BANCA D'ITALIA
EUROSISTEMA

# Temi di Discussione

(Working Papers)

## Central bank and government in a speculative attack model

by Giuseppe Cappelletti and Lucia Esposito

September 2013

Number 934

BANCA D'ITALIA
EUROSISTEMA

# Temi di discussione

(Working papers)

## Central bank and government in a speculative attack model

by Giuseppe Cappelletti and Lucia Esposito

Number 934 - September 2013

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

*Printed by the Printing and Publishing Division of the Bank of Italy*

# CENTRAL BANK AND GOVERNMENT IN A SPECULATIVE ATTACK MODEL

by Giuseppe Cappelletti* and Lucia Esposito*

**Abstract**

This paper studies the interaction between monetary and fiscal authorities while investors are coordinating on a speculative attack. The authorities want to achieve specific targets for output and inflation but also to avoid a regime change (i.e. sovereign default). They use the traditional policy instruments. The model examines the informational role of simultaneous implementation of monetary and fiscal policies in coordination environments. While endogenous information generated by the intervention of one policy maker has been shown to lead to multiple equilibria, we show that if the actions chosen by the central bank and the government not only deliver information to the markets but also influence the fundamentals of the economy, when the authorities have a strong incentive to preserve the status quo over other objectives, then there is no equilibrium in which investors' strategies depend monotonically on their private information on fundamentals.

**JEL Classification**: C7, D8, E5, E6, F3.
**Keywords**: global games, complementarities, signaling, self-fulfilling expectations, multiple equilibria, crises, regime change, policy interactions.

**Contents**



* Bank of Italy, Economic Research and International Relations.

# 1 Introduction[1]

The sovereign debt crisis has highlighted the great extent to which monetary and fiscal policy are influenced by financial instability. The financial strains that had emerged in the summer and worsened in the autumn of 2011 eased temporarily in the first few months of 2012 as the European Central Bank injected massive liquidity in two 3-year refinancing operations with full allotment in December 2011 and February 2012. At the same time, the governments of euro-area member countries reached agreement on strengthening fiscal policy cooperation while the countries under stress adopted fiscal adjustment measures. These actions helped to defuse the financial market strains and bring down the government securities yields.

The abrupt changes in market prices and financial flows would appear to suggest that there is a strong incentive for investors to coordinate their choices. As a matter of fact, coordination plays a prominent role not only in debt crises but also in bank runs, currency attacks and events characterized by sudden halts to current trends. In all these contexts investors may fail to take an action that would be in their collective interest for fear that others will not do the same, causing a coordination failure.

Our paper studies monetary and fiscal policy interaction when financial instability is triggered by a speculative attack, as in the recent sovereign debt crisis. In our model central bank and government have the objective of maintaining financial stability; they choose their policies simultaneously based on their knowledge of macroeconomic fundamentals. Hence monetary and fiscal policies signal the authorities' private information on fundamentals to

[1]We are grateful to P. Battigalli, C. Chamley, F. Giavazzi, G. Gobbi and S. Neri for encouragement and many helpful suggestions. We also thank seminar participants at GAMES12, ESEM13, Barcellona GSE Summer Forum 2013, Economics Department Boston University and at the Bank of Italy.

the markets and the actions chosen have a direct impact on the state of the economy.

**The literature.** A vast literature uses regime change games[2] to model a variety of crisis phenomena: an attack against the status quo may consist in an investment that weakens the sustainability of the sovereign debt, a currency peg or the liquidity of a bank.[3] Some of these models are characterized by multiple equilibria (Diamond and Dybvig 1983, Obstfeld 1996), which makes them not useful for policy analysis, in that the impact of exogenous policies on equilibrium outcomes is indeterminate. Carlsson and van Damme (1993) and Morris and Shin (1998, 2001, 2003) show that in these games a unique equilibrium can be obtained by assuming that agents have heterogeneous information about the fundamentals.[4] However, Angeletos et al. (2006) note that this argument fails to consider that policy decisions often convey information that is relevant for the coordination game.[5] To understand this point, let us examine their example on currency crises. A central bank can defend the peg against a speculative attack by borrowing reserves from abroad, raising interest rates, taxing capital outflows, and taking other measures to make it more costly for speculators attack. But these costly policy interventions may betray the central bank's anxiety to end an attack that could trigger a devaluation. Thus the intervention could backfire by reducing the speculators' uncertainty about the success of a coordinated attack.

Departing from Angeletos et al. (2006), who proposed a regime change game in which agents decide whether to attack the status quo after the central bank has set its policy, we study a game where agents decide once both central bank and government have set

[2] Regime change games are coordination games in which the status quo is abandoned, causing a discrete change in payoffs, when a sufficiently large number of agents take the action against it.

[3] See, for example, Obstfeld (1986), Chamley (1999), Shin and Thomas (1999), Corsetti et al. (2004), Morris and Shin (2004a, 2004b), Hellwig at al. (2005).

[4] See also Heinemann and Illing (2002), Heinemann et al. (2004), Hellwig (2002).

[5] On endogenous information structures, see also Tarashev (2003), Morris and Shin (2006), Angeletos and Werning (2006) and Angeletos et al. (2007).

their policies. That is, we explicitly consider the strategic interaction between monetary and fiscal authorities, which must consider the possibility of mis-coordination under the threat of speculative attack. Also unlike previous contributions (e.g. Morris and Shin, 1998; Angeletos et al., 2006) we allow the policymakers' actions to *influence* the state of the economy, not only to be *influenced.* We begin by analyzing setting where only the first feature is included, i.e. the interaction between the two authorities.

**The Model.** The government sets the budget deficit and at the same time the central bank sets the interest rate. These policies are chosen conditional on the authorities' knowledge of the initial state of the economy and aim at specific output and inflation objectives while also seeking to preserve the status quo, i.e. avoid sovereign debt default. Both the authorities maximize a utility function represented by the sum of a quadratic loss function (which counts both positive and negative deviations from the output and inflation targets as losses) and a state-contingent payoff that quantifies the benefit of avoiding sovereign default. The academic and policy debate has produced a broad consensus that systemic risk should be minimized by monetary, macroprudential and microprudential policies. For example, Angelini et al. 2012, examining the evolution of the sovereign debt crisis in the euro area, argue that there are both complementarities and trade-offs between these policies. Our paper contributes to the debate by bringing out the implications of an institutional framework in which both monetary and fiscal authorities are concerned about a speculative attack on the public debt and they have only the traditional policy instruments (of interest rate and budget) to blunt the attack and avoid default.

We assume that the policy-makers know the economic fundamentals, which can be thought of as the level of debt that would satisfy the government intertemporal budget constraint. Their decisions are publicly observable and affect the state of the economy. A rise in the interest rate worsens the budget deficit, increases the debt and weakens the economy. Similarly a larger deficit increases the debt. This awareness can lead to a stronger aggregate attack and a greater probability of its success.

Investors do not know the fundamentals and observe only noisy private signals about them, so the policies chosen by the authorities convey information about the state of the economy to the markets. Our model is a game of incomplete information characterized by three key features: the coordination incentive among a continuum of agents (the investors), the signalling role of the two policy-makers that know the fundamentals and the impact of the signalers' choices on the state of the economy. Since these features have been shown to play an important role in many episodes of financial distress, in particular debt crises, bank runs, currency attacks and sudden stops, our model is quite widely applicable.

Although the analysis is stylized, the model offers insight into important mechanisms that may have characterized the sovereign debt tensions in some euro-area countries starting in 2010.

**Main Results.** There are three main results.

**(i)** When policy interventions do not convey information (*exogenous policies*) the model admits a unique equilibrium in which the authorities can make the probability of a successful attack arbitrarily low. This would be the case, for instance, when the two authorities credibly commit to a specific profile of policy interventions.

**(ii)** When the policies chosen do convey information on fundamentals (*endogenous policies*) but do not affect the state of the economy, there are multiple equilibria that resemble those found in Angeletos et al. (2006). In these equilibria, it is never optimal for an authority to implement a costly policy[6] when the fundamentals are either very weak or very strong. For sufficiently weak fundamentals, the value of contrasting the speculative attack is too low to justify the cost of policy intervention, while for sufficiently strong ones the probability of attack so low, that there is no need to intervene. Hence for the authorities costly policies are optimal only when the fundamentals are intermediate. In this case the central bank and the government have to coordinate on the implementation of costly actions in order to reduce the equilibrium probability of a successful attack.

**(iii)** When the policies not only convey information on fundamentals (*endogenous policies*) but also affect the state of the economy, we have two possible cases. If the cost of policies that would improve the state of the economy is greater than the benefit, the equilibria again resemble those found in Angeletos et al. (2006); but if the cost is smaller than the benefit, there is no equilibrium in which investors's strategies monotonically depend on their private information on fundamentals.

While these results refer to a setting in which both monetary and fiscal authorities play a role, we will clarify which of them depend critically on having two policy-makers and which would hold even in a setting with a single authority (as in Angelotos et al. 2006). The rest of the paper is organized as follows: section 2 describes the model and defines the equilibrium of the game, section 3 presents the results and section 4 concludes.

[6] We assume that each policy-maker has a preferred policy that is compatible with its long run output and inflation objective. Any deviation from the preferred policy implies a loss.

## 2 The Model

Formally, the game consists of a first stage in which the two policy-makers, conditional on knowing the initial state of the economy, simultaneously choose their instruments, which affect both the agents' payoff from a speculative attack and the state of the economy; a second stage, when investors - conditional on a private signal correlated with the state of the economy and on the observed actions of the central bank and the government - decide whether to undertake an action that undermines the status quo; and a final stage in which, depending on the state of the economy and the strength of the speculative attack, the status quo is either maintained or abandoned.

The investors can be thought as speculators who bet on the reduction of government bond prices in a country with weak fundamentals, selling in hopes of buying them back when the price is lower. When this is done by a large enough number of investors, the aggregate action destabilizes the country's sovereign bond market, puts powerful pressures on bond prices and delivers a profits to the speculators that correctly anticipated the actions of the others. Investors' expectations about price developments, in fact, consist in expectations of what the other investors will do, hence in presumptions concerning the information that they have. A crucial additional bit of information for the markets is the policies that the monetary and fiscal authorities adopt, these are publicly observable and represent a coordination device for speculators from two points of view. First, they suggest what the authorities know about the initial value of the fundamentals; and since policies have an impact on the fundamentals, they also convey information on the future state of the economy.

We consider a continuum of agents of measure one, indexed by $i$ and uniformly distributed over $[0, 1]$, who decide whether to attack or not; $A \in [0, 1]$ measures the mass of agents who decide to attack. Before deciding, the agents observe the actions of two policymakers, the central bank ($CB$) and the government ($G$). The central bank sets the interest rate $r$ and the government sets the the primary deficit $d$ (as a percentage of GDP). The sets of feasible actions for the two policymakers are assumed to be subsets of the unit interval. Formally, $r$ and $d$ are in the interval $[0, 1]$ and the interest rate represents the speculator's opportunity cost of attacking. The initial state of the economy is represented by a random variable $\theta$. We depart from Angeletos et al. (2006) in assuming that the final state of the economy depends on the actions of the policymakers and on the initial state of the economy, i.e. fundamentals:

$$\theta_S = \theta - f\left(r, d\right)$$

where $f_r\left(r, d\right) \geq 0$, $f_{rr}\left(r, d\right) \geq 0$; $f_d\left(r, d\right) \geq 0$, $f_{dd}\left(r, d\right) \geq 0$ and $f_{rd}\left(r, d\right) = 0$, $f_{dr}\left(r, d\right) = 0$ and $\theta \in \Theta \subseteq \mathbb{R}$. The random variable $\theta$ can be interpreted as the inverse of the initial value of the sustainable debt and the function $f\left(r, d\right)$ as the effect on it of interest rate and the deficit level, determining the final amount of debt. Both a higher interest rate and a higher deficit will increase the final level of debt, since both imply greater public expenditure. This equation can be thought as a reduced form of a fully fledged model of the economy, which could explicitly set the relation among state variables ($\theta$) and policy variables ($r$, $d$). This assumption allows us to see how policy intervention can impinge on a potential speculative attack, not only by increasing its opportunity cost of attacking but also by affecting the state of the economy, i.e. the final level of debt. In the current debt crisis, in fact, this assumption constitutes the principal motivation for the policy decisions of the European Central Bank and the national governments.

Based on the final state of the economy ($\theta_S$) and the aggregate attack ($A$), the two policymakers jointly decide the regime outcome, which is denoted as $D$. Let $D$ be equal to 1 when the status quo is abandoned and 0 otherwise.

