E C O N O M I C S B U L L E T I N

Bank runs, political distortions and contagion

Victor Vaugirard
TEAM−CNRS University of Paris at Sorbonne

Abstract

This paper highlights the spread of banking panics across countries, as the public reassesses governments' propensity to bailouts. Policymakers decide whether to rescue a failing banking sector, by weighing the costs of a collapse against the costs associated with raising taxes to finance a bailout package. The former involve social costs for the society and personal costs for policymakers. In addition, they have an informational advantage over creditors regarding the costs of bank liquidation. A crisis in a country leads lenders to reexamine policymakers' willingness to intervene in other countries, which eventually makes their banks more vulnerable to self−fulfilling depositors' runs.

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1. Introduction

It has been argued that trade and financial linkages were weak in the transmission of the Tequila crisis from Mexico to Argentina and Brazil in 1994-95, the contemporaneous crises in several Asian countries in 1997-98, and the ripple effects of the Russian default in August 1998 on many emerging markets. This makes the case for "pure contagion", namely, the propagation of crises unrelated to effective shifts in macroeconomic fundamentals, as advocated by Masson (1999), among others. Related contributions include Goldstein (1998)'s wake-up call hypothesis, Kodres and Pritsker (2002)'s model of optimal portfolio rebalancing, Kumar and Persaud (2002)'s channel of change in risk tolerance and Vaugirard (2004)'s example of contagion of capital flow reversals.

Moreover, the decision to devalue a currency has a strong political dimension, which, combined with incomplete information about governments' objectives in making this decision, is often crucial to the appearance of speculative pressures. It follows that when one of the principal objectives of a country in maintaining a fixed exchange rate is political integration with its neighbors, a devaluation by one of those neighbors is likely to increase speculative pressures on that country. In a similar vein, the willingness of policymakers to bail out a failing banking system in a country may be downgraded by agents following a crisis in another country. This paves the way for a form of informational contagion of banking panics.

Most of third-generation models of financial crises that were designed in the aftermath of the Asia crisis are actually rooted in the prescient work of Diaz-Alejandro (1985), meant to explain the Chilean financial crisis of 1981-1983. One of the building blocks of that paradigm is the presumption by agents of public guarantees (explicit, implicit, or simply presumed) and expected bailouts. A related work, with a detailed empirical component is Dekle and Kletzer (2002), who study institutional features of the banking systems in East Asia, namely, the extent of explicit or implicit government guarantees, the pattern of prudential regulation and corporate reliance on bank credit (as opposed to equity and bond markets). They contrast the cases of Thailand and South Korea that suffered crisis more severely, which rate poorly by those standards, and those of Singapore and Taiwan, which did not experience crisis. This contrast hints to an explanatory power of policymakers bailouts regarding the spread of a crisis originating in Thailand, as it may be anticipated that policymakers would no longer have the means to rescue failing banks in the economies with government guarantees prior to the crisis.

To the best of our knowledge, no paper brings out international transmission of banking panics across emerging markets in a third-generation model of financial crises through an informational channel, and this contribution is intended to fill part of this gap. We prove that a banking panic in a country leads the public to reassess policymakers' incentives to bailouts in other countries, which makes their banks more vulnerable to self-fulfilling depositors' runs.

The remainder of the paper is organized as follows. Section 2 sets up the framework. Section 3 determines equilibria. Section 4 highlights contagion. Section 5 concludes and suggests follow-ups. For ease of exposition, most proofs are in an Appendix.

2. Model

In this section, banks are described as maturity transformers that take liquid deposits and borrow foreign funds, and invest part of the proceeds in illiquid assets. This results in a maturity mismatch between their liabilities and their assets, therefore creating the possibility of self-fulfilling depositors' runs. If so, the government may intervene. In this respect, it may be biased in favor of a business elite and has an informational advantage over the public regarding the social costs of bank liquidation.

Our starting point is an open-economy extension by Chang and Velasco (2001) of the bank run model of Diamond and Dybvig (1983). We bring in the possibility that the government bails out a collapsing banking system.

