



BANK OF GREECE  
EUROSYSTEM

# Special Conference Paper

The crisis in the euro area, May 23-24, 2013

Credit policy in times of financial distress

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Discussion:  
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JULY 2013

23

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ISSN 1792-6564

## **Editorial**

On 23-24 May 2013, the Bank of Greece organised a conference on “The Crisis in the Euro Area”, in Athens.

The papers and commentaries presented at the conference addressed many important issues related to the functioning of the euro area. Our hope is that these contributions will help improve understanding of the nature of Europe’s monetary union, the underpinnings of its crisis, and the changes that are needed so that crises will be prevented in the future.

The papers examined two main sets of issues. One group of papers, adopting a union-wide perspective, assessed the aspects of the euro area’s institutional architecture that, with the benefit of hindsight, may have contributed to the crisis, and the policy responses to the crisis at the union level. A second group of papers focused on developments in three crisis countries -- Greece, Ireland, and Portugal.

The papers presented at the conference, with their discussions, will be published in the *Journal of Macroeconomics*.

Here we present the paper by Costas Azariadis (Washington University and Federal Reserve Bank of St. Louis) with its discussion by Harris Dellas (University of Bern).

# CREDIT POLICY IN TIMES OF FINANCIAL DISTRESS

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## ABSTRACT

This essay evaluates two central bank policy tools, capital requirements and lending of last resort, designed to avert financial panics in the context of endowment economics with complete markets and limited borrower commitment. Credit panics are self-fulfilling shocks to expected credit conditions which cause transitions from an optimal but fragile steady state to a suboptimal state with zero unsecured credit. The main findings are: (i) Countercyclical reserve policies protect the optimum equilibrium against modest shocks but are powerless against large shocks. (ii) If we ignore private information and central banks inefficiencies, this class of models bears out Bagehot's 1873 claim in *Lombard Street*: panics are averted if central banks stand ready to lend at a rate somewhat above the one associated with the optimal state.

*Keywords:* bank panics, last resort, capital requirements, credit conditions

*JEL Classification:* E52, E58, E44

*Acknowledgements:* The views expressed in this paper are personal and do not represent any institution affiliated with the author. Thanks go to Jundong Zhang for excellent research assistance

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# 1 INTRODUCTION: ISSUES, POLICIES, LITERATURE

## 1.1 Issues

In the fall of 2008, the Great Recession brought financial crises out of the dustbin of history into front-page reality. Interest in panics, bubbles and manias suddenly escaped the confines of economic history<sup>1</sup> and obscure theory to become a ripe subject for commentators and op-ed writers.<sup>2</sup> Together with these developments came renewed academic interest in the causes, consequences of and cures for financial crises, a topic that researchers had ignored since the 1930's.<sup>3</sup>

This essay seeks to evaluate the contribution of two central bank policy tools in managing financial crises. The tools reviewed, capital requirements (CR) and lending of last resort (LLR) have been in the arsenal of monetary authorities for a long time; the second one was deployed with success by the Bank of England as early as two centuries ago.<sup>4</sup>

The context for this evaluation is an endowment economy of the type studied by Kehoe and Levine (1993), and Alvarez and Jermann (2000). As individual incomes fluctuate, heterogeneous households attempt to smooth consumption by lending and borrowing without commitment to repay loans.

Loan default in this environment leads to perpetual exclusion from credit markets: it destroys the borrower's reputation and forever disqualifies her from asset trading. Lacking an external source of enforcement, loans are repaid only if repayment is in the borrower's interest, that is, only if gains from future trading in asset markets outweigh the immediate benefit of withholding repayment. All loans exchanged in the credit market must be self-enforcing, that is, they must be constrained by the requirement that the loss of trading privilege outweighs the short-run gain from

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<sup>1</sup>Good examples are Bordo (1986), Goodhart (1999) and Laidler (2002).

<sup>2</sup>See, for example, Lewis (2011), Reinhart and Rogoff (2009)

<sup>3</sup>One exception is work on bank panics by Diamond and Dybvig (1983), Champ, Smith and Williamson (1996) and others. The recent revival of interest in bubbles and related phenomena is expressed in papers by Martin and Ventura (2012), Farhi and Tirole (2012), as well as in policy-driven contributions from Kiyotaki and Moore (2012) and others.

<sup>4</sup>For a brief history of LLR cf. Humphrey (2010).

default. To achieve this, lenders impose on each borrower a debt limit that depends on how much borrowers value their reputations.

Reputation itself is a non-fundamental feature of each household: it depends in part on the borrower's perception of future credit conditions. Borrowers who expect or require substantial future loans will value their reputations more highly than those who do not need or do not expect to obtain sizable loans in the future. This link between the value of reputation and expected credit conditions is called a *dynamic complementarity* which ties current lending to expectations of future lending. Pessimistic expectations of future credit availability will restrict current credit and compromise consumption smoothing; optimism has the opposite effect of facilitating consumption.

The outcome of all these constraints is that economies with limited commitment are capable of two long-run equilibria. One of them is a fragile bubble-like state with highly valued reputations, considerable unsecured lending and good welfare properties; the other is a robust no-bubble state with worthless reputations and no lending. The fragile state is a constrained optimum in which debt limits are forever the largest possible loans that borrowers are willing to repay. The robust state is the textbook outcome of *financial panics*; credit conditions are the worst possible and expected to remain so for the foreseeable future.