As in Angeletos et al. (2006), the policymakers' payoff is trade-off between two components: the cost of policy intervention and the net benefit of maintaining the status quo. The cost of policy intervention is given by a quadratic loss function, while the benefit of maintaining the status quo is given by $V(\theta_S, A, D)$ for both policymakers where $V$ is a continuous function, decreasing in $A$ and $D$ and increasing in $\theta_S$. Therefore, the utility functions of the central bank and of the government are:

$$\begin{aligned} U_{CB}(\theta, r, d, A) &= -\left[\upsilon(d - d_{CB}^*)^2 + \rho(r - r_{CB}^*)^2\right] + V(\theta_S, A, D) \\ U_G(\theta, r, d, A) &= -\left[\alpha(d - d_G^*)^2 + \lambda(r - r_G^*)^2\right] + V(\theta_S, A, D). \end{aligned}$$

In order to simplify the exposition, let the state-contingent part of the payoff function be equal to:

$$V(\theta_S, A, D) = (1 - D)(\theta_S - A).$$

Note that the two policymakers agree on whether or not a regime change is advisable, given that the state-contingent part of their utility functions is the same. Observing the aggregate attack ($A$) and knowing the final state of the economy ($\theta_S$), the policymakers decide whether to maintain the status quo. It is sequentially optimal to abandon the status quo whenever $A \geq \theta_S$ $(D = 1)$ and maintain it when $A < \theta_S$ $(D = 0)$:

$$D(\theta, A) = \begin{cases} 1 \text{ if } A > \theta_S \\ 0 \text{ if } A \leq \theta_S \end{cases}$$

Therefore the state-contingent part of the utility function becomes:

$$V(\theta_S, A, D) = \max\{0, \theta_S - A\}$$

and the payoff functions reduce to:

$$\begin{aligned} U_{CB}(\theta, r, d) &= -[\upsilon(d - d^*_{CB})^2 + \rho(r - r^*_{CB})^2] + \max\{0, \theta_S - A\} \\ U_G(\theta, r, d) &= -[\alpha(d - d^*_G)^2 + \lambda(r - r^*_G)^2] + \max\{0, \theta_S - A\} \end{aligned}$$

The game is strategically equivalent to a two-stage game. In stage 1, the policymakers learn the fundamentals of the economy, $\theta$, and set $r$ and $d$ (simultaneously). In stage 2, agents decide simultaneously whether to attack after observing $r$ and $d$ and receiving a private signal about $\theta$.

The payoff for an agent who does not attack is normalized to zero; that for attacking is $1 - r$ if the status quo is abandoned $(D = 1)$ and $-r$ otherwise $(D = 0)$.

Each policymaker maximizes its own expected payoff function. As regards the quadratic part of the payoff function, each policymaker has its own preferred policy profile (indicated by the starred variables, $(r^*_i, d^*_i)$ for $i \in \{G, CB\}$) and suffers a loss that depends on the distance of the actually chosen policy profile from the most preferred. We assume that

$r^*_{CB} > r^*_G$ and $d^*_G > d^*_{CB}$. The former assumption can be justified by the hypothesis that the government prefers a lower interest rate and a larger deficit because this may favor a higher level of output. Similarly, the central bank prefers a higher interest rate and a smaller deficit for price stability. This quadratic loss function is equivalent to an objective function that depends on output and inflation. Note that the state-contingent payoff function is asymmetric: when the status quo is preserved, the higher $\theta_S$ (the final state of the economy), the greater is the utility of both policymakers; but if the status quo is abandoned the utility of the two policymakers does not depend on $\theta_S$. In the absence of concern over the possibility of a regime change, each policymaker has its preferred policies profile $(r^*_i, d^*_i)$, which can vary if the authorities' intent to defend the status quo is factored in.

Following Morris and Shin (2003), we assume that investors have incomplete information about $\theta$ (and therefore about $\theta_S$). The initial common prior is assumed to be an improper uniform distribution over $\mathbb{R}$. The signal of agent $i$ is denoted as $x_i = \theta + \sigma\xi_i$, where $\sigma > 0$ indicates the quality of private information and $\{\xi_i\}_{i\in[0,1]}$ are idiosyncratic noises i.i.d. and independent from $\theta$, with c.d.f. $\Psi$ and density $\psi$ with support equal to the real line $\mathbb{R}$. The set of possible states of nature conditional on signal $x$ is denoted $\Theta(x) = \left\{\theta : \psi\left(\frac{x-\theta}{\sigma}\right) > 0\right\}$. We consider symmetric perfect Bayesian equilibria. Let $r(\theta)$ and $d(\theta)$ denote the policy chosen by central bank and government when the state of nature is $\theta$. Let $a(x, r, d)$ be the action of agent $i$ given $x$, $r$, $d$ and $A(\theta, r, d)$ be the aggregate attack size given the fundamentals, $\theta$, the actual interest rate, $r$, and the actual primary deficit, $d$, that is $A(\theta, r, d) = \int_{-\infty}^{+\infty} a(x, r, d)\,\psi\left(\frac{x-\theta}{\sigma}\right) dx$. Let $\mu(\theta \in S \mid x, r, d)$ denote the posterior probability measure over $\Theta(x)$ that $\theta$ belongs to $S$ (for some $S \subseteq \Theta(x)$) conditional on the private signal and policy choices. For brevity, we write the c.d.f. as $\mu\left(\overline{\theta} \mid x, r, d\right) := \mu\left(\theta \leq \overline{\theta} \mid x, r, d\right)$.

**Definition 1** *An equilibrium consists of two policy functions $r(\cdot)$ and $d(\cdot)$, a strategy $a(\cdot)$ for each investor and a posterior beliefs $\mu(\cdot)$ such that:*

$$r(\theta, d) \in \arg\max_{r \in [\underline{r}, \overline{r}]} U_{CB}(\theta, r, d, A(\theta, r, d)) \tag{1}$$

$$d(\theta, r) \in \arg\max_{d \in [\underline{d}, \overline{d}]} U_{G}(\theta, r, d, A(\theta, r, d)) \tag{2}$$

$$a(x, r, d) = \arg\max_{a \in \{0,1\}} \; a\left[\int_{\Theta(x)} D(\theta, A)\, d\mu(\theta \mid x, r, d) - r\right] \tag{3}$$

$$\mu(\theta \mid x, r, d) \;\; \textit{is obtained from Bayes' rule using } r(\cdot) \;\; \textit{and } d(\cdot) \tag{4}$$

$$\textit{for any } r \in r(\Theta(x)) \;\; \textit{and } d \in d(\Theta(x))$$

*where*

$$\begin{aligned} A(\theta, r, d) &= \int_{-\infty}^{+\infty} a(x, r, d)\, \psi\left(\frac{x-\theta}{\sigma}\right) dx \\ D(\theta, A) &= \begin{cases} 1 \;\; \textit{if } A > \theta_S \\ 0 \;\; \textit{if } A \leq \theta_S \end{cases} \\ r(\Theta(x)) &\equiv \{r : r = r(\theta) \;\; \textit{for some } \theta \in \Theta(x)\} \\ d(\Theta(x)) &\equiv \{d : d = d(\theta) \;\; \textit{for some } \theta \in \Theta(x)\} \end{aligned}$$

Conditions 1-3 require that the policy choices in stage 1 and the agents' strategies in stage 2 be sequentially rational, condition 4 requires that beliefs be pinned down by Bayes' rule along the equilibrium path.

# 3 The main results

## 3.1 Exogenous policies

Suppose for a moment that the policies have been exogenously fixed at some $r$ and $d$, as if policymakers could credibly commit to given policy choices without knowing the state of the economy. In this case, the game reduces to a standard global game with exogenous information structure, as in Morris and Shin (1998, 2003).

**Proposition 1** *Suppose that $r = \underline{r} = \overline{r}$ and $d = \underline{d} = \overline{d}$. The equilibrium is unique and is such that*

$$a(x, r, d) = \begin{cases} 1 \text{ if } x < \tilde{x} \\ 0 \text{ otherwise} \end{cases} \qquad D(\theta) = \begin{cases} 1 \text{ if } \theta < \tilde{\theta} \\ 0 \text{ otherwise} \end{cases}$$

*where $\tilde{\theta} = 1 - r + f(r, d)$ and $\tilde{x} = \tilde{\theta} + \sigma \Psi^{-1}(1 - r)$.*

This result resembles that of Morris and Shin (2003), although the thresholds differ from theirs and from those of Angeletos et al. (2006), in that we allow the policies chosen to affect the state of the economy. Let us sketch the proof. Suppose that an agent attacks if and only if the private signal is less than $\tilde{x}$. The aggregate attack is $A(\theta, r, d) = \Psi\left(\frac{\tilde{x}-\theta}{\sigma}\right)$. The status quo is abandoned if and only if $\theta < \tilde{\theta}$, where $\tilde{\theta}$ solves $\Psi\left(\frac{\tilde{x}-\tilde{\theta}}{\sigma}\right) = \theta_s$. That is, $\tilde{\theta}$ solves the following equation:

$$\Psi\left(\frac{\tilde{x} - \tilde{\theta}}{\sigma}\right) = \tilde{\theta} - f(r, d)$$

Since the two publicly observable variables are independent of the underlying state of the economy, the posterior probability of a regime change for an agent with signal $x$ is $\mu\left(\tilde{\theta}|x,r,d\right) = 1-\Psi\left(\frac{x-\tilde{\theta}}{\sigma}\right)$ and hence $\tilde{x}$ must solve the indifference condition for the investors:

$$r = 1-\Psi\left(\frac{\tilde{x}-\tilde{\theta}}{\sigma}\right)$$

Solving the previous equations, we obtain $\tilde{\theta}$ and $\tilde{x}$. Proposition 1 shows the range of $\theta$ for which the status quo in equilibrium is modified for given policies, $r$ and $d$. The wider this range implies an higher probability of regime change and hence a greater fragility of the regime. Comparing the threshold $\tilde{\theta}$ with Morris and Shin's equilibrium threshold $\theta^*_{MS}$ (which is also derived under the assumption of exogenous policy setting)

$$\tilde{\theta} = 1-r+f\left(r,d\right); \qquad \theta^*_{MS} = 1-r$$

we see that our threshold depends also on fiscal policy (measured by $d$), as we assume that both policies affect the state of the economy. As a consequence, the threshold $\tilde{\theta}$ in our model depends on $(r,d)$ as follows

$$\frac{\partial\tilde{\theta}}{\partial r} = -1+f_r\left(r,d\right); \quad \frac{\partial\tilde{\theta}}{\partial d} = f_d\left(r,d\right)$$

with $f_r\left(r,d\right)$ and $f_d\left(r,d\right)$ positive or zero. In Morris and Shin an increase in the interest rate always reduces the equilibrium probability of a regime change ($\frac{\partial\theta^*_{MS}}{\partial r} = -1$), through its effect on the expected payoff to speculators. In our model, however, it can increase the probability if $f_r\left(r,d\right) > 1$. A restrictive monetary policy (or a lax fiscal policy) worsens the state of the economy, so a higher interest rate impacts on the equilibrium threshold through its effect on the expected payoff to speculators and on the economy. The effectiveness of the central bank's policy depends on which of these two effects dominates. If for example $f(r,d) = ar^2 + bd^2$ where $a, b > 0$ then

$$\begin{aligned} \frac{\partial \tilde{\theta}}{\partial r} &\geq 0 \text{ if } -1 + 2ar > 0 \Longrightarrow r > \hat{r} = \frac{1}{2a} \\ \frac{\partial \tilde{\theta}}{\partial d} &\geq 0 \text{ if } d \geq 0. \end{aligned}$$

Thus when the central bank raises $r$ but to a level still below the threshold $\hat{r}$, the equilibrium probability of a regime change decreases; when instead the interest rate is above this threshold, the negative effect of $r$ on the economy more than offsets the effect on the expected payoff of the speculators so the equilibrium probability of regime change increases. This tradeoff arises because we allow the central bank's choice to affect the final state of the economy; and it holds even where there is only one policymaker. As for fiscal policy, an increase in the primary deficit always leads to a higher equilibrium threshold, hence a greater probability that the attack will cause regime change.

### 3.2 Endogenous policies

In the previous section we have ignored the fact that policy decisions convey information about $\theta$ and sought equilibria in which agents update their beliefs conditional on the policy choices. As noted in the introduction, we build on Angeletos et al. (2006) to get insights into the equilibria and the outcomes of a speculative attack in the presence of two additional factors: the signalling role of two policymakers and the impact of the signalers' choices on the economy. Note that if we assume $f_r(r,d) = f_d(r,d) = 0$ then the policies have no impact on the fundamentals, so only the signalling role matters. We first present our results under this assumption and then, imposing $f_r(r,d) > 0$ and/or $f_d(r,d) > 0$ we present our general result.