2.1. *Solvent but illiquid bank*

This subsection sets up a framework of a solvent but illiquid representative bank. The bank is solvent over the long run (here, two periods) if depositors behave in accordance with their true "type", in the sense of Diamond and Dybvig (1983); the bank is temporarily illiquid (here, one period) because its potential short-term liabilities exceed the liquidation value of its assets. Foreign lenders assess the probability of a failure when enabling the bank to rollover its short-term debt, which boils down to appraising the likelihood of depositors' runs and government's bailouts.

A small open economy is populated by a large number of identical agents. There are three dates (thus, two periods) indexed by $t = 0, 1, 2$, and only one good, which is freely traded in the world market and can be consumed and invested. The price of consumption in the world market is fixed and normalized to one unit of foreign currency (one "dollar"). Each domestic agent may be forced to consume early depending on her "type", which she discovers at $t = 1$. With probability λ, she is "impatient" and derives utility only from Date-1 consumption, while with probability $(1 - \lambda)$, she is "patient" and derives utility only from Date-2 consumption. Type realizations are independently and identically distributed across agents. In addition, the realization of each agent's type is private information to that agent.

Agents decide to form a bank rather than acting in isolation. This bank writes demand deposit contracts which stipulate that, at $t = 0$, each agent must surrender to the bank her endowment and her capacity to borrow abroad in return for the right to withdraw, at her discretion, either x units of consumption at $t = 1$ or y units of consumption at $t = 2$. The bank borrows abroad an amount, f, at $t = 0$, with a part, d, of this debt maturing at $t = 1$, referred to as the short-term debt hereafter, and thus $f - d$ maturing at $t = 2$. The bank uses the proceeds of its borrowing, f, along with the endowment surrendered by home agents, e, to invest an amount, k, in a long-term technology and to invest an amount, b, in a world liquid asset. The riskfree interest rate on the world capital market is zero. The long-term technology is productive if held for two periods, but illiquid: its yield per dollar invested at $t = 0$ is $R > 1$ dollars at $t = 2$, and $r < 1$ dollars at $t = 1$, with both R and r constant. The bank attends to the requests of depositors on a first-come-first-serve basis, which gives late consumers incentives to misrepresent their type if they fear a bank failure.

We now concentrate on Date 1, with the short-term debt maturing. The representative bank attempts to roll it over by selling to foreign creditors claims to d dollars, payable at Date 2, in a

competitive auction. Assuming that these foreign creditors are risk-neutral, and since they have an opportunity cost of funds of zero within Period 2, they will buy the new debt if and only if its price, denoted by S, is equal to their subjective probability that the debt will be honored. The auction proceeds, $X = Sd$, are immediately transferred to the bank, which simultaneously pays out its maturing debt amounting to d. Hence, the net outflow attached to the debt operation at Date 1 is $(1 - S)\, d$.

DEFINITION 1: The bank illiquidity position, L, is the excess of its potential short-term liabilities over the liquidation value of its assets, i.e., formally:

$$L = x + (1 - S)\, d - (rk + b), \tag{1}$$

with the understanding that x stands for the withdrawal of all depositors, as the number of depositors is normalized to one.

ASSUMPTION 1: The representative bank is solvent but illiquid, even if lenders allow for full debt rollover.

The solvency condition means that demand deposit parameters are determined by the bank to make sure that it can service withdrawal requests in both periods, provided that depositors behave in accordance with their true types. This condition is intended to ensure that an equilibrium without runs always exists.

On the other hand, the parameters chosen are such that the bank winds up in an illiquid position, even if international lenders allow for complete rollover of the foreign debt (i.e., $x - r\,k - b > 0$). This assumption is intended to rule out interactions between depositors and lenders, as the former have incentives to misrepresent their type regardless of the price bid by lenders. This is meant to make the behavior of all agents entirely determined with respect to the government's stance regarding rescuing the banking system.