## 1.2 Policy Tools

Managing financial crises in this context means to deploy the tools at the disposal of the central bank in a manner that improves household expectations about future credit conditions. If policy-makers convince borrowers that reasonable amounts of credit will be available in the future, current lending will pick up, and financial crises will heal or, in the best of circumstances, be nipped in the bud.<sup>5</sup>

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<sup>5</sup>Bordo (1989) lists 16 episodes of bank runs or failures over the period 1870–1933 and 30 crisis events (panics, crashes, failures). Timely action by the Bank of England seems to have defused crises in 1878/1898 and 1941; the Bank of France intervened successfully to prevent declines in money growth in 1882, 1898 and 1930.

Policies to contain or avert panics are most prominently connected with Henry Thornton (1802) and Walter Bagehot (1873). The former was concerned about reductions in credit triggered by rumors of invasion, bank failure etc.; the latter advocated that the Bank of England should prevent shrinkage in broadly defined “money” by committing to lend at a high interest rate to creditworthy borrowers offering good collateral.

“Very large loans at very high rates are the best remedy of the money market when a foreign drain is added to a domestic drain.”<sup>6</sup>

In the remainder of this essay we examine the role of CR and LLR policy rules as devices that select desirable equilibria and avert financial panics in environments where limited commitment is the only financial friction emanating from the private sector.<sup>7</sup> We ignore financial frictions that arise from private information or incomplete markets, e.g., moral hazard, adverse selection and liquidity shortages. These are adequately treated in the literature referred to in footnote 3 and in more recent extensions by Martin (2006), Ennis and Keister (2010) and others.

Capital reserves and lending of last resort are viewed in what follows as instruments that manipulate the economy’s available consumption resources in a manner that raises aggregate consumption when private loans are large, and lowers consumption when lenders pull back. Central bank policies derive their power from two sources. One is the government’s ability to extract from households a small fraction of their income in a way that private lenders cannot. The central bank in effect can “collateralize” part of each borrower’s income. In addition, the central bank’s payoff is assumed to be social welfare which implies that policymakers will choose to repay all loans and abstain from acts damaging to households.

Against these advantages, we will build into policy three limitations that make the central bank inferior to private institutions as a financial intermediary. One, the central bank invests reserves

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<sup>6</sup>Bagehot (1873), *Lombard Street*, p.56. Also see Rochet and Vives (2004) for a modern view on LLR.

<sup>7</sup>Antinolfi, Azariadis and Bullard (2007) is an early example of managing credit crises by monetary feedback rules that connect liquidity injections with the state of the credit market. The basic model presented in section 2 is the same as in the AAB paper.

of private capital in an inferior storage technology whose return is so low that no private investor would make any use of it. Two, when the central bank converts private deposits into loans, an exogenous fraction  $\delta \in [0, 1]$  of deposits is wasted in income-destroying “leakages”. Three, the central bank cannot completely exclude renegade borrowers from credit markets; it can prevent them from ever borrowing again but cannot keep them from lending. The outcome is that the central bank is able to keep the credit spigot always open but is unable to punish credit mischief as resolutely as private lenders will in good times. To avoid a flood of defaulters and the heavy losses that come from non-performing loans, *the central bank will have to lend less than private intermediaries would under ideal conditions.*

Section 2 lays out the basic model of financial fragility and credit crises in laissez-faire environments. CR policies are evaluated in section 3 and LLR policies in section 4. The last section sums up and discusses extensions.

## 2 FINANCIAL CRISES UNDER LAISSEZ-FAIRE

We examine consumption smoothing in an economy with deterministic individual incomes, populated by two groups of agents which are indexed by  $i = 0, 1$ , with unit mass each. Time is discrete and denoted by  $t = 0, 1, 2, \dots$ . Each agent  $i$  has preferences given by

$$\sum_{t=0}^{\infty} \beta^t u(c_t^i) \tag{1}$$

with  $0 < \beta < 1$ . The aggregate endowment is constant at two units, but its distribution over agents changes deterministically over time. In particular, individual endowments are periodic<sup>8</sup>; that is,

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<sup>8</sup>This simple deterministic endowment process is the degenerate case of a stochastic economy with two Markovian states and a zero probability of remaining in the same state. Markovian endowments with two states are a straightforward extension.

$$(\omega_t^0, \omega_t^1) = \begin{cases} (1 + \alpha, 1 - \alpha) & \text{if } t = 0, 2, \dots \\ (1 - \alpha, 1 + \alpha) & \text{if } t = 1, 3, \dots \end{cases} \quad (2)$$

with  $\alpha \in (0, 1)$ . In addition, agent zero owes an initial debt,  $B = \alpha / (1 + \beta)$ , to agent one. This debt makes the initial wealth of the two agents identical when incomes are discounted at the common rate of time preference. In a more complicated economy, agents would be indexed by  $\alpha \in (0, 1)$ ; some individual incomes would fluctuate only a little, others would fluctuate quite a bit.

## 2.1 Perfect Enforcement

To fix ideas and notation, we start with a standard dynamic general equilibrium model with perfect enforcement of loan contracts. In this setting, an equilibrium is an infinite sequence  $(c_t^H, c_t^L, R_t)$  that describes for each period  $t$  consumption for the high- and low-income agents and the gross yield on loans. This sequence satisfies consumption Euler equations for each person, two intertemporal budget constraints, and market clearing. Based on our assumptions concerning the initial distribution of wealth, it is obvious that the unique equilibrium is  $(c_t^H, c_t^L, R_t) = (1, 1, 1/\beta)$  for all  $t$ , and it is an equal-treatment Pareto optimum (E-TO). Individual consumption is a *constant fraction* of aggregate consumption at all times.