**Proposition 2** *Suppose that the policies do not have an impact on the fundamentals, i.e. $f_r(r,d) = f_d(r,d) = 0$. If $\underline{r} < \overline{r}$ and $\underline{d} < \overline{d}$ there exist multiple equilibria.*

1. *[Pooling or Inactive-policy Equilibrium] There exists an equilibrium in which $r(\theta) = r^*_{CB}$, $d(\theta) = d^*_G$ for all $\theta$ and*

$$a(x,r,d) = \begin{cases} 1 \text{ if } x < \widetilde{x} \\ 0 \text{ otherwise} \end{cases} \qquad D(\theta) = \begin{cases} 1 \text{ if } \theta < \widetilde{\theta} \\ 0 \text{ otherwise} \end{cases}$$

   *where $\widetilde{\theta} = 1 - r^*_{CB} + f(r^*_{CB}, d^*_G)$ and $\widetilde{x} = \widetilde{\theta} + \sigma\Psi^{-1}(1 - r^*_{CB})$.*

2. *[Separating or Active-policy Equilibrium] For any $r^* \in (r^*_{CB}, \overline{r}]$ and $d^* \in [\underline{d}, d^*_G)$ there exists an equilibrium in which:*

   *- the central bank sets $r(\theta) = r^*$ if $\theta \in [\underline{\theta}_{CB}, \overline{\theta}_{CB}]$ and $r(\theta) = r^*_{CB}$ otherwise;*

   *- the government sets $d(\theta) = d^*$ if $\theta \in [\underline{\theta}_G, \overline{\theta}_G]$ and $d(\theta) = d^*_G$ otherwise;*

   *- agents attack if and only if $x < \underline{x}$ or $(x,r) < (x^*, r^*)$ or $(x,-d) < (x^*, -d^*)$, and the status quo is abandoned if and only if $\theta < \underline{\theta}$ where*

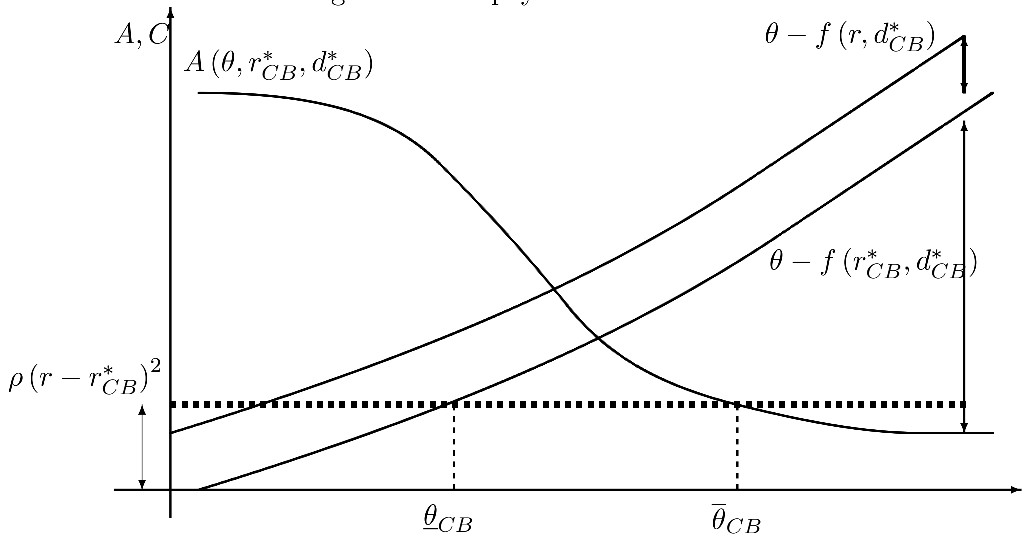
$$\underline{\theta} = \underline{\theta}_{CB} = \underline{\theta}_G = \max \left\{ \theta \in \Theta : \theta - f\left(r^*, d^*\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \rho \left(r^* - r^*_{CB}\right)^2 \text{ or } \right.$$
$$\left. \theta - f\left(r^*, d^*\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \alpha \left(d^* - d^*_{CB}\right)^2 \right\}$$
$$\overline{\theta} = \overline{\theta}_{CB} = \overline{\theta}_G = \min \left\{ \theta \in \Theta : \Psi\left(\frac{x^* - \theta}{\sigma}\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \rho \left(r^* - r^*_{CB}\right)^2 \text{ or } \right.$$
$$\left. \Psi\left(\frac{x^* - \theta}{\sigma}\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \alpha \left(d^* - d^*_{CB}\right)^2 \right\}$$
$$x^* \text{ such that } \frac{r^*}{1 - r^*} \Psi\left(\frac{x^* - \overline{\theta}}{\sigma}\right) = 1 - \Psi\left(\frac{x^* - \underline{\theta}}{\sigma}\right)$$

The equilibria of Proposition 2 resemble those set out in Angeletos et al. (2006). As in their paper when policy interventions convey information this leads to multiple equilibria. There exists an *inactive-policy equilibrium* in which intervention never occurs: agents expect no policy intervention and follow a strategy $a(x, r, d)$ that is insensitive to $(r, d)$. Hence the policymakers have no incentive to intervene. There are also *active-policy equilibria* in which intervention occurs only for intermediate $\theta$: agents expect policymakers to intervene for some $\theta$ and coordinate on a strategy $a(x, r, d)$ that is decreasing not only in $x$ but also in $r$ (and/or increasing in $d$). Therefore, policymakers can reduce the size of the attack by raising $r$ or decreasing $d$. However, for low $\theta$ the cost of intervention may exceed the value of maintaining the status quo; similarly, when $\theta$ is high the size of the potential attack may be too small to justify the cost of intervention. In particular, in the active-policy equilibria that we found the agents' strategy is sensitive to $(r, d)$ only if both policymakers intervene, which implies that the central bank and the government coordinate on costly policies (i.e. a relatively high interest rate and a relatively low deficit by the government) in correspondence with the same range of intermediate fundamentals. In fact, neither policymaker has an incentive to intervene unless the other policymaker coordinates on it. In equilibrium there is no state of the economy in which only one policymaker undertakes a costly action; instead they choose restrictive policies in coordinated fashion.

The preferences of the policymakers determine the intervals $\left[\underline{\theta}_{CB}, \overline{\theta}_{CB}\right]$ and $\left[\underline{\theta}_{G}, \overline{\theta}_{G}\right]$. The region of fundamentals within which the central bank and the government coordinate to take the costly action profile always consists of an intersection of these two intervals. For example, take the preferences of the central bank as fixed and assume that the government's utility function coincides. In this case, the active-policy equilibrium the interval of coordinated intervention would be $\left[\underline{\theta}_{CB}, \overline{\theta}_{CB}\right]$. Letting the preferences of the government vary the interval would be $\left[\underline{\theta}, \overline{\theta}\right]$, where $\underline{\theta} = \max\left\{\underline{\theta}_{CB}, \underline{\theta}_{G}\right\}$ and $\overline{\theta} = \min\left\{\overline{\theta}_{CB}, \overline{\theta}_{G}\right\}$, which is included in the initial interval of the central bank. Therefore, if the two policymakers' preferences are the same, the intervention region $\left[\underline{\theta}, \overline{\theta}\right]$ is larger. The presence of a second policymaker, the government, always reduces the intervention region and hence the measure of states in which speculators coordinate on a less aggressive strategy.

Now let us impose $f_r\left(r, d\right) > 0$ and/or $f_d\left(r, d\right) > 0$. When policies affect the fundamentals and these can be improved (choosing a lower deficit or a lower interest rate), but at a cost that exceeds the benefit, neither policymaker has the incentive for a costly policy measure when the attack that would ensue when $(r^*_{BC}, d^*_G)$ is set would be too small to justify the cost of intervention (i.e. when fundamentals are high). But if the fundamentals can be improved at a cost that is less than the benefit, the policymakers have an incentive to choose an expensive policy even when fundamentals are high, simply in order to improve the state of the economy and reduce the systemic risk (Figure 1). As Proposition 3 makes

Figure 1: The payoff of the Central Bank




clear, in the first case the equilibria of the model again resemble those of Angeletos et al. (2006). However, Proposition 4 and 5 show that in the second case there is no inactive-policy equilibrium and no active equilibria in which investors' strategies depend monotonically on their private information on the fundamentals. Furthermore, the results in Proposition 4 and 5 do not depend on strategic interaction between the two policymakers; instead they are driven by the assumption that the policy affects the fundamentals and would hold even if there were only one policymaker, the central bank.

**Proposition 3** *Suppose that the policies have an impact on the fundamentals, i.e.* $f_r(r,d) > 0$ *and* $f_d(r,d) > 0$ *but that for each policymaker the cost of deviating from* $(d_G^*, r_{BC}^*)$ *is greater than the benefit in terms of state of the economy for any* $d < d_G^*$ *and* $r < r_{BC}^*$*:*

$$\begin{aligned} \text{for} \quad r &< r_{CB}^{*} : \rho\left(r - r_{CB}^{*}\right)^{2} \geq f\left(r_{CB}^{*}, d_{G}^{*}\right) - f\left(r, d_{G}^{*}\right) \\ \text{for} \quad d &< d_{CB}^{*} : \alpha(d - d_{CB}^{*})^{2} \geq f\left(r_{CB}^{*}, d_{G}^{*}\right) - f\left(r_{CB}^{*}, d\right) \end{aligned}$$

*If $\underline{r} < \overline{r}$ and $\underline{d} < \overline{d}$ there exist multiple equilibria.*

1. *[Pooling or Inactive-policy Equilibrium] There exists an equilibrium in which $r(\theta) = r^*_{CB}$, $d(\theta) = d^*_G$ for all $\theta$ and*

$$a(x,r,d) = \begin{cases} 1 \text{ if } x < \widetilde{x} \\ 0 \text{ otherwise} \end{cases} \qquad D(\theta) = \begin{cases} 1 \text{ if } \theta < \widetilde{\theta} \\ 0 \text{ otherwise} \end{cases}$$

   *where $\widetilde{\theta} = 1 - r^*_{CB} + f(r^*_{CB}, d^*_G)$ and $\widetilde{x} = \widetilde{\theta} + \sigma\Psi^{-1}(1 - r^*_{CB})$.*

2. *[Separating or Active-policy Equilibrium] For any $r^* \in (r^*_{CB}, \overline{r}]$ and $d^* \in [\underline{d}, d^*_G)$ there exists an equilibrium in which:*

   *- the central bank sets $r(\theta) = r^*$ if $\theta \in [\underline{\theta}_{CB}, \overline{\theta}_{CB}]$ and $r(\theta) = r^*_{CB}$ otherwise;*

   *- the government sets $d(\theta) = d^*$ if $\theta \in [\underline{\theta}_G, \overline{\theta}_G]$ and $d(\theta) = d^*_G$ otherwise;*

   *- agents attack if and only if $x < \underline{x}$ or $(x,r) < (x^*, r^*)$ or $(x, -d) < (x^*, -d^*)$, and the status quo is abandoned if and only if $\theta < \underline{\theta}$ where*

$$\underline{\theta} = \underline{\theta}_{CB} = \underline{\theta}_G = \max\left\{\theta \in \Theta : \theta - f(r^*, d^*) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \rho(r^* - r^*_{CB})^2 \right.$$
$$\left. \text{or } \theta - f(r^*, d^*) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \alpha(d^* - d^*_{CB})^2\right\}$$
$$\overline{\theta} = \overline{\theta}_{CB} = \overline{\theta}_G = \min\left\{\theta \in \Theta : f(r^*_{CB}, d^*) - f(r^*, d^*) + \Psi\left(\frac{x^* - \theta}{\sigma}\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \rho(r^* - r^*_{CB})^2\right.$$
$$\left.\text{or } f(r^*, d^*) - f(r^*, d^*_G) + \Psi\left(\frac{x^* - \theta}{\sigma}\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) = \alpha(d^* - d^*_{CB})^2\right\}$$
$$x^* \text{ such that } \frac{r^*}{1 - r^*}\Psi\left(\frac{x^* - \overline{\theta}}{\sigma}\right) = 1 - \Psi\left(\frac{x^* - \underline{\theta}}{\sigma}\right)$$

**Proposition 4** *Suppose that the policies have an impact on the fundamentals, i.e.* $f_r(r,d) > 0$ *and* $f_d(r,d) > 0$ *and for each policymaker the benefit to the state of the economy of deviating from* $(d_G^*, r_{BC}^*)$ *is greater than the cost for any* $d < d_G^*$ *and* $r < r_{BC}^*$

$$\begin{aligned} \textit{for} \quad r &< r_{CB}^* : f(r_{CB}^*, d_G^*) - f(r, d_G^*) > \rho (r - r_{CB}^*)^2 \\ \textit{for} \quad d &< d_{CB}^* : f(r_{CB}^*, d_G^*) - f(r_{CB}^*, d) > \alpha (d - d_{CB}^*)^2 \end{aligned}$$

*Then there is no pooling or inactive-policy equilibrium.*

In an inactive-policy equilibrium agents expect no policy intervention and follow a strategy $a(x, r, d)$ that is insensitive to $(r, d)$. Hence, policymakers have no incentive to intervene. But when policies affect the fundamentals, agents know that, when the fundamentals are high the policymakers have the incentive to set their policies to $(r^{**}, d^{**}) \neq (r_{CB}^*, d_G^*)$ even if they know that the status quo will be maintained by setting $(r, d) = (r_{BC}^*, d_G^*)$.

$$\begin{aligned} r^{**}(\theta, d) &: = \arg\max_r - \upsilon (d - d_{CB}^*)^2 - \rho (r - r_{CB}^*)^2 + \max\{0, \theta_S - A\} \\ d^{**}(\theta, r) &: = \arg\max_d - \alpha (d - d_G^*)^2 - \lambda (r - r_G^*)^2 + \max\{0, \theta_S - A\} \end{aligned}$$

The ability of policymakers to influence the economy even when the attack would cause no concern - when cost-minimizing policies are pursued - implies that the inactive policy profile is not an equilibrium outcome. Moreover, the following proposition holds.

