

# How to avoid self-fulfilling crises

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## Abstract

Obstfeld (1994) shows that a currency crisis can be explained by the occurrence of multiple equilibria (2 interior equilibria). For the same level of economic fundamentals, it may be optimal for the government either to devalue or to maintain the peg. The decision depends on the inflationary expectations of economic agents: it is the phenomenon of self-fulfilling crisis. In order to avoid this kind of crisis, this article offers a new proposal: a partial delegation of exchange rate policy to a more inflation-averse central banker. It shows that if the government continues to decide whether to maintain the peg while the central banker chooses the magnitude of any realignment, lower inflationary expectations will lead to the existence of only one equilibrium. The probability of crisis will then be considerably reduced and a currency crisis will occur only if negative shocks substantially damage the level of economic fundamentals.

**Keywords:** Currency crisis; Multiple equilibria; Credibility; Monetary delegation

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# 1 Introduction

The aim of this article is to determine what conditions allow improvement in the stability of a fixed exchange-rate system with an escape clause. It focuses on what are commonly called “second generation” of models of currency crises, the most well-known of which is Obstfeld (1994).<sup>1</sup> These models describe the crises in the nineties by stressing the fact that “the real cause of currency crises is not so much what you [policymakers] are actually doing as what the financial markets suspect you might want to do” (Krugman, 1998).

As the cost of defending a fixed rate increases when private agents expect a devaluation, a means of strengthening the credibility of the fixed exchange-rate system is to partially delegate exchange-rate policy to a more inflation-averse central banker. The best strategy for the government is only to devolve the decision concerning the realignment magnitude. It cannot delegate the decision whether to maintain the peg as this decision requires taking into account the cost of realignment (in terms of credibility for instance) that it will incur if a crisis occurs. In this context, even if the policy maker is rather accommodative, the stability of the fixed exchange rate increases, as economic agents know that this more inflation-averse central banker will choose a smaller devaluation rate if the government decides to devalue.

Obstfeld (1984), Connolly and Taylor (1984) and Grilli (1986) dealt with this question of the influence of the expected devaluation rate in the context of the “first-generation” models à la Krugman (1979) and Flood and Garber (1984). In the “second-generation” models à la Obstfeld (1994), the interaction between the behaviour of policy makers and economic agents explains the occurrence of two interior equilibria and then the phenomenon of self-fulfilling crisis. As a result, according to private agents’ expectations, the same initial levels of economic fundamentals may be consistent both with the maintenance and the abandonment of the fixed exchange-rate system. At the lower equilibrium, as inflationary expectations are high, competitiveness and unemployment problems are so painful that a devaluation occurs unless shocks on output are quite favourable, while at the higher equilibrium, the crisis occurs only if shocks substantially

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<sup>1</sup>These “second-generation” models are different from the canonical model laid out initially by Krugman (1979) and refined by Flood and Garber (1984). The latter explains crises as a result of a fundamental inconsistency between domestic policies - typically the persistence of money-financed budget deficits - and the attempt to maintain a fixed exchange rate.

cut the output level. In this context, the objective of this article is to determine conditions under which the lower equilibrium can be removed. More particularly, it shows that devolving a part of exchange-rate policy to a more inflation-averse central banker can ensure the achievement of a unique equilibrium with a lower probability of realignment.

The first section presents the framework. The second section considers the partial delegation of exchange rate policy to a more inflation-averse central banker and finds conditions required to make the fixed exchange-rate system more stable by widening the range of shocks to which the policy maker maintains the peg. The last section concludes.

## 2 The framework

The framework is based on the “second-generation” models à la Obstfeld (1994). The chronology of events is the following. First, economic agents’ expectations are determined. Second, a shock on output occurs. Then the demand for labour is determined by firms. Finally, on the basis of all this information, the policy maker decides whether to maintain the peg.

In Obstfeld’s model with an escape clause, policy makers have to choose in each period between maintaining the peg and proceeding to a realignment. From this decision, two interior equilibria occur as “devaluations are triggered by the government’s desire to offset negative output shocks, but a sudden shift in market sentiment regarding the government’s willingness to tolerate unemployment can trigger a devaluation that could not have occurred under different private expectations” (Obstfeld, 1994). So, in one case, the government maintains the peg and pursues a tightening policy except if negative output shocks occur (the higher equilibrium). In the other case, as the expected depreciation is high, public authorities will be forced to proceed to a realignment unless shocks on output are sufficiently favourable (the lower equilibrium).

The government’s loss function is:

$$L_t^G = \frac{1}{2} \theta^G \Pi_t^2 + (y_t - y^*)^2 + \Omega_t C \quad (1)$$

$\theta^G$  represents the degree of inflation aversion,  $\Pi_t$  the current inflation rate,  $y_t$  the output level and  $y^*$  the output target, which is assumed above zero (the equilibrium level).  $C$  represents the

realignment cost incurred by the policy maker (in terms of credibility for instance) after the abandonment of the peg. Consequently,  $\Omega_t$  is a binary variable equal to zero when the policy maker decides to maintain the peg and equal to one when he decides to devalue.