Commitment to repay debts is essential in achieving this allocation of resources. If borrowers can in principle default on their loan obligations at the cost of perpetual exclusion from both sides of the asset market, as suggested by Kehoe and Levine (1993), then the Pareto-optimal allocation cannot be decentralized as a competitive equilibrium with limited enforcement unless it is weakly preferred to autarky (that is, to default) by all agents at all times. It is easy to check that the current autarky payoff is

$$\frac{u(1 + \alpha) + \beta u(1 - \alpha)}{1 - \beta^2} \quad (3)$$

for a high-income agent and

$$\frac{u(1 - \alpha) + \beta u(1 + \alpha)}{1 - \beta^2} \quad (4)$$

for a low-income agent. These are dominated by market participation and perpetual consumption of one unit if, and only if,

$$u_A := u(1 + \alpha) + \beta u(1 - \alpha) \leq (1 + \beta)u(1) \quad (5)$$

This inequality holds under conditions similar to those enumerated in Alvarez and Jermann (2000, Proposition 4.9), which require that all individuals have a strong need for consumption smoothing. In particular, inequality (5) holds if all individuals have a low intertemporal elasticity of substitution, or a low rate of time preference, or are subject to large individual income shocks. Reasonable as they might seem for an economy with two agents, these conditions are difficult to achieve in an environment with a large variety of agent types, some of whom will necessarily experience small income shocks. In what follows we assume that inequality (5) fails and that autarky is a *dynamically inefficient* state with a low implied rate of interest. Specifically, we assume

$$u_A := u(1 + \alpha) + \beta u(1 - \alpha) > (1 + \beta)u(1) \quad (6)$$

and

$$u'(1 + \alpha) < \beta u'(1 - \alpha) \quad (7)$$

In a more complicated model with a continuum of agents indexed by  $\alpha$ , inequality (7) would have to hold for some interval of  $\alpha$ , in particular for the highest values of  $\alpha$ .<sup>9</sup>

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<sup>9</sup>If the utility function were logarithmic, inequality (7) would require that the maximal value of  $\alpha$  should exceed  $(1 - \beta) / (1 + \beta)$ , which implies that the maximal annual fluctuation in individual income should be no less than ap-

These relations are shown in Figure 1, where the first-best allocation is point  $E$  on the diagonal, point  $A$  represents autarky, and point  $GR$  is the golden-rule allocation at which the growth rate equals the implied interest rate. Points  $E, GR$  and  $A$  are associated with interest factors equal to  $1/\beta$ , unity and less than one, respectively.

## 2.2 Limited Enforcement

In environments where loan contracts are enforced by perpetual exclusion of defaulters from asset markets, equilibria are defined somewhat differently from standard models. In particular, an equilibrium is an infinite sequence,  $(c_t^H, c_t^L, R_t, b_t)$ , where  $b_t$  is the debt limit assigned to the low-income person at  $t - 1$ . Agents maximize taking  $R_t$  and  $b_t$  as given, markets clear, and  $b_t$  is the largest possible debt limit that will keep borrowers at  $t - 1$  from defaulting at date  $t$ . These limits must be binding by inequality (6), which states that the first-best allocation  $(c_t^H, c_t^L) = (1, 1) \forall t$  is ruled out by debt limits. Specifically:

(i) the consumption Euler equation holds for the high income agent and fails for the low-income agent; that is,

$$\beta R_{t+1} = \frac{u'(c_t^H)}{u'(c_{t+1}^L)} < \frac{u'(c_t^L)}{u'(c_{t+1}^H)} \quad (8)$$

(ii) Budget constraints apply, with the low-income agent borrowing at the debt limit from the high income agent; that is,

$$c_t^H = 1 + \alpha - R_t b_t - b_{t+1} \quad (9)$$

and

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proximately 2 percent. Hence, it seems quite plausible that the first-best allocation will be ruled out by endogenous debt limits.

$$c_t^L = 1 - \alpha - R_t b_t - b_{t+1} \quad (10)$$

(iii) Markets clear; that is,

$$c_t^H + c_t^L = 2 \quad (11)$$

and

(iv) Debt limits equate the autarkic and market payoffs for a high-income consumer who is about to repay last period's debt; specifically,

$$u(c_t^H) + \beta u(c_{t+1}^L) = u(1 + \alpha) + \beta u(1 - \alpha) \quad (12)$$

for all  $t$ .

If we define  $c_t^H = x_t \in [1, 1 + \alpha]$ , then it is clear that equilibria are solution sequences to equation (12), that is, to

$$u(x_t) + \beta u(2 - x_{t+1}) = u_A \quad (13)$$

These sequences are shown in Figure 1, and also as the blue line in Figure 2. That figure solves equation (13) explicitly for

$$x_{t+1} = f(x_t) \quad (14)$$

Here  $f$  is an increasing concave function, the mirror image of the indifference curve shown in Figure 1. The function  $f$  has two fixed points  $\{\hat{x}, 1 + \alpha\}$  with slope

$$f'(1 + \alpha) = \frac{u'(1 + \alpha)}{\beta u'(1 - \alpha)} := \bar{R} < 1 \quad (15)$$



at  $x = 1 + \alpha$ , and

$$f'(\hat{x}) := \hat{R} = \frac{u'(\hat{x})}{\beta u'(2 - \hat{x})} \in (1, 1/\beta) \quad (16)$$

at  $x = \hat{x}$ .