**Proposition 5** *Under the same assumptions as Proposition 4, there are no separating equilibria supported by the following monotone strategies.*

$$a(x, r, d) = \begin{cases} 1 \textit{ if } (x, r) < (x^*, r^*) \textit{ or } (x, -d) < (x^*, -d^*) \\ 0 \textit{ otherwise} \end{cases}$$

*or*

$$a(x, r, d) = \begin{cases} 1 \textit{ if } (x, -r) < (x^*, -r^*) \textit{ or } (x, -d) < (x^*, -d^*) \\ 0 \textit{ otherwise} \end{cases}$$

Since for each policymaker the preferred strategy varies with different ranges of the fundamentals, investors can infer from the policy decisions that $\theta$ is very low or very high and be certain whether a speculative attack will succed or not. Therefore having the power to affect the state of the economy can be distruptive for the actual possibility of intervention during a crisis.

Equilibria in which investors' decision varies monotonically with monetary and fiscal policies would appear to be more realistic and justifiable from a positive perspective. Propositions 4 and 5 prove that such equilibria do not exist when policies can affect the fundamentals and when these can be improved at a cost that is less than the benefit. Note that these propositions do not imply that the game does not admit an equilibrium but that in all possible equilibria the speculative attack could occur in an unpredictable manner given the state of the economy and the policies undertaken. This points to a possible drawback in pursuing financial stability with traditional policy instruments.

Significantly, monetary policy is set more frequently than fiscal policy, which is ordinarily decided only once every year. Accordingly we posit the case where the two policymakers take their decisions sequentially: specifically the government chooses first and then the central bank afterwards.[7] Introducing a sequential setting for decision making does not change previous results either assuming that the marginal benefit from improving the final state of the economy is always less than the marginal cost of departing from the preferred policy profile ( $r^*_{CB}, d^*_G$) or in the more general case.

## 4 Conclusions

We model a game of regime change, in which agents decide whether to attack the status quo after central bank and government have set their policies. Departing from Angeletos et al. (2006) we allow the policymakers' actions to influence the state of the economy, and we explicitly consider the strategic interaction between monetary and fiscal authorities, who must consider the possibility of miscoordination under the threat of a possible speculative attack. We obtain three main principal results.

First, if policy interventions are assumed to not convey information, the model admits a unique equilibrium in which the monetary and fiscal authorities can make the probability of a successful attack arbitrarily small. This would be the case if the two authorities credibly committed to a specific profile of policy interventions. This result depends on the assumption that policy actions affect the underlying state of the economy.

Second, when the policies chosen by the authorities do convey information on funda-

[7] The case in which the central bank chooses first can be treated in the same manner, the results are equivalent.

mentals but do not affect the state of the economy, there are multiple equilibria in which monetary and fiscal policymakers coordinate to minimize systemic risk. As in Angeletos et al. (2006), there exists an equilibrium in which the authorities believe that markets will not be influenced by their choices and accordingly choose policies that minimize their own loss function. In the other equilibria the central bank and the government coordinate on more restrictive policies (namely, a higher interest rate for the central bank and a smaller budget deficit for the government) in order to reduce the equilibrium probability of a successful attack.

Lastly, when the policies chosen by the authorities convey information on fundamentals and also affect the state of the economy, we have two cases. If the cost of policies that would improve the state of the economy is greater than the benefit, the equilibria of the model again resemble those of Angeletos et al. (2006). Instead if the cost is less than the benefit, there are no equilibria in which investors' strategies depend monotonically on their private information on fundamentals.

# Appendix

## Proof of Proposition 2

For this proof see that of Proposition 3, setting $f_r(r,d) = f_d(r,d) = 0$.

## Proof of Proposition 3

We first prove the existence of a pooling equilibrium in which $r(\theta,d) = r^*_{CB}$ and $d(\theta,r) = d^*_G$ for all $\theta$; we then construct a continuum of semi-separating equilibria in which $r(\theta,d) > r^*_{CB}$ and $d(\theta,r) < d^*_G$ for an intermediate interval of $\theta$.

**Part 1 - Pooling equilibrium.**

When the agents play the equilibrium strategy (attack if and only if the private signal is less than $\tilde{x}$) the aggregate size of the attack is $A(\theta,r,d) = \Psi\left(\frac{\tilde{x}-\theta}{\sigma}\right)$ and it does not depend on $(r,d)$ where $\tilde{x}$ is such that the expected payoff from attacking is equal to the certain payoff of not attacking given beliefs about the probability of regime change.

Given the strategy of the government $(d^*_G)$, $r^*_{CB}$ must be preferred by the central bank for every state of nature. Therefore the following inequality must hold for every $\theta$ and every $r \in [\underline{r}, \overline{r}]$:

$$
\begin{aligned}
U_{CB}\left(\theta, r^*_{CB}, d^*_G, A(\tilde{x})\right) &\geq U_{CB}\left(\theta, r, d^*_G, A(\tilde{x})\right) \\
\max\left\{0, \theta_S\left(r^*_{CB}, d^*_G\right) - A(\tilde{x})\right\} &\geq -\rho\left(r - r^*_{CB}\right)^2 + \max\left\{0, \theta_S\left(r, d^*_G\right) - A(\tilde{x})\right\}
\end{aligned}
$$

or

$$-\rho\left(r-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\right\}-\max\left\{0,\theta-f\left(r_{CB}^{*},d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\right\}\leq 0 \tag{5}$$

If $\theta>\widetilde{\theta}$, the previous inequality reduces to:

$$-\rho\left(r-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\right\}-\theta+f\left(r_{CB}^{*},d_{G}^{*}\right)+\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\leq 0.$$

For $r<r_{CB}^{*}$ it becomes

$$f\left(r_{CB}^{*},d_{G}^{*}\right)-f\left(r,d_{G}^{*}\right)\leq\rho\left(r-r_{CB}^{*}\right)^{2}\ \text{ for } r<r_{CB}^{*}. \tag{6}$$

Instead for $r>r_{CB}^{*}$ it is equivalent to

$$-\rho\left(r-r_{CB}^{*}\right)^{2}\leq\theta-f\left(r_{CB}^{*},d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)-\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\right\}$$

where the right hand side of the inequality is at least zero and the left hand side is always negative. This implies that the initial inequality always holds when $\theta>\widetilde{\theta}$ and $r>r_{CB}^{*}$.

If $\theta<\widetilde{\theta}$, condition (5) reduces to:

$$-\rho\left(r-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{\widetilde{x}-\theta}{\sigma}\right)\right\}\leq 0.$$

For $r < r^*_{CB}$, it becomes

$$\max\left\{0, \theta - f\left(r, d^*_G\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} \leq \rho\left(r - r^*_{CB}\right)^2.$$

Since the left hand side is increasing in $\theta$, the previous condition is implied by

$$\begin{aligned}
\max\left\{0, \widetilde{\theta} - f\left(r, d^*_G\right) - \Psi\left(\frac{\widetilde{x} - \widetilde{\theta}}{\sigma}\right)\right\} &\leq \rho\left(r - r^*_{CB}\right)^2 \\
\max\left\{0, \widetilde{\theta} - f\left(r, d^*_G\right) - \widetilde{\theta} + f\left(r^*_{CB}, d^*_G\right)\right\} &\leq \rho\left(r - r^*_{CB}\right)^2 \\
f\left(r^*_{CB}, d^*_G\right) - f\left(r, d^*_G\right) &\leq \rho\left(r - r^*_{CB}\right)^2
\end{aligned}$$

which is condition (6).

For $r > r^*_{CB}$, the previous condition reduces to

$$0 \leq \rho\left(r - r^*_{CB}\right)^2$$

which is always valid.

By the same reasoning, given the strategy of the central bank $\left(r^*_{CB}\right)$, $d^*_{CB}$ must be preferred by the government for every state of nature. Therefore the following inequality must hold for every $\theta$ and every $d \in \left[\underline{d}, \overline{d}\right]$:

$$\begin{aligned}
U_G\left(\theta, r^*_{CB}, d^*_G, A\left(\tilde{x}\right)\right) &\geq U_G\left(\theta, r^*_{CB}, d, A\left(\tilde{x}\right)\right) \\
+\max\left\{0, \theta_S\left(r^*_{CB}, d^*_G\right) - A\left(\tilde{x}\right)\right\} &\geq -\alpha\left(d - d^*_G\right)^2 + \max\left\{0, \theta_S\left(r^*_{CB}, d\right) - A\left(\tilde{x}\right)\right\}
\end{aligned}$$

or

$$-\alpha(d - d^*_{CB})^2 + \max\left\{0, \theta - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} - \max\left\{0, \theta - f\left(r^*_{CB}, d^*_G\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} \leq 0. \tag{7}$$

If $\theta > \widetilde{\theta}$, the previous inequality reduces to:

$$-\alpha(d - d^*_{CB})^2 + \max\left\{0, \theta - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} - \theta + f\left(r^*_{CB}, d^*_G\right) + \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right) \leq 0.$$

For $d < d^*_{CB}$ it becomes

$$f\left(r^*_{CB}, d^*_G\right) - f\left(r^*_{CB}, d\right) \leq \alpha(d - d^*_{CB})^2 \text{ for } d < d^*_{CB}. \tag{8}$$

Instead for $d > d^*_{CB}$ it is equivalent to

$$\max\left\{0, \theta - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} - \theta + f\left(r^*_{CB}, d^*_G\right) + \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right) \leq \alpha(d - d^*_{CB})^2$$

which always holds, because the left hand side is always less than or equal to zero and the right hand side is always strictly positive.

If $\theta < \widetilde{\theta}$, the previous inequality reduces to:

$$-\alpha(d - d^*_{CB})^2 + \max\left\{0, \theta - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} \leq 0.$$

For $d < d^*_{CB}$ it becomes

$$\max\left\{0, \theta - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\} \leq \alpha(d - d^*_{CB})^2.$$

The left hand side is increasing in $\theta$, hence it is implied by

$$\begin{aligned}
\max\left\{0, \widetilde{\theta} - f\left(r^*_{CB}, d\right) - \Psi\left(\frac{\widetilde{x} - \widetilde{\theta}}{\sigma}\right)\right\} &\leq \alpha(d - d^*_{CB})^2 \\
\max\left\{0, \widetilde{\theta} - f\left(r^*_{CB}, d\right) - \left(1 - r^*_{CB}\right)\right\} &\leq \alpha(d - d^*_{CB})^2 \\
\max\left\{0, \widetilde{\theta} - f\left(r^*_{CB}, d\right) - \left(\widetilde{\theta} - f\left(r^*_{CB}, d^*_G\right)\right)\right\} &\leq \alpha(d - d^*_{CB})^2 \\
f\left(r^*_{CB}, d^*_G\right) - f\left(r^*_{CB}, d\right) &\leq \alpha(d - d^*_{CB})^2
\end{aligned}$$

which is condition 8.

For $d > d^*_G$ the previous condition is equivalent to

$$0 \leq \alpha(d - d^*_{CB})^2 \tag{9}$$

which is always valid.