This illiquidity assumption is not as stringent as it may first appear. Indeed, this is a rational position from the bank standpoint if the cost of doing so is more than offset by the expected payoff of the long-term technology. In addition, this may be thought of as the upshot of over-investment induced by moral hazard associated with bank managers being optimistic about governments' guarantees in case of trouble.

ASSUMPTION 2: Depositors base their decision to run on the realization of sunspots and their beliefs about governments' bailouts. More specifically, there is a publicly-observed random variable that takes the value 1 with probability $p \in [0, 1]$ or 0 with probability $(1 - p)$. While this variable does not affect the fundamentals of the economy, it acts as a coordination device of depositors' behavior: A bank run takes place if and only if depositors expect the government not to bail out the bank and the realization of the sunspot variable is 1.

2.2. *Bailouts*

In this subsection, we model the policymakers' decision to intervene as a tradeoff between the costs of not rescuing the banking system and the costs associated with raising taxes to finance a

bailout package. The former involve social costs for the society and personal costs for policymakers if they are biased in favor of a group. In addition, they have an informational edge over the public regarding the costs of bank liquidation.

The amount necessary to bail out a collapsing banking system matches the illiquidity position of the bank. The rescue package is financed by taxes, denoted by T, raised on citizens, here, home depositors. This taxation may have a distortionary effect on the economy, of which the government takes account. We introduce a non-decreasing function ψ that captures this effect, and it follows that the cost of rescuing the system, denoted by V, is $V = T + \psi(T)$.

On the other hand, not saving a collapsing banking system has major consequences: loss of reputation for the country, the difficulty of future access to the international credit market, and an economic crisis is likely to take place. The social cost of not bailing out a failing system, denoted by χ, captures those pitfalls.

ASSUMPTION 3: The government has an informational advantage over the public regarding the social cost of bank liquidation. More precisely, the true value of χ becomes known to the government at Date 1, upon deciding whether to rescue the bank (if necessary). On the other hand, home depositors and foreign creditors only know its prior distribution, when about to make a decision about running on the bank and buying the new debt, respectively. We assume that χ is a Bernoulli random variable, taking a low value χ_L, with probability $q \in]0, 1[$, or a high value $\chi_H > \chi_L$, with probability $(1 - q)$.

Indeed, policymakers often obtain information regarding the pros and cons of bailouts beforehand, through their political advisers and economic research team, and this information is not generally available to the public until there actually is a crisis. In addition, this information may be costly to gather.

ASSUMPTION 4: There are political distortions. Policymakers may incur personal costs if they do not rescue a failing bank, in addition to the social cost of liquidation. More precisely, they suffer personal costs β of either zero or $\gamma\chi$, with probabilities $s \in]0, 1[$ and $(1 - s)$, respectively. Thus, s is the probability that they are "benevolent", and $(1 - s)$ the probability that they are "biased".

In a strict interpretation, personal costs may translate into loss of policymakers' reputation or questioning about their abilities, which makes them "self-interested". On a broader register, political distortions capture any discrepancy between the fate of the average citizen and policymakers' objectives, such as catering for special groups. Concretely, reluctance to step in may induce a fallout with cronies, which may imply a loss of income and wealth or a utility loss associated with a loss of power. In other words, those distortions epitomize a "state capture" by powerful economic interests.

We will refer in the sequel to the policymakers' incentives to intervene, as a catch-all that captures the social costs of a bank crisis incurred by citizens as well as the personal costs suffered by policymakers, as compared with the value of not stepping in, in terms of tax relief.

All in all, upon observing the onset of a depositors' run, the government will intervene if and only if:

$$\chi + \beta \geq x + (1 - S)\, d - rk - b + \psi(x + (1 - S)\, d - rk - b). \quad (2)$$

3. Equilibria

In this section, we determine the outcomes of the interaction between the government and the public. We prove that there may be multiple equilibria as a result of self-fulfilling public's expectations and that bank crises are outcomes in equilibrium whose likelihood increases with the subjective assessment by creditors of a lesser propensity of policymakers to bailouts.

3.1. *Equilibrium types*

An equilibrium is a description of the strategies of the government, depositors and creditors and of aggregate outcomes such that: the aggregate outcomes are implied by those strategies; and each government's or depositor's or creditor's strategy is optimal for her, given the aggregate outcomes.

