue. However, the cost of liquidity injection is high. A huge bailout package financed by the emission of new public debt can trigger the sovereign debt crisis. Likewise, the sovereign debt crisis will reduce the confidence of investors in the economy of the small open country, which in turn will increase the risk premium paying by domestic banks in the international financial market and increase the risk of a bank run. The only case where the government is able to bailout the banking system in crisis is when the initial public debt is sufficiently low.

In order to deliver a simple yet general theoretical model to outline the basic connection between the banking and sovereign debt crises, we have made a number of simplifying assumptions in this paper. However, this framework is able to adjust readily to several extensions.

First, the Eurobonds has become a subject of debate from its very creation. The framework is useful to evaluate the effectiveness of the "Eurobonds" to reduce the risk of a general sovereign debt crisis.

Second, the maturity mismatch remains always one of the central topics in the analysis of banking crisis. In this paper, we assume only the short-term foreign debt in bank's balance sheet. The framework allows the comparison of the between the short-term and long-term foreign investments and further permits the examination of the event of "flight to quality".

Third, we concentrated our attention on the effect of the liquidity regulation. The framework enables the introduction the role of bank capital in the balance sheet of the bank. It is thus potential to effectuate the analysis the other types of banking regulations in this framework such as the capital adequacy ratio.

Furthermore, we ignore the role of money in this model to illustrate the current crisis in some peripheral countries in the Euro-Zone. This framework permits as well the integration of the money to examine the situation of crisis in countries like Iceland and Britain and therefore the impacts of different monetary and exchange policies.

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