Therefore if for every $r$ and $d$ the following conditions hold, the candidate strategy and belief profiles constitute an equilibrium of the game:

$$\begin{aligned}
f\left(r^*_{CB}, d^*_G\right) - f\left(r, d^*_G\right) &\leq \rho\left(r - r^*_{CB}\right)^2 \text{ for } r < r^*_{CB} \\
f\left(r^*_{CB}, d^*_G\right) - f\left(r^*_{CB}, d\right) &\leq \alpha(d - d^*_{CB})^2 \text{ for } d < d^*_{CB}
\end{aligned}$$

We now turn to the agents' choice. An agent who is certain that all the other agents will follow the equilibrium strategy expects regime change if and only if $\theta < \widetilde{\theta}$ independent of $r$ and $d$. Then in order for its strategy to be optimal, it must be the case that:

$$\Pr\left(\theta < \widetilde{\theta}\middle| x, r, d\right) > r \text{ if and only if } x < \widetilde{x}, \text{ for all } r \text{ and } d$$

Since in equilibrium $r(\theta) = r^*_{CB}$ and $d(\theta) = d^*_G$ for all $\theta$, on the equilibrium path the observed policy choices are not informative and conditional beliefs are determined by Bayes' rule. Conditional on the private signal $x$, the probability of a regime change is given by:

$$\Pr\left(\theta < \widetilde{\theta}\middle| x, r^*_{CB}, d^*_G\right) = \Pr\left(\frac{x-\widetilde{\theta}}{\sigma} < \varepsilon\middle| x\right) = 1 - \Psi\left(\frac{x-\widetilde{\theta}}{\sigma}\right)$$

where $\widetilde{\theta} = 1 - r^*_{CB} - f\left(r^*_{CB}, d^*_G\right)$ and $\Psi\left(\frac{\widetilde{x}+\widetilde{\theta}}{\sigma}\right) = 1 - r^*_{CB}$. Hence, each agent will find it optimal to attack whenever $x < \widetilde{x}$.

**Part 2 - Separating equilibria.**

By inspection, we can show that $\underline{\theta}_{CB} = \underline{\theta}_G = \underline{\theta}$ and $\overline{\theta}_{CB} = \overline{\theta}_G = \overline{\theta}$. Suppose that $\underline{\theta}_{CB} < \underline{\theta}_G$ and $\overline{\theta}_{CB} < \overline{\theta}_G$. This implies that for $\theta \in \left[\overline{\theta}_{CB}, \overline{\theta}_G\right]$, the strategy profile $\left(r^*_{CB}, d^*\right)$ must be part of an equilibrium. Given the agents' strategy and the choice of the government $(d^*)$, $r^*_{CB}$ is preferred by the central bank if

$$\rho\left(r^* - r^*_{CB}\right)^2 > f\left(r^*, d^*\right) - f\left(r^*_{CB}, d^*\right)$$

If $\theta \in \left[\underline{\theta}_G, \overline{\theta}_{CB}\right]$, the strategy profile $\left(r^*, d^*\right)$ must be part of an equilibrium. Given the agents' strategy and the choice of the government $(d^*)$, $r^*$ is preferred by the central bank if and only if:

$$\rho\left(r-r_{CB}^{*}\right)^{2}<f\left(r^{*},d^{*}\right)-f\left(r_{CB}^{*},d^{*}\right)$$

The two conditions are independent of $\theta$ and cannot be simultaneously valid. Therefore, the bounds defining the two strategies must coincide. When agents coordinate on the equilibrium strategy, the aggregate size of the attack is $A\left(\theta,r,d\right)=A\left(\theta,r_{CB}^{*},d_{G}^{*}\right)=\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)$ for any $(r,d)$ such that either $r<r^{*}$ or $d>d^{*}$; and it is $A\left(\theta,r,d\right)=A\left(\theta,r^{*},d^{*}\right)=\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)$ for any $(r,d)$ such that $r\geq r^{*}$ and $d\leq d^{*}$. Starting from the central bank, take $r=r^{*}$ and $\theta\in\left[\underline{\theta},\overline{\theta}\right]$; for any $r<r^{*}$ the following inequality must hold:

$$\begin{aligned}-\rho\left(r-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r,d^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)\right\}\leq\\ -\rho\left(r^{*}-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r^{*},d^{*}\right)-\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)\right\}\end{aligned}\tag{10}$$

since $\theta\in\left[\underline{\theta},\overline{\theta}\right]$, this reduces to:

$$\rho\left(r^{*}-r_{CB}^{*}\right)^{2}-\rho\left(r-r_{CB}^{*}\right)^{2}+f\left(r^{*},d^{*}\right)-f\left(r,d^{*}\right)\leq\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)-\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)$$

whenever $\theta-f\left(r,d^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)$ is greater than 0[8]; that is when the improvement in the fundamentals due to lower interest rate outweight the worsening of the aggregate attack.

[8] If if $\theta-f\left(r,d^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)\leq 0$ the inequality becomes:

$$\rho\left(r^{*}-r_{BC}^{*}\right)^{2}-\rho\left(r-r_{BC}^{*}\right)^{2}\leq\theta-f\left(r^{*},d^{*}\right)-\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)$$

which is always valid.

But $\overline{\theta}$ is such that:

$$\rho\left(r^{*}-r_{CB}^{*}\right)^{2}+f\left(r^{*},d^{*}\right)-f\left(r_{CB}^{*},d^{*}\right)\leq\Psi\left(\frac{x^{*}-\overline{\theta}}{\sigma}\right)-\Psi\left(\frac{\underline{x}-\overline{\theta}}{\sigma}\right)$$

so the previous condition is always valid in the interval $\left[\underline{\theta},\overline{\theta}\right]$.

Increasing the interest rate $(r>r^{*})$ could not be a profitable deviation since it would require that:

$$\max\left\{0,\theta-f\left(r,d^{*}\right)-\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)\right\}-\theta+f\left(r^{*},d^{*}\right)+\Psi\left(\frac{\underline{x}-\theta}{\sigma}\right)\geq\rho\left(r-r_{CB}^{*}\right)^{2}-\rho\left(r^{*}-r_{CB}^{*}\right)^{2}$$

which is never satisfied.

Take $r=r_{CB}^{*}$ and $\theta<\underline{\theta}$ or $\theta>\overline{\theta}$; for any $r<r_{CB}^{*}$, the loss from departing from the preferred action must be greater than the potential improvement in the outcome of the speculative attack:

$$\max\left\{0,\theta-f\left(r_{CB}^{*},d_{G}^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)\right\}\geq-\rho\left(r-r_{CB}^{*}\right)^{2}+\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)\right\}$$

if $\theta<\underline{\theta}$ we obtain

$$\rho\left(r-r_{CB}^{*}\right)^{2}\geq\max\left\{0,\theta-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{x^{*}-\theta}{\sigma}\right)\right\}$$

which is implied by the following condition

$$\rho\left(r-r_{CB}^{*}\right)^{2}\geq\underline{\theta}-f\left(r,d_{G}^{*}\right)-\Psi\left(\frac{x^{*}-\underline{\theta}}{\sigma}\right)\text{ for any }r<r_{CB}^{*}.$$

Since $\Psi\left(\frac{x^*-\theta}{\sigma}\right) \geq \underline{\theta} - f\left(r_{CB}^*, d_G^*\right)$, we can rewrite this condition as:

$$\rho\left(r - r_{CB}^*\right)^2 \geq f\left(r_{CB}^*, d_G^*\right) - f\left(r, d_G^*\right) \text{ for any } r < r_{CB}^*$$

If $\theta > \overline{\theta}$, the previous condition becomes:

$$\rho\left(r - r_{CB}^*\right)^2 \geq f\left(r_{CB}^*, d_G^*\right) - f\left(r, d_G^*\right) \text{ for any } r < r_{CB}^* \tag{11}$$

These last two conditions are equivalent to condition (8). Increasing the interest rate to any $r > r_{CB}^*$ is not profitable, since it will only worsen $\theta_S$ without improving the resilience of the status quo.

When $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$ the government prefers $d^*$ to any $d < d^*$ if

$$\alpha\left(d - d_G^*\right)^2 - \alpha\left(d^* - d_G^*\right)^2 \geq f\left(r^*, d^*\right) - f\left(r^*, d\right) \text{ for every } d < d^*; \tag{12}$$

that is, when the cost of lowering the deficit is greater than the benefit from the improvement in the outcome of the speculative attack.

Also, $d^*$ should be preferred to any $d > d^*$ that requires:

$$-\alpha\left(d^* - d_G^*\right)^2 - f\left(r^*, d^*\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) \geq -\alpha\left(d - d_G^*\right)^2 - f\left(r^*, d\right) - \Psi\left(\frac{x^* - \theta}{\sigma}\right)$$

whenever $\theta - f\left(r^*, d\right) - \Psi\left(\frac{x^*-\theta}{\sigma}\right) > 0$, but we know that for every $\theta \in \left[\underline{\theta}, \overline{\theta}\right]$:

$$-\alpha\left(d^* - d_G^*\right)^2 - f\left(r^*, d^*\right) - \Psi\left(\frac{\underline{x} - \theta}{\sigma}\right) \geq -f\left(r^*, d_G^*\right) - \Psi\left(\frac{x^* - \theta}{\sigma}\right).$$

Hence, the previous inequality is implied by:

$$\alpha\left(d-d_G^*\right)^2 \geq f\left(r^*, d_G^*\right) - f\left(r^*, d\right) \text{ for every } d > d^*,$$

which is condition (8).

When $\theta < \underline{\theta}$ or $\theta > \overline{\theta}$, the government's preferred action is $d_G^*$ only if the following condition holds:

$$\max\left\{0, \theta - f\left(r_{CB}^*, d_G^*\right) - \Psi\left(\frac{x^*-\theta}{\sigma}\right)\right\} \geq$$
$$-\alpha\left(d-d_G^*\right)^2 + \max\left\{0, \theta - f\left(r_{CB}^*, d\right) - \Psi\left(\frac{x^*-\theta}{\sigma}\right)\right\}.$$

That is:

$$\begin{aligned}
\alpha\left(d-d_G^*\right)^2 &\geq \underline{\theta} - f\left(r_{CB}^*, d\right) - \Psi\left(\frac{x^*-\underline{\theta}}{\sigma}\right) \text{ if } \theta < \underline{\theta} \text{ and } d < d_G^* \\
\alpha\left(d-d_G^*\right)^2 &\geq 0 \text{ if } \theta < \underline{\theta} \text{ and } d > d_G^* \\
\alpha\left(d-d_G^*\right)^2 &\geq f\left(r_{CB}^*, d_G^*\right) - f\left(r_{CB}^*, d\right) \text{ if } \theta > \overline{\theta} \text{ and } d^* < d_G^* \\
\alpha\left(d-d_G^*\right)^2 &\geq
\end{aligned}$$

$$-\theta + f\left(r_{CB}^*, d_G^*\right) + \Psi\left(\frac{x^*-\theta}{\sigma}\right) + \max\left\{0, \theta - f\left(r_{CB}^*, d\right) - \Psi\left(\frac{x^*-\theta}{\sigma}\right)\right\}$$

if $\theta > \overline{\theta}$ and $d^* > d_G^*$; which are equivalent to:

$$\alpha\left(d - d_G^*\right)^2 \geq \underline{\theta} - f\left(r_{CB}^*, d\right) - \Psi\left(\frac{x^* - \theta}{\sigma}\right) \text{ if } \theta < \underline{\theta} \text{ and } d < d_G^* \tag{13}$$

$$\alpha\left(d - d_G^*\right)^2 \geq 0 \qquad \text{if } \theta < \underline{\theta} \text{ and } d > d_G^*$$

$$\alpha\left(d - d_G^*\right)^2 \geq f\left(r_{CB}^*, d_G^*\right) - f\left(r_{CB}^*, d\right) \text{ if } \theta > \overline{\theta} \text{ and } d < d_G^* \tag{14}$$

$$\alpha\left(d - d_G^*\right)^2 \geq 0 \qquad \text{if } \theta > \overline{\theta} \text{ and } d > d_G^*.$$

Since $\Psi\left(\frac{x^* - \theta}{\sigma}\right) \geq \underline{\theta} - f\left(r_{CB}^*, d_G^*\right)$, the previous conditions are implied by:

$$\alpha\left(d - d_G^*\right)^2 \geq f\left(r_{CB}^*, d_G^*\right) - f\left(r_{CB}^*, d\right) \text{ if } \theta < \underline{\theta} \text{ and } d < d_G^* \tag{15}$$

$$\alpha\left(d - d_G^*\right)^2 \geq 0 \qquad \text{if } \theta < \underline{\theta} \text{ and } d > d_G^*$$

$$\alpha\left(d - d_G^*\right)^2 \geq f\left(r_{CB}^*, d_G^*\right) - f\left(r_{CB}^*, d\right) \text{ if } \theta > \overline{\theta} \text{ and } d < d_G^* \tag{16}$$

$$\alpha\left(d - d_G^*\right)^2 \geq 0 \qquad \text{if } \theta > \overline{\theta} \text{ and } d > d_G^*.$$

That is they are implied by condition (8).