We assume that: $(1 + \gamma)\, \chi_L > \chi_H$, to limit the number of configurations.

PROPOSITION 1: Equilibria can be of five types, with the understanding that "bailout" means "bailout if depositors run":

Type *i*: Both biased and benevolent governments bail out irrespectively of the realization of χ:

$$\chi_L \geq x - r\,k - b + \psi(x - r\,k - b); \quad (3a)$$

Type *ii*: A biased government always bails out, while a benevolent one does if and only if $\chi = \chi_H$:

$$\chi_H \geq x + pqsd - r\,k - b + \psi(x + pqsd - r\,k - b) > \chi_L; \quad (3b)$$

Type *iii*: A biased government always bails out, whereas a benevolent one never does:

$$(1 + \gamma)\, \chi_L \geq x + psd - r\,k - b + \psi(x + psd - r\,k - b) > \chi_H; \quad (3c)$$

Type *iv*: A biased government bails out if and only if $\chi = \chi_H$, while a benevolent one never does:

$$(1 + \gamma)\, \chi_H \geq x + [ps + pq(1 - s)]\, d - r\,k - b + \psi(x + [ps + pq(1 - s)]\, d - r\,k - b) > (1 + \gamma)\, \chi_L; \quad (3d)$$

Type *v*: Both biased and benevolent governments never bail out:

$$x + pd - r\,k - b + \psi(x + pd - r\,k - b) > (1 + \gamma)\, \chi_H. \quad (3e)$$

Proof: □ We illustrate with Type *ii*. The probability that depositors run and thus that foreign lenders are not repaid is *pqs*. As a matter of fact, first, if the government is distorted, then

depositors do not misrepresent their type and lenders are sure to be repaid. Second, let's assume that the government is benevolent (probability s): if $\chi = \chi_H$, then depositors do not lie about their type and lenders are sure to be repaid, and if $\chi = \chi_L$ (probability q), then depositors run in the case of adverse sunspot (probability p) and lenders are not reimbursed in that event. Accordingly, foreign creditors bid $S = (1 - pqs)$, which amounts to down to a debt extension of $pqsd$. Making use of the restriction $(1 + \gamma)\ \chi_L > \chi_H$, an optimal government's behavior and Condition (2) yield the necessary and sufficient condition (3b). The proof for other types follow along similar lines. □

3.2. *Determinants of crises*

This subsection highlights the importance of the public's expectations in the realization of crises.

COROLLARY 1: Public's expectations about equilibria are self-fulfilling.

Proof: □ Any two consecutive equilibrium types can concomitantly stand. To be concrete, take Types *i* and *ii*. If the parameters are such that Condition (3a) is an equality (or close to an equality), then (3b) will hold for realistic values of p, q and s. In that configuration, there are two equilibria, one with no crises (sure bailout), and one in which runs take place with positive probability. □

This possibility of multiple equilibria means that financial crises may result from public's self-fulfilling prophecies. The underlying rationale is that, whenever two equilibria coexist, if lenders hold adverse expectations about the outcome that will eventually prevail, then they require higher interest rates on their loans, which magnifies the illiquidity position of the bank. In the end, the higher taxation cost of bailout becomes compatible only with the outcome that features a more likely crisis, thus validating lenders' adverse expectations. On the other hand, if they hold favorable beliefs about the outcome, they request lower interest rates and the taxation cost of bailout gets consistent with the outcome that displays less likely financial crises.

Whenever there are multiple equilibria, we need a mechanism to coordinate public's expectations. We assume that there is a random variable that allows the public to select a particular equilibrium. If so, we will bring in Bernoulli variables with weights of ½, for the sake of simplicity. These sunspot variables have no effects on fundamentals (liquidation costs) and are independent of that one defined for home depositors alone. An unfavorable occurrence of sunspots can be equated with possibly unjustified but self-fulfilling adverse expectations.