We assume the partial delegation of exchange-rate policy to a central banker who has the same targets as the policy maker but who places greater weight on the costs of higher inflation. The central banker's loss function is

$$L_t^B = \frac{1}{2} \theta^B \Pi_t^2 + (y_t - y^*)^2 \quad (2)$$

$\theta^B$  represents the central banker's degree of inflation aversion where  $\theta^B \geq \theta^G$ .<sup>2</sup>

Purchasing Power Parity (PPP) holds. Foreign prices are exogenous and normalised to 1. Control of exchange-rate variations  $\Delta e_t$  and of the inflation rate  $\Pi_t$  are therefore equivalent.

The output function is

$$y_t = (\Pi_t - \Pi_t^a) - u_t \quad (3)$$

$\Pi_t^a$  represents inflationary expectations and  $u_t$  is a shock which influences the output level. When  $u_t$  is positive, it is a negative shock on output. This function means that the achievement of the output target ( $y^* > 0$ ) requires, all things being equal, non-expected inflation. For this reason,  $y^*$  can also be interpreted as an inflationary bias.

When the peg is maintained ( $\Pi_t = \Delta e_t = 0$ ), the government's loss is

$$L_{FX}^G = \frac{1}{2} (y^* + \Pi_t^a + u_t)^2 \quad (4)$$

This loss depends positively on the level of the output target, inflationary expectations and the size of the adverse output shock.

When the policy maker decides to proceed to a realignment, exchange-rate policy is delegated to the central banker. This later chooses a devaluation rate which minimizes its loss function. So,  $\Delta e_t$  is determined such that  $\frac{\partial L_t^B}{\partial \Delta e_t} = 0$ , that is,

$$\Delta e_t = \Pi_t = \frac{1}{1 + \theta^B} (y^* + \Pi_t^a + u_t) \quad (5)$$

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<sup>2</sup>There is no cost of realignment to the central banker because it is the government that decides whether realignment occurs. If there were full delegation (the central banker also deciding whether to realign), the model would be the same as Obstfeld's, but with the government replaced by the central banker as decision maker. The results would be qualitatively the same as Obstfeld's.

The more the central banker is inflation averse ( $\theta^B$  high), the more the influence of output shocks or inflationary expectations on the devaluation rate is reduced.

Substituting (5) in (1) and taking into account the output function (3), the government's loss when it decides to proceed to a realignment is

$$L_{FL}^G = \frac{\theta^G + \theta^B}{2(1 + \theta^B)} (y^* + \Pi_t^a + u_t)^2 + C \quad (6)$$

Comparison of the losses according to the decision of maintaining the peg or not allows the determination of conditions (evaluated in terms of shocks) under which the policy maker will decide to proceed to a realignment. The condition for realignment is  $L_{FX}^G - L_{FL}^G > 0$ , that is,

$$\frac{1 + 2\theta^B - \theta^G}{1 + \theta^B} (y^* + \Pi_t^a + u_t)^2 > 2C \quad (7)$$

This realignment condition depends on the degrees of inflation aversion of the government and the central banker, the inflationary bias, inflationary expectations, the cost of realignment and the shock which occurs on output. Given that the degree of inflation aversion of the central banker is greater than or equal to that of the government, this inequality indicates that the probability of realignment increases when the inflationary bias and expected inflation are higher and when a shock negatively influences the output level.

The two solutions of this equation correspond to the thresholds  $\bar{u}_i$  from which the policy maker will decide to devalue,

$$\bar{u}_i = \pm \frac{1}{1 + \theta^B} \sqrt{\frac{2C}{1 + 2\theta^B - \theta^G} - y^* - \Pi_t^a} \quad i = 1, 2 \quad (8)$$

These thresholds are determined in two steps as they depend on inflationary expectations, which in turn depend on these expected thresholds. The only source of uncertainty is the real shock so that, at the equilibrium, expected thresholds are equal to  $\bar{u}_i$ . This equilibrium threshold is defined by Obstfeld (1994) as “the highest value of the shock at which the government still finds it optimal to defend the exchange parity”.