Now we turn to the agents' choice. An agent who is certain that all the other agents will follow the equilibrium strategy expects a regime change if and only if $\theta < \widetilde{\theta}$, independently of $r$ and $d$. Then in order for its strategy to be optimal it must be the case that:

$$\Pr\left(\theta < \underline{\theta} \middle| x, r, d\right) > r \text{ if and only if } x < x^* \text{ and either } r < r^* \text{ or } d > d^*$$

$$\Pr\left(\theta < 0 \middle| x, r, d\right) > r \text{ if and only if } x < \underline{x} \text{ and } r \geq r^* \text{ and } d \leq d^*$$

Beliefs are pinned down by Bayes' rule whenever $(r, d) = \left(r_{CB}^*, d_G^*\right)$ or $(r, d) = (r^*, d^*)$ and

$\Theta(x) \cap [\underline{\theta}, \overline{\theta}] \neq 0$.

When $(r,d) = (r^*_{CB}, d^*_G)$ it must be that the following condition holds:

$$\Pr\left(\theta < \underline{\theta} \middle| x^*, r^*_{CB}, d^*_G\right) = \frac{1 - \Psi\left(\frac{x^* - \underline{\theta}}{\sigma}\right)}{1 - \Psi\left(\frac{x^* - \underline{\theta}}{\sigma}\right) + \Psi\left(\frac{x^* - \overline{\theta}}{\sigma}\right)} = r^*_{CB}$$

and when $(r,d) = (r^*, d^*)$:

$$\Pr\left(\theta < 0 \middle| x, r^*, d^*\right) = 0$$

## Proof of Proposition 4

In a candidate pooling equilibrium, the investor's choice function should be independent of the action of policymakers:

$$a(x,r,d) = \begin{cases} 1 \text{ if } x < \widetilde{x} \\ 0 \text{ otherwise} \end{cases}$$

where $\widetilde{x}$ is some threshold. We consider the choice of the central bank conditional on the initial state of the economy $\theta$ and the choice of the government, $d$:

$$r(\theta, d) = \arg\max_r - \rho\left(r - r^*_{CB}\right)^2 + \max\left\{0, \theta - f(r,d) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)\right\}.$$

If condition (6) does not hold let us define $\bar{r}(\theta, d)$ such that $\theta - f(\bar{r}, d) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right) = 0$ and with $r^*_{CB+SPEC} := \arg\max -\rho\left(r - r^*_{CB}\right)^2 + \theta - f(r,d) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right)$.

If $\bar{r}(\theta) \leq r^*_{CB+SPEC}$ we have two candidate best responses for the central bank, $r^*_{CB}$ and $\bar{r}$ such that:

$$U\left(\theta, r^*_{CB}, d\right) = 0 > -\rho\left(\bar{r} - r^*_{CB}\right)^2 = U\left(\theta, \bar{r}, d\right)$$

Hence, the best choice for the central bank is to set the interest rate equal to $r^*_{CB}$, since the costly policy action will not prevent a successful speculative attack.

If $r^*_{CB+SPEC} < \bar{r}(\theta)$, we have two candidate best responses for the central bank, $r^*_{CB}$ and $r^*_{CB+SPEC}$ such that:

$$U\left(\theta, r^*_{CB}, d\right) = 0 < -\rho\left(r^*_{CB+SPEC} - r^*_{CB}\right)^2 + \theta - f\left(r^*_{CB+SPEC}, d\right) - \Psi\left(\frac{\widetilde{x} - \theta}{\sigma}\right) = U\left(\theta, r^*_{CB+SPEC}, d\right).$$

That is, the best choice is to set the interest rate equal to $r^*_{CB+SPEC}$ since the costly policy action will prevent a successful speculative attack, producing a net gain for the policymaker.

Since $\bar{r}(\theta, d)$ depends on $\theta$ and the corresponding preferred policy varies with $\theta$, there is no equilibrium in which the strategy of policymaker is independent of the initial state of the economy, because the policy action does influence the final state of the economy.

## Proof of Proposition 5

For any $r^* \geq r^*_{CB}$, take as a possible strategy for investors the following function:

$$a(x, r, d) = \begin{cases} 1 \text{ if } (x, r) < (x^*, r^*) \text{ or } (x, -d) < (x^*, -d^*) \\ 0 \text{ otherwise} \end{cases}.$$

Hence the aggregate attack is:

$$A(\theta, r, d) = \begin{cases} \Psi\left(\frac{x^* - \theta}{\sigma}\right) \text{ if } r < r^* \text{ or } -d < -d^* \\ 0 \text{ otherwise} \end{cases}.$$

For low level of the initial state of the economy the central bank prefers to set the interest rate at the non-contingent optimal level ($r^*_{CB}$), knowing that the status quo will be abandoned whenever the $\theta$ is less than $\underline{\theta}_{CB}$ defined as:

$$\underline{\theta}_{CB} = f\left(r^*, d^*\right) + \rho\left(r^* - r^*_{CB}\right)^2.$$

Moreover, if the initial state of the economy is greater than $\overline{\theta}_{CB}$, such that:[9]

$$\Psi\left(\frac{x - \overline{\theta}_{CB}}{\sigma}\right) = f\left(r^*, d^*\right) - f\left(r^*_{CB+SPEC}, d^*\right) + \rho\left(r^* - r^*_{CB}\right)^2 - \rho\left(r^*_{CB+SPEC} - r^*_{CB}\right)^2,$$

the central bank prefers to set the interest rate at the contingent optimal level ($r^*_{CB+SPEC}$).[10] Therefore the optimal strategy for the central bank is:

$$r\left(\theta\right) = \begin{cases} r^*_{CB} \text{ if } \theta < \underline{\theta}_{CB} \\ r^* \text{ if } \theta \in \left[\underline{\theta}_{CB}, \overline{\theta}_{CB}\right] \\ r^*_{CB+SPEC} \text{ if } \theta > \overline{\theta}_{CB} \end{cases}$$

The same reasoning applies for the government whose optimal strategy is:

$$d\left(\theta\right) = \begin{cases} d^*_{G} \text{ if } \theta < \underline{\theta}_{G} \\ d^* \text{ if } \theta \in \left[\underline{\theta}_{G}, \overline{\theta}_{G}\right] \\ d^*_{G+SPEC} \text{ if } \theta > \overline{\theta}_{G} \end{cases}$$

In order to have an equilibrium, the two policymakers should coordinate and undertake

[9] It must be the case that $\Psi\left(\frac{x^* - \theta'}{\sigma}\right) \geq f\left(r^*, d^*\right) - f\left(r^*_{CB+SPEC}, d^*\right)$ where $\theta'$ is such that $\theta' - \Psi\left(\frac{x^* - \theta'}{\sigma}\right) = f\left(r^*_{CB+SPEC}, d^*\right)$.

[10] Where $r^*_{CB+SPEC} := \arg\max_{r} - \rho\left(r - r^*_{CB}\right)^2 + \theta - f\left(r, d\right) - \Psi\left(\frac{x^* - \theta}{\sigma}\right)$.

a costly policy simultaneously, so the equilibrium strategies should be:

$$r(\theta) = \begin{cases} r^*_{CB} \text{ if } \theta < \underline{\theta} \\ r^* \text{ if } \theta \in \left[\underline{\theta}, \overline{\theta}\right] \\ r^*_{CB+SPEC} \text{ if } \theta > \overline{\theta} \end{cases}$$

$$d(\theta) = \begin{cases} d^*_{G} \text{ if } \theta < \underline{\theta} \\ d^* \text{ if } \theta \in \left[\underline{\theta}, \overline{\theta}\right] \\ d^*_{G+SPEC} \text{ if } \theta > \overline{\theta} \end{cases}$$

where

$$\begin{aligned} \underline{\theta} &= \max\left\{f(r^*, d^*) + \rho\left(r^* - r^*_{CB}\right)^2, f(r^*, d^*) + \alpha\left(d^* - d^*_{G}\right)^2\right\} \\ \overline{\theta} &= \min\left\{: \Psi\left(\frac{x-\theta}{\sigma}\right) = f(r^*, d^*) - f\left(r^*_{CB+SPEC}, d^*\right) + \rho\left(r^* - r^*_{CB}\right)^2 - \rho\left(r^*_{CB+SPEC} - r^*_{CB}\right)^2 \right. \\ &\quad \left. \text{or } \Psi\left(\frac{x-\theta}{\sigma}\right) = f(r^*, d^*) - f\left(r^*, d^*_{G++SPEC}\right) + \alpha\left(d^* - d^*_{CB}\right)^2 - \alpha\left(d^*_{G+SPEC} - d^*_{CB}\right)^2\right\}. \end{aligned}$$

The investors' beliefs are pinned down by Bayes' rule whenever the policies choosen are respectively $r^*_{CB}$, $r^*$ or $r^*_{CB+SPEC}$ and $d^*_{G}$, $d^*$ or $d^*_{G+SPEC}$. But conditional on observing $r^*_{CB}$ ($r^*_{CB+SPEC}$), they can infer whether the state of the economy is such that the status quo will be abandoned or preserved. This implies that the candidate initial beliefs are not equilibrium beliefs. Therefore there is no equilibrium supported by them.

## References

[1] Angeletos, G.M., C. Hellwig, and A. Pavan (2006): "Signalling in a Global Game: Coordination and Policy Traps", *Journal of Political Economy*

[2] Angeletos, G.M., C. Hellwig, and A. Pavan (2007): "Dynamic Global Games of Regime Change: Learning, Multiplicity, and Timing of Attacks", *Econometrica*

[3] Angeletos, G.M., and I. Werning (2006): "Crises and Prices: Information Aggregation, Multiplicity, and Volatility", *American Economic Review*

[4] Angelini, P., S. Nicoletti-Altimari and I. Visco (2012): "Macroprudential, microprudential and monetary policies: conflicts, complementarities and trade-offs", *Questioni di Economia e Finanza*, Bank of Italy publications

[5] Carlsson, H., and E. van Damme (1993): "Global Games and Equilibrium Selection", *Econometrica*

[6] Chamley, C. (1999): "Coordinating Regime Switches", *The Quarterly Journal of Economics*

[7] Corsetti, G., A. Dasgupta, S. Morris, and H.S Shin (2004): "Does one Soros Make a Difference: a Theory of Currency Crises with Large and Small Traders", *The Review of Economic Studies*

[8] Diamond, D.W., and P.H. Dybvig (1983): "Bank Runs, Deposit Insurance, and Liquidity" *Journal of Political Economy*

[9] Heinemann, F., and G. Illing (2002): "Speculative Attacks: Unique Equilibrium and Transparency", *Journal of International Economics*

[10] Heinemann, F., R. Nagel and P. Ockenfels (2004): "The Theory of Global Games on Test: Experimental Analysis of Coordination Games with Public and Private Information", *Econometrica*

[11] Hellwig, C. (2002): "Public Information, Private Information and the Multiplicity of Equilibria in Coordination Games", *Journal of Economic Theory*

[12] Hellwig, C., A. Mukherji, and A. Tsyvinski (2005): "Self-Fulfilling Currency Crises: the Role of Interest Rates", *American Economic Review*

[13] Morris, S., and H.S. Shin (1998): "Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks", *American Economic Review*

[14] Morris, S., and H.S Shin (2001): "Rethinking Multiple Equilibria in Macroeconomics", *NBER Macroeconomics Annual*

[15] Morris, S., and H.S. Shin (2003): "Global Games: Theory and Applications", *Advances in Economics and Econometrics*

[16] Morris, S., and H.S. Shin (2004a): "Liquidity Black Holes", *Review of Finance*

[17] Morris, S., and H.S. Shin (2006): "Endogenous Public Signals and Coordination", *Working Paper*

[18] Morris, S., and H.S. Shin (2004b): "Coordination Risk and the Price of Debt", *European Economic Review*

[19] Morris, S., H.S. Shin, and J.P. Thomas (1999): "A Theory of the Onset of Currency Attacks", *Asian Financial Crisis: Causes, Contagion and Consequences, Cambridge University Press*

[20] Obstfeld, M. (1986): "Rational and Self-Fulfilling Balance-of-Payments Crises", *American Economic Review*

[21] Obstfeld, M. (1996): "Models of Currency Crises with Self-Fulfilling Features", *European Economic Review*

[22] Tarashev, N. (2003): "Currency Crises and the Informational Role of Interest Rates", *Bank for International Settlements*

RECENTLY PUBLISHED "TEMI" (*)

N. 905 – *Family firms and the Great Recession: out of sight, out of mind?*, by Leandro D'Aurizio and Livio Romano (April 2013).