Now that the coordination device is specified, the model determines the probability of bank runs in equilibrium. To illustrate, suppose that the parameters are such that Conditions (3d) and (3e) simultaneously hold. With probability ½, the equilibrium is "never bailout" and the probability of crisis is p. With probability ½, the equilibrium is of Type *iv* and the probability of crisis is $ps + pq(1 - s)$. It follows that the probability of financial crisis is $\frac{1}{2}\, p(1 + s(1 - q) + q)$.

COROLLARY 2: The probability of bank crisis in equilibrium is increasing in q and s, the prior subjective probabilities that the social cost of liquidation is low and that the government is benevolent; namely, with the perception by the public of a lesser propensity of the government to intervene.

Proof: Straightforward. □

Eventually, bank runs stem from the perception by the public of government's incentives to bailouts. So far, we have likened the subjective assessments of the liquidation social cost and the government type to their prior distributions, and we have not thought of what may trigger expectational shifts. We turn to this issue in the next section.

4. Contagion

In this section, we prove that a banking crisis in a country may spread to other countries through an informational channel, as the public reassesses the incentives of those countries' governments to bail out a failing banking system.

4.1. *Two-country model*

In this subsection, we extend the preceding framework to two economies. To do so, we specify the distributional relation between their liquidation social costs and policymakers' personal costs, and we pay attention to the sequential coordination of the public's expectations.

We consider two small open economies, say, A and B, during two consecutive periods. Country B is the economy examined in Section 2, and we re-label its parameters with Superscript B, while we use Superscript A for the other country. The two countries have the same fundamental structure. The analysis in A is analogous to what was done in Section 2. As for B, the crucial difference is that international lenders and depositors in B know whether or not a bank run has occurred in A when about to make a decision regarding buying the new debt by the representative bank in B and regarding misrepresenting their type, respectively. We will prove that a financial crisis in A may impinge on the likelihood of a run in B due to this additional information.

ASSUMPTION 5: Policymakers' propensities to bailouts are correlated across countries. Formally, random social costs of liquidation χ^A and χ^B are positively correlated, as well as policymakers' personal costs β^A and β^B.

Groups of countries in emerging markets display clear-cut similarities relevant for social costs of liquidation: The fragility of their financial systems, their reliance on foreign capital inflows, the likelihood of social unrest following a collapse. This homogeneity entails that social costs of liquidation are correlated across those countries. Besides, together with that information acquisition is costly, it also implies that the public is likely to reappraise those costs should a crisis materialize in any of those countries.

Crony capitalism underpins similarities among certain groups of emerging markets regarding policymakers being biased. This is magnified when the corporate sector is mainly funded by domestic banks, in contrast with equity and bond markets. This homogeneity entails political distortions being correlated across those countries.

ASSUMPTION 6: Sunspot variables coordinating public's expectations are independently and identically distributed across time and countries.

This not only means that the way an equilibrium is selected in *B* is the same as in *A* when multiple equilibria exist, but also that the coordination mechanism in *B* is independent of what occurred in *A*.

4.2. *Informational contagion*

International creditors and home depositors of country *B* determine their behavior not with the unconditional probabilities of *B*'s social costs of bank liquidation, but with such probabilities conditional on whether there was a crisis in *A*. This opens the door for contagion.

THEOREM 1: There is informational contagion from Country *A* to Country *B*, namely, a bank crisis in *A* increases the likelihood of a bank crisis in *B*, and this infection is solely based on a Bayesian reassessment by the public of the inclination of *B*'s government to bailouts. More specifically, the realization of a crisis in *A* increases the subjective probability that the cost of liquidation is low and that policymakers are benevolent in *B*.

Denoting by C^A (C^B, respectively) a crisis in *A* (*B*), and with $P(X \mid C^A)$ standing for the probability of the event *X* conditional on C^A, the previous statements write: $P(C^B \mid C^A) \geq P(C^B)$, $P(\chi^B = \chi^B_L \mid C^A) \geq P(\chi^B = \chi^B_L)$, and $P(\beta^B = 0 \mid C^A) \geq P(\beta^B = 0)$, respectively.