### 2.3 Fragility

Figure 1 shows that there are two steady states. This first is a robust and stable autarkic state,  $(c_t^H, c_t^L, R_t, b_t) = (1 + \alpha, 1 - \alpha, \bar{R}, 0)$  for all  $t$ , which corresponds to point  $A$ . The loan market is shut down in this state. The second is a fragile and unstable trade state,  $(c_t^H, c_t^L, R_t, b_t) = (\hat{x}, 2 - \hat{x}, \hat{R}, \hat{b})$  for all  $t$ , where  $\hat{x} \in (1, 1 + \alpha)$  is the smallest fixed point of  $f$  and

$$\hat{b} = \frac{1 + \alpha - \hat{x}}{1 + \hat{R}} \quad (17)$$

This state corresponds to point  $CO$  in Figure 1. The loan market is active in this state. Since  $CO$  lies between point  $GR$  and the diagonal, we have

$$\hat{R} \in (1, 1/\beta) \quad (18)$$

Because autarky is associated with an interest factor below 1, and the trading state with an interest factor above 1, it follows from Alvarez and Jermann (2000, Proposition 4.6) that the trading state is constrained optimal<sup>10</sup> and the autarkic state is not. Individual consumption shares fluctuate less in the constrained optimal state than they do in the autarkic state.

In addition to the two steady states, there is a continuum of equilibrium sequences  $(x_t)$  indexed on  $x_0 \in (\hat{x}, 1 + \alpha)$ , which converge to autarky. See the broken black lines in Figure 1. All of these

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<sup>10</sup>Note from Figure 1 that  $CO$  is at the highest indifference curve of the social welfare function  $u(x) + u(2 - x)$  consistent with resource and incentive constraints.

sequences can be Pareto ranked by the initial consumption,  $x_0$ .

Equilibrium outcomes are indeterminate in this nonmonetary economy because of *dynamic complementarities* between current and expected future debt limits. In particular, low future debt limits reduce gains from future asset trading and lower the *current* payoff to solvency. This, in turn, raises the incentive to default, which must be deterred by tighter debt limits now.

We conclude that the constrained optimal allocation of consumption  $(\hat{x}, 2 - \hat{x})$  can be achieved only if all future debt limits are expected to stay *exactly* at  $\hat{b}$ . Any other expectations will lead inevitably to panics and financial autarky. In the remainder of the paper, we will explore whether, and how, policies can guide individual expectations in a manner that leads away from autarky and, perhaps, toward the constrained optimal allocation.

### 3 MANIPULATING RESERVE CAPITAL

Capital reserves are a weapon of some importance in deterring financial panics. A typical countercyclical policy is to raise requirements when private lending and economic activity weaken, and to lower them when equilibrium is sufficiently close to its constrained optimal state. Acting in this manner, the central bank uses its power to extract resources from private intermediaries when expectations drive them to restrict both credit and consumption smoothing. In the opposite event of favorable expectations that induce intermediaries to lend generously, the central bank lowers capital requirements, rewarding intermediaries with high consumption.

We suppose in the sequel that, at each  $t$ , the central bank extracts from each lender a small amount of capital  $k_t \in [0, \bar{k}]$  where  $\bar{k}$  is much smaller than one unit. Suppose further that reserve capital is stored in an inferior storage technology bearing the autarkic yield  $\bar{R} < 1$  which no private investors would voluntarily choose to save in. The central bank's policy rule is a smooth two-dimensional function

$$k_t = \phi(x_t, k_{t-1}) \quad (19)$$

which conditions current capital requirements on past ones and on the current state of the economy. If the rule admits both autarky and constrained efficiency as steady states, then

$$\phi(1 + \alpha, 0) = \phi(\hat{x}, 0) = 0 \quad (20)$$

Each equilibrium that rations borrowers requires two things: one, aggregate consumption equals endowment minus new capital reserves, plus principal and interest on existing reserves; two, when rationed borrowers repay, they are indifferent between solvency and default. The relevant equations are

$$c_t^H + c_t^L = 2 - k_t + \bar{R}k_{t-1} \quad (21)$$

$$u(c_t^H) + \beta u(c_{t+1}^L) = u_A \quad (22)$$

Denote  $x_t := c_t^H$ , we rewrite these equations in the same way as eq. (13):

$$u_A = u(x_t) + \beta u(2 - x_{t+1} - k_{t+1} + \bar{R}k_t) \quad (23)$$

Proceeding as in eq. (14), we solve eq. (23) for  $x_{t+1}$  and combine that solution with the policy rule to obtain system of two equations

$$x_{t+1} = f(x_t) + \bar{R}k_t - k_{t+1} \quad (24)$$

$$k_{t+1} = \phi(x_{t+1}, k_t) \quad (25)$$

These equations tell us that capital requirements are an efficient tool against relatively small credit shocks. For example, eq. (24) allows the economy to escape the inferior autarkic state and converge to the constrained optimum allocation  $x_{t+1} = \hat{x}$  if the policy rule takes the form

$$k_{t+1} = \bar{R}k_t + p(x_{t+1}) \quad (26)$$

where  $p : [\hat{x}, 1 + \alpha] \rightarrow [0, (1 - \bar{R})\bar{k}]$  is a smooth function that satisfies eq. (20). Equivalently,

$$p(\hat{x}) = p(1 + \alpha) = 0 \quad (27)$$

Then eq. (24) reduces to

$$x_{t+1} = f(x_t) - p(x_{t+1}) \quad (28)$$

and is drawn in Figure 2 as a red line. The policy  $p(\cdot)$  shifts the blue laissez-faire dynamics downward thus permitting policymakers instantly to stabilize the constrained efficient state  $x = \hat{x}$  and escape the panic state  $x = 1 + \alpha$ . This is accomplished by keeping the red line nearly horizontal near  $\hat{x}$  and nearly vertical near  $1 + \alpha$ .