N. 906 – *Price discovery in the Italian sovereign bonds market: the role of order flow*, by Alessandro Girardi and Claudio Impenna (April 2013).

N. 907 – *Public-private wage differentials in euro area countries: evidence from quantile decomposition analysis*, by Domenico Depalo and Raffaela Giordano (April 2013).

N. 908 – *Asking income and consumption questions in the same survey: what are the risks?*, by Giulia Cifaldi and Andrea Neri (April 2013).

N. 909 – *Credit supply during a sovereign debt crisis*, by Marcello Bofondi, Luisa Carpinelli and Enrico Sette (April 2013).

N. 910 – *Geography, productivity and trade: does selection explain why some locations are more productive than others?*, by Antonio Accetturo, Valter Di Giacinto, Giacinto Micucci and Marcello Pagnini (April 2013).

N. 911 – *Trust and preferences: evidence from survey data*, by Giuseppe Albanese, Guido de Blasio and Paolo Sestito (April 2013).

N. 912 – *Tempered stable Ornstein-Uhlenbeck processes: a practical view*, by Michele Leonardo Bianchi, Svetlozar T. Rachev and Frank J. Fabozzi (June 2013).

N. 913 – *Forward-looking robust portfolio selection*, by Sara Cecchetti and Laura Sigalotti (June 2013).

N. 914 – *When the baby cries at night. Inelastic buyers in non-competitive markets*, by Giacomo Calzolari, Andrea Ichino, Francesco Manaresi and Viki Nellas (June 2013).

N. 915 – *Local development that money can't buy: Italy's Contratti di Programma*, by Monica Andini and Guido de Blasio (June 2013).

N. 916 – *The effect of organized crime on public funds*, by Guglielmo Barone and Gaia Narciso (June 2013).

N. 917 – *Relationship and transaction lending in a crisis*, by Patrick Bolton, Xavier Freixas, Leonardo Gambacorta and Paolo Emilio Mistrulli (July 2013).

N. 918 – *Macroeconomic effects of precautionary demand for oil*, by Alessio Anzuini, Patrizio Pagano and Massimiliano Pisani (July 2013).

N. 919 – *Skill upgrading and exports*, by Antonio Accetturo, Matteo Bugamelli and Andrea Lamorgese (July 2013).

N. 920 – *Tracking world trade and GDP in real time*, by Roberto Golinelli and Giuseppe Parigi (July 2013).

N. 921 – *Should monetary policy lean against the wind? An analysis based on a DSGE model with banking*, by Leonardo Gambacorta and Federico M. Signoretti (July 2013).

N. 922 – *Marshallian labor market pooling: evidence from Italy*, by Monica Andini, Guido de Blasio, Gilles Duranton and William C. Strange (July 2013).

N. 923 – *Do euro area countries respond asymmetrically to the common monetary policy?*, by Matteo Barigozzi, Antonio M. Conti and Matteo Luciani (July 2013).

N. 924 – *Trade elasticity and vertical specialisation*, by Ines Buono and Filippo Vergara Caffarelli (July 2013).

N. 925 – *Down and out in Italian towns: measuring the impact of economic downturns on crime*, by Guido de Blasio and Carlo Menon (July 2013).

N. 926 – *The procyclicality of foreign bank lending: evidence from the global financial crisis*, by Ugo Albertazzi and Margherita Bottero (July 2013).

(*) Requests for copies should be sent to:
Banca d'Italia – Servizio Studi di struttura economica e finanziaria – Divisione Biblioteca e Archivio storico – Via Nazionale, 91 – 00184 Rome – (fax 0039 06 47922059). They are available on the Internet www.bancaditalia.it.

"TEMI" LATER PUBLISHED ELSEWHERE

*2010*

A. PRATI and M. SBRACIA, *Uncertainty and currency crises: evidence from survey data*, Journal of Monetary Economics, v, 57, 6, pp. 668-681, **TD No. 446 (July 2002).**

L. MONTEFORTE and S. SIVIERO, *The Economic Consequences of Euro Area Modelling Shortcuts*, Applied Economics, v. 42, 19-21, pp. 2399-2415, **TD No. 458 (December 2002).**

S. MAGRI, *Debt maturity choice of nonpublic Italian firms* , Journal of Money, Credit, and Banking, v.42, 2-3, pp. 443-463, **TD No. 574 (January 2006).**

G. DE BLASIO and G. NUZZO, *Historical traditions of civicness and local economic development,* Journal of Regional Science, v. 50, 4, pp. 833-857, **TD No. 591 (May 2006).**

E. IOSSA and G. PALUMBO, *Over-optimism and lender liability in the consumer credit market,* Oxford Economic Papers, v. 62, 2, pp. 374-394, **TD No. 598 (September 2006).**

S. NERI and A. NOBILI, *The transmission of US monetary policy to the euro area,* International Finance, v. 13, 1, pp. 55-78, **TD No. 606 (December 2006).**

F. ALTISSIMO, R. CRISTADORO, M. FORNI, M. LIPPI and G. VERONESE, *New Eurocoin: Tracking Economic Growth in Real Time,* Review of Economics and Statistics, v. 92, 4, pp. 1024-1034, **TD No. 631 (June 2007).**

U. ALBERTAZZI and L. GAMBACORTA, *Bank profitability and taxation,* Journal of Banking and Finance, v. 34, 11, pp. 2801-2810, **TD No. 649 (November 2007).**

L. GAMBACORTA and C. ROSSI, *Modelling bank lending in the euro area: a nonlinear approach,* Applied Financial Economics, v. 20, 14, pp. 1099-1112 ,**TD No. 650 (November 2007).**

M. IACOVIELLO and S. NERI, *Housing market spillovers: evidence from an estimated DSGE model,* American Economic Journal: Macroeconomics, v. 2, 2, pp. 125-164, **TD No. 659 (January 2008).**

F. BALASSONE, F. MAURA and S. ZOTTERI, *Cyclical asymmetry in fiscal variables in the EU*, Empirica, **TD No. 671**, v. 37, 4, pp. 381-402 **(June 2008).**

F. D'AMURI, GIANMARCO I.P. OTTAVIANO and G. PERI, *The labor market impact of immigration on the western german labor market in the 1990s,* European Economic Review, v. 54, 4, pp. 550-570, **TD No. 687 (August 2008).**

A. ACCETTURO, *Agglomeration and growth: the effects of commuting costs,* Papers in Regional Science, v. 89, 1, pp. 173-190, **TD No. 688 (September 2008).**

S. NOBILI and G. PALAZZO, *Explaining and forecasting bond risk premiums,* Financial Analysts Journal, v. 66, 4, pp. 67-82, **TD No. 689 (September 2008).**

A. B. ATKINSON and A. BRANDOLINI, *On analysing the world distribution of income*, World Bank Economic Review , v. 24, 1 , pp. 1-37, **TD No. 701 (January 2009).**

R. CAPPARIELLO and R. ZIZZA, *Dropping the Books and Working Off the Books,* Labour, v. 24, 2, pp. 139-162 ,**TD No. 702 (January 2009).**

C. NICOLETTI and C. RONDINELLI, *The (mis)specification of discrete duration models with unobserved heterogeneity: a Monte Carlo study,* Journal of Econometrics, v. 159, 1, pp. 1-13, **TD No. 705 (March 2009).**

L. FORNI, A. GERALI and M. PISANI, *Macroeconomic effects of greater competition in the service sector: the case of Italy,* Macroeconomic Dynamics, v. 14, 5, pp. 677-708, **TD No. 706 (March 2009).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Dynamic macroeconomic effects of public capital: evidence from regional Italian data,* Giornale degli economisti e annali di economia, v. 69, 1, pp. 29-66, **TD No. 733 (November 2009).**

F. COLUMBA, L. GAMBACORTA and P. E. MISTRULLI, *Mutual Guarantee institutions and small business finance,* Journal of Financial Stability, v. 6, 1, pp. 45-54, **TD No. 735 (November 2009).**

A. GERALI, S. NERI, L. SESSA and F. M. SIGNORETTI, *Credit and banking in a DSGE model of the Euro Area*, Journal of Money, Credit and Banking, v. 42, 6, pp. 107-141, **TD No. 740 (January 2010).**

M. AFFINITO and E. TAGLIAFERRI, *Why do (or did?) banks securitize their loans? Evidence from Italy*, Journal of Financial Stability, v. 6, 4, pp. 189-202, **TD No. 741 (January 2010).**

S. FEDERICO, *Outsourcing versus integration at home or abroad and firm heterogeneity*, Empirica, v. 37, 1, pp. 47-63, **TD No. 742 (February 2010).**

V. DI GIACINTO, *On vector autoregressive modeling in space and time,* Journal of Geographical Systems, v. 12, 2, pp. 125-154, **TD No. 746 (February 2010).**

L. FORNI, A. GERALI and M. PISANI, *The macroeconomics of fiscal consolidations in euro area countries,* Journal of Economic Dynamics and Control, v. 34, 9, pp. 1791-1812, **TD No. 747 (March 2010).**

S. MOCETTI and C. PORELLO, *How does immigration affect native internal mobility? new evidence from Italy,* Regional Science and Urban Economics, v. 40, 6, pp. 427-439, **TD No. 748 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap spread changes before and during the subprime financial turmoil,* Journal of Current Issues in Finance, Business and Economics, v. 3, 4, pp., **TD No. 749 (March 2010).**

P. CIPOLLONE, P. MONTANARO and P. SESTITO, *Value-added measures in Italian high schools: problems and findings*, Giornale degli economisti e annali di economia, v. 69, 2, pp. 81-114, **TD No. 754 (March 2010).**

A. BRANDOLINI, S. MAGRI and T. M SMEEDING, *Asset-based measurement of poverty,* Journal of Policy Analysis and Management, v. 29, 2 , pp. 267-284, **TD No. 755 (March 2010).**

G. CAPPELLETTI, *A Note on rationalizability and restrictions on beliefs,* The B.E. Journal of Theoretical Economics, v. 10, 1, pp. 1-11,**TD No. 757 (April 2010).**

S. DI ADDARIO and D. VURI, *Entrepreneurship and market size. the case of young college graduates in Italy*, Labour Economics, v. 17, 5, pp. 848-858, **TD No. 775 (September 2010).**

A. CALZA and A. ZAGHINI, *Sectoral money demand and the great disinflation in the US*, Journal of Money, Credit, and Banking, v. 42, 8, pp. 1663-1678, **TD No. 785 (January 2011).**

*2011*

S. DI ADDARIO, *Job search in thick markets*, Journal of Urban Economics, v. 69, 3, pp. 303-318, **TD No. 605 (December 2006).**

F. SCHIVARDI and E. VIVIANO, *Entry barriers in retail trade*, Economic Journal, v. 121, 551, pp. 145-170, **TD No. 616 (February 2007).**

G. FERRERO, A. NOBILI and P. PASSIGLIA, *Assessing excess liquidity in the Euro Area: the role of sectoral distribution of money,* Applied Economics, v. 43, 23, pp. 3213-3230, **TD No. 627 (April 2007).**

P. E. MISTRULLI, *Assessing financial contagion in the interbank market: maximun entropy versus observed interbank lending patterns,* Journal of Banking & Finance, v. 35, 5, pp. 1114-1127, **TD No. 641 (September 2007).**

E. CIAPANNA, *Directed matching with endogenous markov probability: clients or competitors?,* The RAND Journal of Economics, v. 42, 1, pp. 92-120, **TD No. 665 (April 2008).**

M. BUGAMELLI and F. PATERNÒ, *Output growth volatility and remittances,* Economica, v. 78, 311, pp. 480-500, **TD No. 673 (June 2008).**

V. DI GIACINTO e M. PAGNINI, *Local and global agglomeration patterns: two econometrics-based indicators,* Regional Science and Urban Economics, v. 41, 3, pp. 266-280, **TD No. 674 (June 2008).**

G. BARONE and F. CINGANO, *Service regulation and growth: evidence from OECD countries*, Economic Journal, v. 121, 555, pp. 931-957, **TD No. 675 (June 2008).**

R. GIORDANO and P. TOMMASINO, *What determines debt intolerance? The role of political and monetary institutions*, European Journal of Political Economy, v. 27, 3, pp. 471-484, **TD No. 700 (January 2009).**