Proof: See Appendix *A*. □

International transmission of bank crises in equilibrium through this channel can be further disentangled as follows. First, the occurrence of a bank crisis in *A* induces the public to reassess the government's incentives to intervene in that country. Indeed, the likelihood of bank crises were shown to be increasing in the prior subjective probabilities that the cost of liquidation takes a low value and that the government is benevolent; therefore, upon the realization of a run, the *posterior* probabilities that the cost of liquidation takes its low value and the government is benevolent rise, on the grounds of Bayes' rule. Second, that downgrade in the catalyst country in turn implies a rise in the subjective probabilities that the cost of liquidation takes a low value in *B* and that its government is benevolent, provided these costs are correlated across those countries. And third, those higher probabilities in *B* consequently entail bank runs being more likely in that country, using again Corollary 2.

5. Conclusion

Our main findings have been the following: First, the public's expectations about equilibria are self-fulfilling. Second, bank collapses are outcomes in equilibrium whose likelihood decreases with the subjective assessment by the public of stronger policymakers' incentives to save a failing system. Third, bank runs in a country may propagate to other countries, as the public downgrades governments' propensity to intervene in those countries. Accordingly, lenders bid lower prices to buy new debt issued by banks in those countries, which entails those banks

becoming more illiquid. As a result, taxation costs of bailouts are higher, making governments more reluctant to step in, and banks are therefore more prone to runs.

A possible follow-up is to pave the way for concomitant drops in securities prices. Indeed, collapses of asset values have often been observed in recent crises. Introducing collateralized borrowing in the model may be a step in the right direction. Another possible continuation is to account for the possibility of dismissal of the government by a median voter.

References

Chang, R., and A. Velasco (2001) "A Model of Financial Crises in Emerging Markets" *Quarterly Journal of Economics* **116**, 489-517.

Dekle, R., and K. Kletzer (2002) "Domestic Bank Regulation and Financial Crises: Theory and Empirical Evidence from East Asia" In Sebastian Edwards and Jeffrey Frankel (eds.) *Preventing Currency Crises in Emerging Markets*, Chicago: University of Chicago Press, 507-552.

Diamond, D. W., and P. H. Dybvig (1983) "Bank Runs, Deposit Insurance, and Liquidity" *Journal of Political Economy* **91**, 401-419.

Diaz-Alejandro, C., (1985) "Good-bye Financial Repression, Hello Financial Crash" *Journal of Development Economics* **19**, 1-24.

Goldstein, M. (1998) "The Asian Financial Crises: Causes, Cures and Systemic Implications" *Policy Analyses in International Economics* 55. Washington, D.C.: Institute for International Economics.

Kodres, L. E., and M. Pritsker (2002) "A Rational Expectations Model of Financial Contagion" *The Journal of Finance* **57**, 769-799.

Kumar, M. S., and A. Persaud (2002) "Pure Contagion and Investors' Shifting Risk Appetite: Analytical Issues and Empirical Evidence" *International Finance* **5**, 401-436.

Masson, P. R. (1999) "Contagion: Macroeconomic Models with Multiple Equilibria" *Journal of International Money and Finance* **18**, 587-602.

Vaugirard, V. E. (2004) "Informational Contagion of Sudden Stops in a Global Games Framework" *Open Economies Review* **15**, 169-192.

Appendix

A. Proof of Theorem 1.

Due to Corollary 2, it suffices to check that:

$$\mathrm{P}(\chi^B = \chi^B{}_L \mid C^A) \geq \mathrm{P}(\chi^B = \chi^B{}_L), \tag{A1}$$

and

$$P(\beta^B = 0 \mid C^A) \geq P(\beta^B = 0). \qquad \text{(A2)}$$

While the economic intuition behind these inequalities is clear-cut and was sketched after Assumption 5, formally proving them involves coping with the different configurations displayed in Section 3. We will just consider the configuration where the equilibrium types *iv* (Condition (3d)) and *v* (3e) coexist in Country *A*.