Activist policy, as captured by the red line, successfully deals with small shocks to expectations and guides the economy back to its optimum state. The red line also captures the downside to activism: *policy is powerless against large expectational shocks*. If the upper bound on reserve requirements  $\bar{k}$  is relatively small, then any activist policy graph that connects  $x = \hat{x}$  with  $x = 1 + \alpha$  *must* cross the 45° line from above. That means policy creates a new attractor not too far away from autarky, at  $x = \tilde{x}$ , which will now become the focal point for the economy if it is shocked outside the immediate neighborhood of the efficient state.

The baseline model concludes that a well-designed reserve policy lessens the fragility of the optimal state and improves credit supply in the bad one at the cost of some resource wastage which

occurs when the central bank takes commands of private capital.

## 4 LENDING OF LAST RESORT

Deterring sharp contractions in private credit has been a key aspect of a central bank's mission since Thornton (1802) and Bagehot (1873). Thornton was as concerned about shortages in business credit as Bagehot was about bank failure. Their views dominate current thinking about how central banks should behave in times of financial distress. Together with Milton Friedman and Anna Schwartz (1968), these views have shaped the responses of both the Federal Reserve System and the European Central Bank during the Great Recession.

The qualification “last resort” imparts a note of caution, indicating a public desire for central banks to abstain from lending activity unless the credit market is in dire straits. To capture this caution, we disadvantage central banks in our general equilibrium model in two ways. One, they are assumed to waste a fixed fraction  $\delta$  of all deposits they accept before they convert those into loans; wastage is a pure deadweight loss that creates no income for anybody. Two, central banks are not as good as private intermediaries in identifying and punishing defaulters. In particular, we suppose that monetary authorities can withhold credit from renegade borrowers in perpetuity but cannot prevent them from lending or accumulating assets.

Denoting  $L_{t+1}$  the volume of loans made by the central bank at time  $t$  and maturing at  $t + 1$ , the market clearing condition (11) becomes

$$c_t^H + c_t^L = 2 - \frac{\delta}{1 - \delta} L_{t+1} \quad (29)$$

Here the central bank wastes a fraction  $\delta$  of all its deposits and, hence  $[\delta/(1 - \delta)]$  of all loans. To make up for resources wasted, central banks must charge borrowers a higher rate than the one paid lenders. The binding participation constraint (12) remains unchanged if the central bank can

exclude defaulters from both sides of the credit market. If defaulters can still save, that constraint tightens to

$$u(c_t^H) + \beta u(c_{t+1}^L) = \max_{s \in [0, 1+\alpha]} \{u(1 + \alpha - s) + \beta u(1 - \alpha + R_{t+1}s)\} \quad (30)$$

where

$$R_{t+1} = u'(c_t^H) / [\beta u'(c_{t+1}^L)] \quad (31)$$

is the solvent household's yield on saving and  $R_{t+1} / (1 - \delta)$  is what central banks charge last-resort borrowers.

We assume that lending policy follows a feedback rule of the form

$$L_t = L(c_{t-1}^H) \quad (32)$$

where  $L : [\hat{x}, 1 + \alpha] \rightarrow \mathbb{R}_+$  is an increasing function such that  $L(\hat{x}) = 0$ , i.e., no last-resort lending occurs in efficient equilibrium states.

Equilibria are solutions to eqs. (29), (32) together with the appropriate participation constraint – either (12) or (30). If central banks are as efficient as private intermediaries in excluding defaulters from asset markets, then our model replicates the policy prescriptions of Thornton and Bagehot. This follows immediately if we denote  $c_t^H = x_t$  and choose the strongly countercyclical policy rule

$$L(x) = \frac{1 - \delta}{\delta} [f(x) - \hat{x}] \quad (33)$$

which says that the central bank stands ready to make up any shortfall of private lending from what is required for an optimal equilibrium. Figure 3 illustrates. Under this rule, the market clearing condition (29) reduces to

$$x_t + c_t^L = 2 + \hat{x} - f(x_{t+1}) \quad (34)$$

and the participation constraint (12) is satisfied uniquely if the optimum allocation prevails, i.e.,

$$x_{t+1} = \hat{x} \text{ for any } x_t \in [1, 1 + \alpha] \quad (35)$$

Under the policy rule (33), the central bank rules out all suboptimal equilibria as the economy gravitates instantly to the optimum. This is shown by the lower red line in Figure 4. In fact, the central bank *never has to lend at all*. The panic is stayed by the mere announcement of the policy described in equation (33). Just as Bagehot claimed in *Lombard Street*, the central bank stands ready to lend to individuals who never default in equilibrium, doing so at the high yield

$$R = \hat{R} / (1 - \delta) \quad (36)$$

For example, if the equilibrium yield in the efficient state is a bit above the normal growth rate at 4% and the waste parameter is  $\delta = .05$ , then the central bank lends at nearly 9%.

This rosy scenario changes considerably if the central bank cannot punish defaulters as energetically as private intermediaries. In that event, the default payoff rises to what is described as the RHS of eq. (30). That expression now tracks an offer curve through autarky, not an indifference curve.<sup>11</sup> The best allocation that the central bank can deliver in this environment is the golden rule at  $x = x_g$ , as shown by the upper red line in Figure 4. Activist policy homes in on a suboptimal permanent state that lies between the laissez-faire extremes of an efficient state  $\hat{x}$  or a disastrously inefficient autarkic state. To escape the worst outcome, policy has to sacrifice the best.

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<sup>11</sup>This is the key point in Hellwig and Lorenzoni (2009).

## 5 CONCLUSIONS AND EXTENSIONS

This paper provides general equilibrium examples of how active credit policy can be used to select a desirable outcome in economies where passive policies are associated with occasional financial fragility.