Private agents' expectations are formed on the basis of the authorities' decision rule, taking into account the existence of an escape clause and the fact that exchange-rate policy is partially devolved to a more inflation-averse central banker. These expectations will then influence the

decision of the government to maintain the fixed rate or to proceed to a realignment. As a result,

$$\Pi_t^a = \delta(\bar{u}_i) = \Pr(u_t \leq \bar{u}_i) \times 0 + \Pr(u_t > \bar{u}_i) \times E_{t-1}(\Pi_t/u_t > \bar{u}_i) \quad (9)$$

where  $\Pr(u_t \leq \bar{u}_i)$  is the probability that  $u_t$  is below or equal to the equilibrium threshold  $\bar{u}_i$ ,  $\Pr(u_t > \bar{u}_i)$  is the probability that  $u_t$  is above the equilibrium threshold  $\bar{u}_i$  and  $E_{t-1}(\Pi_t/u_t > \bar{u}_i)$  is a rational expectation of the inflation rate when the government devalues (in which case  $u_t$  is above  $\bar{u}_i$ ).

Following the example of Obstfeld (1994), shocks are assumed uniformly distributed on the interval  $(-\mu, \mu)$ . Then,

$$\Pr(u_t > \bar{u}_i) = \frac{\mu - \bar{u}_i}{2\mu} \text{ and } E_{t-1}(u_t/u_t > \bar{u}_i) = \frac{\mu + \bar{u}_i}{2} \quad (10)$$

High values of the threshold  $\bar{u}_i$  (close to  $\mu$ ) mean the probability of crisis is very low while lower values (close to  $-\mu$ ) mean the probability of realignment is high.

Under these assumptions, inflationary expectations are:

$$\Pi_t^a = \delta(\bar{u}_i) = \frac{\mu - \bar{u}_i}{1 + \theta^B} \left( y^* + \frac{\mu + \bar{u}_i}{2} \right) \quad (11)$$

Two factors are critical for the determination of these expectations. First, when the central banker is very inflation averse, inflationary expectations are close to zero. As a result, the stability of the exchange-rate regime is improved. Second, when the threshold is close to  $-\mu$ , inflationary expectations are very high because such a threshold means that a crisis occurs unless shocks on employment are very favourable. Conversely, when  $\bar{u}$  is close to  $\mu$ , inflationary expectations are close to zero. The crisis occurs only if shocks negatively influence the employment level.

As policy makers take into account these expectations, equation (11) is integrated in the equation (7). The realignment condition becomes

$$\frac{1 + 2\theta^B - \theta^G}{1 + \theta^B} > \frac{4\mu}{2} \frac{1 + \theta^B}{2\mu} \frac{(y^* + \bar{u}) + \mu(\mu - 2\bar{u})}{1 + \theta^B - \mu + \bar{u}} > 2C \quad (12)$$

Therefore, equilibrium thresholds from which policy makers decide to devalue are equal to

$$\bar{u}_i = -\frac{1}{1 + 2\theta^B} \mu + \frac{2C}{1 + 2\theta^B - \theta^G} \pm \frac{\sqrt{2C^2(1 + 2\theta^B - \theta^G)^2 - 4\mu(1 + \theta^B)(y^* - \theta^B\mu)}}{1 + 2\theta^B - \theta^G} \quad (13)$$

We have two interior equilibrium thresholds:  $\bar{u}_1$  is the lower equilibrium threshold and  $\bar{u}_2$  the higher equilibrium threshold. As the sign in front of the square root differs according to which equilibrium threshold occurs, the impact of variables and parameters on the two equilibrium thresholds can be different.<sup>3</sup>

In order to improve the stability of the exchange-rate system, a first step is to determine conditions under which the lower equilibrium threshold can be removed<sup>4</sup>. Under these conditions, the probability of self-fulfilling crisis will decrease. It will be then important to analyse the properties of the higher equilibrium threshold (the only equilibrium remaining).

### 3 Analysis of the stability of the exchange-rate system

#### 3.1 Conditions for the removal of the lower equilibrium threshold

Let  $\rho = \frac{1}{\sqrt{2\theta^B}} \mu(1 + \theta^B) \pm \frac{\sqrt{2C^2(1 + 2\theta^B - \theta^G)^2 - 4\mu(1 + \theta^B)(y^* - \theta^B\mu)}}{\mu(1 + \theta^B) + 1}$ . Conditions for the removal of the lower equilibrium threshold are summarized by the following proposition.

**Proposition 1.** The weight placed by the policy maker on inflation costs  $\theta^G$  has to be greater than or equal to  $\frac{-C + \rho^2 + 2\rho^2\theta^B}{\rho^2}$  in order to remove the lower equilibrium and reduce the probability of self-fulfilling crisis.

As the output shock is assumed to be distributed in  $(-\mu, \mu)$ , the condition to remove the lower equilibrium is

$$\bar{u}_1 \leq -\mu \quad (14)$$

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<sup>3</sup>The case studied by Obstfeld is just a particular case of this model where the degree of inflation aversion of the central banker is the same as that of the government, that is  $\theta^G = \theta^B$ .

<sup>4</sup>As the realignment condition and thus equilibrium thresholds depend on the parameter  $\mu$ , changing the interval in which shocks are distributed is not sufficient to eliminate the lower equilibrium.