A no-bailout of Type *iv* writes: $(\beta^A = 0)$ ū $[(\chi^A = \chi^A{}_L) \cap (\beta^A \neq 0)]$, where the symbol ū designates the union of two disjoint sets, while a no-bailout of Type *v* writes: Ω, the universe. A crisis follows from the intersection of those sets and the realization of an unfavorable value of the sunspot variable for *A*-depositors: $(D^A = D^A{}_U)$. The selection between the two Types *iv* and *v* is based on a sunspot variable F^A for international lenders, which takes two values, $F^A{}_{iv}$ or $F^A{}_v$, each with probability ½, where $F^A{}_v$ means that the public coordinates on an equilibrium of Type *v*. C^A can thus be disentangled into:

$$C^A \equiv \{(F^A = F^A{}_v) \cap (D^A = D^A{}_U)\}$$

$$\text{ū}\{(F^A = F^A{}_{iv}) \cap (D^A = D^A{}_U) \cap ((\beta^A = 0) \text{ ū } [(\chi^A = \chi^A{}_L) \cap (\beta^A \neq 0)])\}, \qquad \text{(A3)}$$

where $(D^A = D^A{}_U)$ means that the sunspot variable for *A*-depositors takes the unfavorable value. It follows that:

$$\begin{aligned}
&P(\chi^B = \chi^B{}_L \mid C^A) \\
&= P(\chi^B = \chi^B{}_L \cap C^A) \,/\, P(C^A) \\
&= \{P((\chi^B = \chi^B{}_L) \cap (F^A = F^A{}_v) \cap (D^A = D^A{}_U)) \\
&\quad + P((\chi^B = \chi^B{}_L) \cap (\beta^A = 0) \cap (F^A = F^A{}_{iv}) \cap (D^A = D^A{}_U)) \\
&\quad + P((\chi^B = \chi^B{}_L) \cap (\chi^A = \chi^A{}_L) \cap (\beta^A \neq 0) \cap (F^A = F^A{}_{iv}) \cap (D^A = D^A{}_U))\} \,/\, P(C^A) \\
&= \{P(\chi^B = \chi^B{}_L)\, P(F^A = F^A{}_v)\, P(D^A = D^A{}_U) \\
&\quad + P(\chi^B = \chi^B{}_L)\, P(\beta^A = 0)\, P(F^A = F^A{}_{iv})\, P(D^A = D^A{}_U) \\
&\quad + P((\chi^B = \chi^B{}_L) \mid (\chi^A = \chi^A{}_L))\, P(\chi^A = \chi^A{}_L)\, P(\beta^A \neq 0)\, P(F^A = F^A{}_{iv})\, P(D^A = D^A{}_U)\} \,/\, P(C^A), \qquad \text{(A4)}
\end{aligned}$$

where we use that sunspots do not affect costs of bank crises nor being biased, that social costs of crises and being benevolent are independent, together with that the sunspot variables for depositors alone and for the public are independent.

Now, making use of: $P(\chi^B = \chi^B{}_L \mid (\chi^A = \chi^A{}_L) > P(\chi^B = \chi^B{}_L)$, due to the positive correlation between χ^A and χ^B, (A4) yields:

$$P(\chi^B = \chi^B{}_L \mid C^A) > P(\chi^B = \chi^B{}_L)\ \{P(F^A = F^A{}_v)\, P(D^A = D^A{}_U)$$

$$+P(\beta^A = 0)\ P(\ F^A = F^A{}_{iv})\ P(D^A = D^A{}_U)$$

$$+\ P(\chi^A = \chi^A{}_L)\ P(\beta^A \neq 0)\ P(F^A = F^A{}_{iv})\ P(D^A = D^A{}_U)\} \ /\ P(C^A). \qquad \text{(A5)}$$

Finally, the member between brackets in the right-hand side member of (A5) is equal to $P(C^A)$, due to (A3), and then (A5) comes down to Inequality (A1).

Deriving (A1) is similar in other cases of multiple equilibria and straightforward in cases of unique equilibrium. Inequality (A2) can be proved following along the same lines. □