In our setting, policy works directly on rational beliefs about future credit conditions. It does so by *committing* to rules that connect current or expected financial conditions with future values of the policy instrument and, in particular, to a shared belief that asset returns will improve substantially when credit volume falls below what is consistent with an efficient allocation of resources.

When viewed as an exercise in equilibrium selection, credit policy is an attempt to foster expectations that lead to socially desirable states of the economy as rapidly as possible. In particular, we evaluate capital requirements and lending of last resort as weapons that avert financial panics in economies with relatively mild financial frictions. Frictions are embodied in the assumption that all loans are self-enforcing, with reputation being the enforcement tool. We ignore all other distortions; information is public, markets are complete, and default never happens in equilibrium.

Even in this relatively benign environment, central banks cannot deliver outcomes as good as what laissez-faire can under normal conditions. Activist credit policies can rule out the financial panics that have historically afflicted unregulated financial markets at the cost of also ruling out the efficient outcomes that unregulated markets can deliver under the best of circumstances. The main reason for this trade-off is that central banks have powers to commit and to seize private incomes that are out of reach for private intermediaries. On the minus side, public lending is not as efficient as private lending in its ability to collect information cheaply and to convert deposits into loans.

Public policy towards financial panics seems to face a trade-off between insurance and incentives of the type recently examined by Myerson (2012). What rules we wish to follow in the event of financial panics may very well depend on how much of our income in “good times” we are willing to sacrifice as an insurance policy against “bad times”.



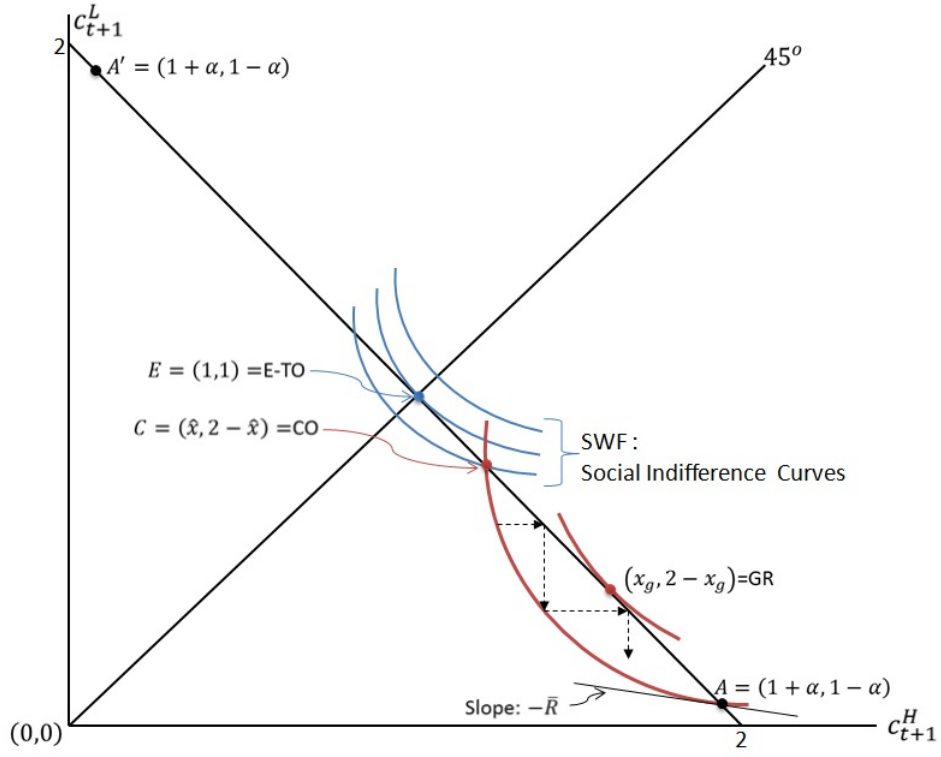


FIGURE 1: FINANCIAL FRAGILITY UNDER LAISSEZ-FAIRE

$$\text{Steady states: } c_t^H = \begin{cases} 1 + \alpha & \longleftrightarrow \text{suboptimal \& robust} \\ \hat{x} & \longleftrightarrow \text{optimal \& fragile} \end{cases}$$