P. ANGELINI, A. NOBILI e C. PICILLO, *The interbank market after August 2007: What has changed, and why?*, Journal of Money, Credit and Banking, v. 43, 5, pp. 923-958, **TD No. 731 (October 2009).**

G. BARONE and S. MOCETTI, *Tax morale and public spending inefficiency,* International Tax and Public Finance, v. 18, 6, pp. 724-49, **TD No. 732 (November 2009).**

L. FORNI, A. GERALI and M. PISANI, *The Macroeconomics of Fiscal Consolidation in a Monetary Union: the Case of Italy,* in Luigi Paganetto (ed.), Recovery after the crisis. Perspectives and policies, VDM Verlag Dr. Muller, **TD No. 747 (March 2010).**

A. DI CESARE and G. GUAZZAROTTI, *An analysis of the determinants of credit default swap changes before and during the subprime financial turmoil*, in Barbara L. Campos and Janet P. Wilkins (eds.), The Financial Crisis: Issues in Business, Finance and Global Economics, New York, Nova Science Publishers, Inc., **TD No. 749 (March 2010).**

A. LEVY and A. ZAGHINI, *The pricing of government guaranteed bank bonds,* Banks and Bank Systems, v. 6, 3, pp. 16-24, **TD No. 753 (March 2010).**

G. BARONE, R. FELICI and M. PAGNINI, *Switching costs in local credit markets,* International Journal of Industrial Organization, v. 29, 6, pp. 694-704, **TD No. 760 (June 2010).**

G. BARBIERI, C. ROSSETTI e P. SESTITO, *The determinants of teacher mobility: evidence using Italian teachers' transfer applications*, Economics of Education Review, v. 30, 6, pp. 1430-1444, **TD No. 761 (marzo 2010).**

G. GRANDE and I. VISCO, *A public guarantee of a minimum return to defined contribution pension scheme members*, The Journal of Risk, v. 13, 3, pp. 3-43, **TD No. 762 (June 2010).**

P. DEL GIOVANE, G. ERAMO and A. NOBILI, *Disentangling demand and supply in credit developments: a survey-based analysis for Italy*, Journal of Banking and Finance, v. 35, 10, pp. 2719-2732, **TD No. 764 (June 2010).**

G. BARONE and S. MOCETTI, *With a little help from abroad: the effect of low-skilled immigration on the female labour supply*, Labour Economics, v. 18, 5, pp. 664-675, **TD No. 766 (July 2010).**

S. FEDERICO and A. FELETTIGH, *Measuring the price elasticity of import demand in the destination markets of italian exports,* Economia e Politica Industriale, v. 38, 1, pp. 127-162, **TD No. 776 (October 2010).**

S. MAGRI and R. PICO, *The rise of risk-based pricing of mortgage interest rates in Italy*, Journal of Banking and Finance, v. 35, 5, pp. 1277-1290, **TD No. 778 (October 2010).**

M. TABOGA, *Under/over-valuation of the stock market and cyclically adjusted earnings,* International Finance, v. 14, 1, pp. 135-164, **TD No. 780 (December 2010).**

S. NERI, *Housing, consumption and monetary policy: how different are the U.S. and the Euro area?*, Journal of Banking and Finance, v.35, 11, pp. 3019-3041, **TD No. 807 (April 2011).**

V. CUCINIELLO, *The welfare effect of foreign monetary conservatism with non-atomistic wage setters*, Journal of Money, Credit and Banking, v. 43, 8, pp. 1719-1734, **TD No. 810 (June 2011).**

A. CALZA and A. ZAGHINI, *welfare costs of inflation and the circulation of US currency abroad,* The B.E. Journal of Macroeconomics, v. 11, 1, Art. 12, **TD No. 812 (June 2011).**

I. FAIELLA, *La spesa energetica delle famiglie italiane*, Energia, v. 32, 4, pp. 40-46, **TD No. 822 (September 2011).**

R. DE BONIS and A. SILVESTRINI, *The effects of financial and real wealth on consumption: new evidence from OECD countries,* Applied Financial Economics, v. 21, 5, pp. 409–425, **TD No. 837 (November 2011).**

F. CAPRIOLI, P. RIZZA and P. TOMMASINO, *Optimal fiscal policy when agents fear government default*, Revue Economique, v. 62, 6, pp. 1031-1043, **TD No. 859 (March 2012).**

*2012*

F. CINGANO and A. ROSOLIA, *People I know: job search and social networks*, Journal of Labor Economics, v. 30, 2, pp. 291-332, **TD No. 600 (September 2006).**

G. GOBBI and R. ZIZZA, *Does the underground economy hold back financial deepening? Evidence from the italian credit market*, Economia Marche, Review of Regional Studies, v. 31, 1, pp. 1-29, **TD No. 646 (November 2006).**

S. MOCETTI, *Educational choices and the selection process before and after compulsory school*, Education Economics, v. 20, 2, pp. 189-209, **TD No. 691 (September 2008).**

M. PERICOLI and M. TABOGA, *Bond risk premia, macroeconomic fundamentals and the exchange rate*, International Review of Economics and Finance, v. 22, 1, pp. 42-65, **TD No. 699 (January 2009).**

F. LIPPI and A. NOBILI, *Oil and the macroeconomy: a quantitative structural analysis,* Journal of European Economic Association, v. 10, 5, pp. 1059-1083, **TD No. 704 (March 2009).**

G. ASCARI and T. ROPELE, *Disinflation in a DSGE perspective: sacrifice ratio or welfare gain ratio?,* Journal of Economic Dynamics and Control, v. 36, 2, pp. 169-182, **TD No. 736 (January 2010).**

S. FEDERICO, *Headquarter intensity and the choice between outsourcing versus integration at home or abroad,* Industrial and Corporate Chang, v. 21, 6, pp. 1337-1358, **TD No. 742 (February 2010).**

I. BUONO and G. LALANNE, *The effect of the Uruguay Round on the intensive and extensive margins of trade,* Journal of International Economics, v. 86, 2, pp. 269-283, **TD No. 743 (February 2010).**

S. GOMES, P. JACQUINOT and M. PISANI, *The EAGLE. A model for policy analysis of macroeconomic interdependence in the euro area,* Economic Modelling, v. 29, 5, pp. 1686-1714, **TD No. 770 (July 2010).**

A. ACCETTURO and G. DE BLASIO, *Policies for local development: an evaluation of Italy's "Patti Territoriali"*, Regional Science and Urban Economics, v. 42, 1-2, pp. 15-26, **TD No. 789 (January 2006).**

F. BUSETTI and S. DI SANZO, *Bootstrap LR tests of stationarity, common trends and cointegration*, Journal of Statistical Computation and Simulation, v. 82, 9, pp. 1343-1355, **TD No. 799 (March 2006).**

S. NERI and T. ROPELE, *Imperfect information, real-time data and monetary policy in the Euro area*, The Economic Journal, v. 122, 561, pp. 651-674, **TD No. 802 (March 2011).**

G. CAPPELLETTI, G. GUAZZAROTTI and P. TOMMASINO, *What determines annuity demand at retirement?,* The Geneva Papers on Risk and Insurance – Issues and Practice, pp. 1-26, **TD No. 805 (April 2011).**

A. ANZUINI and F. FORNARI, *Macroeconomic determinants of carry trade activity,* Review of International Economics, v. 20, 3, pp. 468-488, **TD No. 817 (September 2011).**

M. AFFINITO, *Do interbank customer relationships exist? And how did they function in the crisis? Learning from Italy,* Journal of Banking and Finance, v. 36, 12, pp. 3163-3184, **TD No. 826 (October 2011).**

R. CRISTADORO and D. MARCONI, *Household savings in China,* Journal of Chinese Economic and Business Studies, v. 10, 3, pp. 275-299, **TD No. 838 (November 2011).**

P. GUERRIERI and F. VERGARA CAFFARELLI, *Trade Openness and International Fragmentation of Production in the European Union: The New Divide?*, Review of International Economics, v. 20, 3, pp. 535-551, **TD No. 855 (February 2012).**

V. DI GIACINTO, G. MICUCCI and P. MONTANARO, *Network effects of public transposrt infrastructure: evidence on Italian regions,* Papers in Regional Science, v. 91, 3, pp. 515-541, **TD No. 869 (July 2012).**

A. FILIPPIN and M. PACCAGNELLA, *Family background, self-confidence and economic outcomes,* Economics of Education Review, v. 31, 5, pp. 824-834, **TD No. 875 (July 2012).**

*2013*

F. CINGANO and P. PINOTTI, *Politicians at work. The private returns and social costs of political connections,* Journal of the European Economic Association, v. 11, 2, pp. 433-465, **TD No. 709 (May 2009).**

F. BUSETTI and J. MARCUCCI, *Comparing forecast accuracy: a Monte Carlo investigation,* International Journal of Forecasting, v. 29, 1, pp. 13-27, **TD No. 723 (September 2009).**

A. FINICELLI, P. PAGANO and M. SBRACIA, *Ricardian Selection,* Journal of International Economics, v. 89, 1, pp. 96-109, **TD No. 728 (October 2009).**

L. MONTEFORTE and G. MORETTI, *Real-time forecasts of inflation: the role of financial variables*, Journal of Forecasting, v. 32, 1, pp. 51-61, **TD No. 767 (July 2010).**

E. GAIOTTI, *Credit availablility and investment: lessons from the "Great Recession",* European Economic Review, v. 59, pp. 212-227, **TD No. 793 (February 2011).**

A. ACCETTURO e L. INFANTE, *Skills or Culture? An analysis of the decision to work by immigrant women in Italy,* IZA Journal of Migration, v. 2, 2, pp. 1-21, **TD No. 815 (July 2011).**

G. BARONE and G. DE BLASIO, *Electoral rules and voter turnout,* International Review of Law and Economics, v. 36, 1, pp. 25-35, **TD No. 833 (November 2011).**

*FORTHCOMING*

M. BUGAMELLI and A. ROSOLIA, *Produttività e concorrenza estera,* Rivista di politica economica, **TD No. 578 (February 2006).**

M. BRATTI, D. CHECCHI and G. DE BLASIO, *Does the expansion of higher education increase the equality of educational opportunities? Evidence from Italy,* in R. Matoušek; D. Stavárek (eds.), Labour, **TD No. 679 (June 2008).**

A. MERCATANTI, *A likelihood-based analysis for relaxing the exclusion restriction in randomized experiments with imperfect compliance*, Australian and New Zealand Journal of Statistics, **TD No. 683 (August 2008).**

P. SESTITO and E. VIVIANO, *Reservation wages: explaining some puzzling regional patterns,* Labour, **TD No. 696 (December 2008).**

P. PINOTTI, M. BIANCHI and P. BUONANNO, *Do immigrants cause crime?*, Journal of the European Economic Association, **TD No. 698 (December 2008).**

Y. ALTUNBAS, L. GAMBACORTA and D. MARQUÉS-IBÁÑEZ, *Bank risk and monetary policy,* Journal of Financial Stability, **TD No. 712 (May 2009).**

M. TABOGA, *The riskiness of corporate bonds*, Journal of Money, Credit and Banking, **TD No. 730 (October 2009).**

F. D'AMURI, *Gli effetti della legge 133/2008 sulle assenze per malattia nel settore pubblico*, Rivista di Politica Economica, **TD No. 787 (January 2011).**

E. COCOZZA and P. PISELLI, *Testing for east-west contagion in the European banking sector during the financial crisis*, in R. Matoušek; D. Stavárek (eds.), Financial Integration in the European Union, Taylor & Francis, **TD No. 790 (February 2011).**

F. NUCCI and M. RIGGI, *Performance pay and changes in U.S. labor market dynamics*, Journal of Economic Dynamics and Control, **TD No. 800 (March 2011).**

A. DE SOCIO, *Squeezing liquidity in a "lemons market" or asking liquidity "on tap"*, Journal of Banking and Finance, **TD No. 819 (September 2011).**

O. BLANCHARD and M. RIGGI, *Why are the 2000s so different from the 1970s? A structural interpretation of changes in the macroeconomic effects of oil prices*, Journal of the European Economic Association, **TD No. 835 (November 2011).**

E. GENNARI and G. MESSINA, *How sticky are local expenditures in Italy? Assessing the relevance of the flypaper effect through municipal data*, International Tax and Public Finance, **TD No. 844 (January 2012).**

S. FEDERICO, *Industry dynamics and competition from low-wage countries: evidence on Italy*, Oxford Bulletin of Economics and Statistics, **TD No. 879 (September 2012).**

F. D'AMURI and G. PERI, *Immigration, jobs and employment protection: evidence from Europe before and during the Great Recession*, Journal of the European Economic Association, **TD No. 886 (October 2012).**