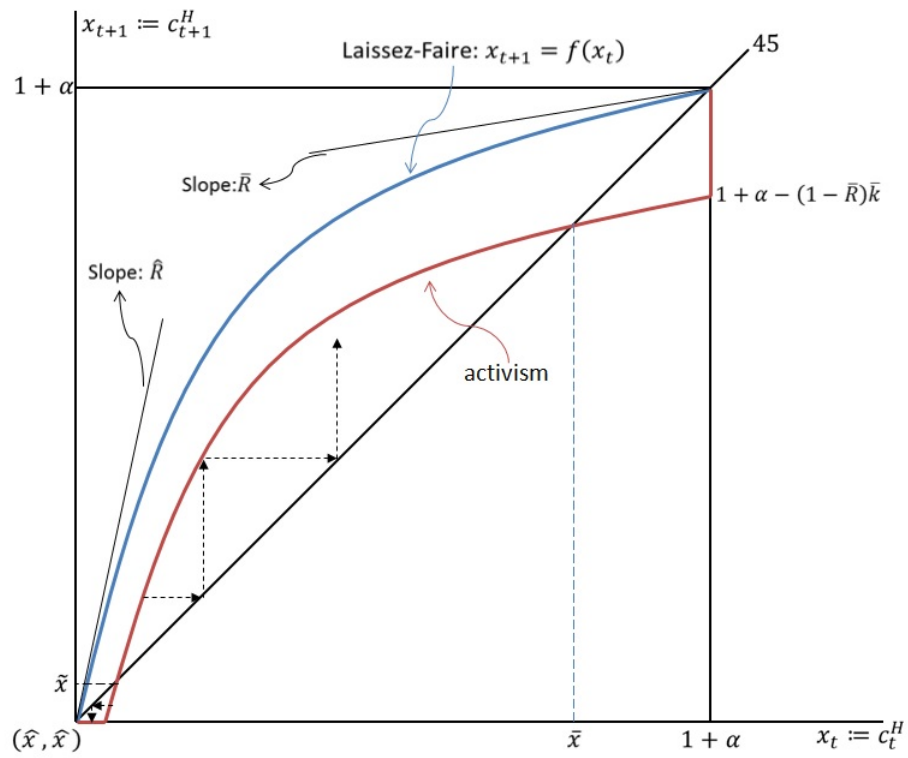


FIGURE 2: PROS AND CONS OF CAPITAL RESERVE POLICIES

$$\text{Steady states: } \begin{cases} c_t^H = \hat{x} & \longleftrightarrow \text{optimal \& locally robust} \\ c_t^H = \bar{x} > \hat{x} & \longleftrightarrow \text{suboptimal \& locally robust} \end{cases}$$

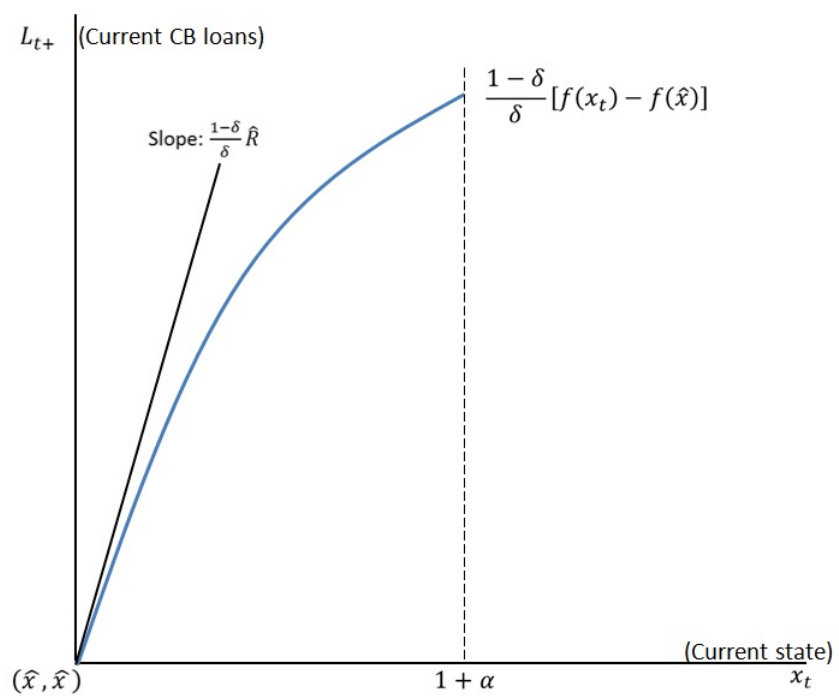


FIGURE 3: OPTIMAL LLR POLICY

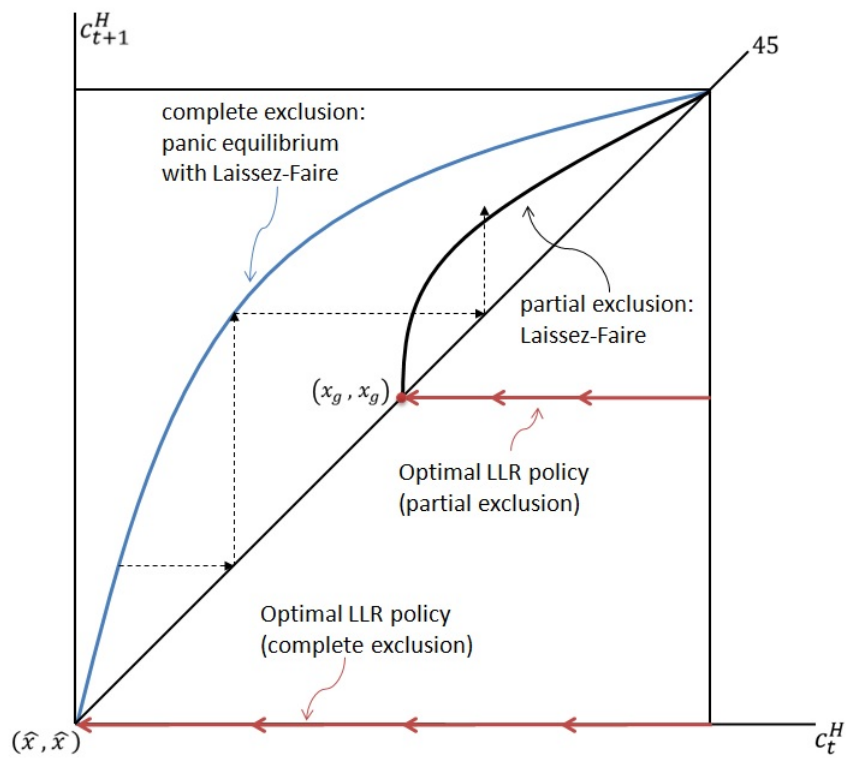


FIGURE 4: LOAN DYNAMICS UNDER OPTIMAL LLR POLICY

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DISCUSSION OF  
CREDIT POLICY IN TIMES OF FINANCIAL DISTRESS

by Costas Azariadis'

*Harris Dellas*

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## 1 Introduction

The recent financial crisis has given rise to a large body of research investigating its causes and implications. It has also motivated efforts to develop policies that could prevent/mitigate crises. A large number of factors have been identified as causes of the crisis, including easy monetary policy, affordable housing initiatives, lax regulation, poisonous poorly understood financial products, etc. Among the policies that have been proposed to prevent financial crises, unconventional monetary policy and more stringent regulations are the most prominent.

Azariadis' paper focuses on a particular, plausible cause of the crisis: A credit panic that arises from an adverse, self fulfilling shock to expected future credit conditions. It proposes two central bank policies to cope with (or preempt) a collapse of credit: Capital (reserve) requirements –CR– on financial intermediaries; and a lender of last resort function by the Central Bank, CB, in which the CB accepts deposits and makes loans to the private sector. The model uses a dynamic, endowment economy with complete markets in which the borrowers suffer from limited commitment to repay. The lack of commitment may result in a debt ceiling (and hence suboptimal consumption smoothing for the borrower). In case a borrower defaults on his private loans, he suffers permanent exclusion from credit markets. Note that, as it is the case in models possessing these features, the existence of a deterministic debt ceiling guarantees that there will be no default in the equilibrium of the model.

The key idea in the model is the following: The incentive to repay currently due debt depends on the expected value of future participation in credit markets. For instance, if an agent who is due to repay debt in the current period does not plan to participate in the future credit markets (either as a lender or as borrower) then he suffers no consequences from being excluded from credit markets. That is, the cost of default is zero while the

benefit (the amount not repaid) is non zero. In such a case, no repayment ever takes place. Anticipating this, no creditor will ever make any loan. In general, the expected value of future participation in credit markets will depend on time preferences, the volatility of future income and so on. It follows that expectations of adverse future credit conditions lower the value of participation and increase the incentive to default on current debt. This in turn decreases the amount of safe debt that can be issued today. Consequently, the model has the key implication that expectations of malfunctioning credit markets in the future can lead to the collapse of credit now. Under some conditions, such an economy can only support the autarkic equilibrium with zero credit.

What can policymakers do in order to prevent such an outcome? One possibility is to institute reserve requirements: That is, to make the financial intermediary (lender) pay a small tax (a fraction of which will be returned to him in the next period) when he lends less than the constrained efficient amount. It turns out that for small enough adverse belief shocks this suffices to deter credit contraction (default) and keep the economy in the efficient steady state.

Another possibility is for the central bank to act as a lender of last resort (LLR). This requires that the Central Bank is prepared to act as a financial intermediary itself in the sense of accepting deposits and making loans to the private sector. One then needs to specify how the central bank deals with loan delinquency, that is, how it punishes the agents it has lent to in case they refuse to repay their loans. Two alternative specifications regarding punishment in case of default are considered. Under the first specification, public (the Central Bank) and private intermediaries are treated symmetrically. That is, like private intermediaries, the CB can exclude defaulters from both borrowing and lending in credit markets. This policy turns out to support an intermediate (between the good and the bad) equilibrium. The second specification treats public and private intermediaries asymmetrically in the sense that the CB can prevent defaulters from borrowing but it cannot prevent them from saving. Azariadis shows that this LLR policy can eliminate the bad equilibrium. Moreover, there is no need to actually implement this policy as its mere announcement suffices to implement the efficient allocation.

## 2 Evaluation

The paper deals with an important topic in a rigorous, elegant and clear way. I also applaud its treatment of the government as a less capable financial intermediary than the private ones. Much of the policy discussion and proposals in the literature assume the opposite, which gives rise to justified skepticism regarding the empirical relevance of the policy prescriptions.

My main comment concerns the connection of the model to the empirical facts and the mainstream views of the financial crisis as well as to the nature of appropriate policy responses. The present paper relies on the Kehoe and Levine complete asset markets model. This model has the feature –which is also shared by the standard sovereign debt model– that the incentive to default is higher when income levels are high. But it seems that the data rather favor the opposite correlation: Typically, default incentives seem to



be higher in bad times. Moreover, in the model, default tendencies (financial crises) can be mitigated by having countercyclical requirements. That is, the reserve requirement (tax) is lower when the intermediaries lend a lot. Note that these two properties (higher incentive to default in good times, countercyclical reserve requirements) are related.

The conventional view (and policies currently contemplated) involve procyclical capital (or reserve) requirements as a means of curtailing credit expansion (building capital buffers) in good times and encouraging expansion during bad times. This view has a lot to do with the assumption of systemic risk and negative externalities associated with lending by individual banks. The model in this paper has no aggregate risk and no credit externalities so it is not totally surprising that it does not support procyclical requirements. It remains to be seen which view of financial crises has better empirical content.

Another point of departure from the mainstream view concerns the source of fragility: According to the mainstream view, fragility is the result (or is associated with) excessive credit creation (rational exuberance,..) that is followed by a large reversal. The model in this paper does not have the property that the probability of credit market collapse depends *positively* on the quantity of credit. It is an open issue whether such a positive correlation is a critical feature of financial crises.

Finally, an issue that is not addressed in the paper but is always present in dynamic models with public policy concerns the government's ability to commit. One wonders whether it is reasonable to assume that policymakers can commit to implement the prescribed policies. Are announced policies incentive compatible (and under what specification of the government's objective function)? Do they suffer from time inconsistency and under what conditions?

## Conclusions

I found the paper to represent a nice, thought provoking piece of research. It offers an interesting alternative to mainstream views regarding the prevention of financial crises. It would be interesting to explore the policies proposed in this paper in a model in which the incentive to default is countercyclical.

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