From this condition, the value of  $\theta^G$  from which the lower equilibrium will be removed is

$$\theta^G = \frac{-C + \rho^2 + 2\rho^2\theta^B}{\rho^2} \quad (15)$$

where  $\rho = \frac{1}{\sqrt{2\theta^B}} \left[ \mu \theta^B + 1 \pm \sqrt{\mu^2 \theta^{2B} + 2(2\mu - y^*)\theta^B + \mu - 2y^*} \right]$ .

Using Obstfeld's parameter values, that is  $C = 0.00045$ ,  $y^* = 0.01$ ,  $\mu = 0.03$  and  $\theta^G = 0.15$  (policy maker rather accommodative), the condition to remove the lower equilibrium is that

$$\theta^B \geq 0.20083$$

Hence, when  $\theta^G = 0.15$ , the degree of inflation aversion of the central banker has to be greater than or equal to 0.20083 to obtain only one equilibrium threshold  $\bar{u}_2$ .<sup>5</sup>

So, to make a fixed exchange-rate system more stable when a government is rather accommodative, the solution is to convince economic agents that in case of realignment the policy followed will not be too accommodative and that, even if output changes will be corrected, the weight placed on inflation will remain relatively high  $\theta^B > \theta^G$ .

### 3.2 The properties of the unique equilibrium threshold

Under the conditions defined previously, the range of shocks under which the policy maker maintains the peg has been widened and only the higher equilibrium threshold remains. However, what are the properties of this unique equilibrium? Do additional instruments exist which allow reduction of the probability of crisis?

The characteristics of the higher equilibrium threshold can be summarized by the proposition below.

**Proposition 2.** Under the conditions defined in Proposition 1 and using Obstfeld's parameter values,

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<sup>5</sup>There is only one solution as there is no solution for

$$\rho = \frac{1}{\sqrt{2\theta^B}} \left[ \mu \theta^B + 1 + \sqrt{\mu^2 \theta^{2B} + 2(2\mu - y^*)\theta^B + \mu - 2y^*} \right]$$



- i) the higher equilibrium threshold obtained is greater than the higher equilibrium threshold evaluated by Obstfeld (1994);
- ii) the associated expected depreciation rate and the probability of crisis are lower.

Taking the values of  $\theta^G$  and  $\theta^B$  from which the lower equilibrium threshold is removed ( $\theta^G = 0.15$ ,  $\theta^B = 0.20083$ ), the value of the higher equilibrium threshold is

$$\bar{u}_2 = 1.0301 \times 10^{-2} \quad (16)$$

At this threshold, the expected depreciation rate is  $\Pi_t^a = 1.1345\%$  per period and the probability of devaluation  $\Pr(u > \bar{u}_2)$  is 32.83%.  $\bar{u}_2$  is above the higher equilibrium threshold evaluated by Obstfeld (1994), which is 0.00098 with an expected depreciation rate of 1.23% per period. These results are illustrated in Figures 1 and 2 where equilibrium thresholds are determined by the intersection between the curve and the horizontal line.

Figure 1

Figure 2

This leads to the conclusion that partial delegation to a more inflation-averse central banker allows, via inflationary expectations, the removal of the lower equilibrium threshold, but also reduces the probability of crisis at the higher equilibrium. As illustrated in Figure 3, the more inflation-averse the central banker is, the lower is the probability of crisis.

Figure 3

The two last propositions focus on the influence of the government's degree of inflation aversion, the inflationary bias and the realignment cost on the higher equilibrium threshold.

**Proposition 3.** A decrease in the policy maker's degree of inflation aversion  $\theta^G$  and an increase in the inflationary bias  $y^*$ , by reducing the higher equilibrium threshold, strengthen the need to devolve exchange-rate policy to a central banker.

The relationship between  $\theta^G$  and  $\bar{u}_2$  is represented in Figure 4.

Figure 4

**Proposition 4.** With only one equilibrium threshold, an increase in the realignment cost  $C$  causes a reduction of the probability of crisis.

This corresponds to a shift upward of the horizontal line in Figure 2. Note that this effect was ambiguous when two interior equilibria existed (Figure 1), as the lower equilibrium threshold became lower and the higher equilibrium threshold increased (Flood and Marion, 1997).

Using (13) with a positive sign in front of the square root, Propositions 3 and 4 are confirmed by the following derivatives,

$$\frac{\partial \bar{u}_2}{\partial \theta^G} > 0 \quad (17)$$

$$\frac{\partial \bar{u}_2}{\partial y^*} < 0 \quad (18)$$

$$\frac{\partial \bar{u}_2}{\partial C} > 0 \quad (19)$$

The last derivative leads to the conclusion that a strengthening of the commitment to maintain the peg (like the implementation of the EMS or like the Maastricht criterion on the exchange rate<sup>6</sup>), by making exit from the system more costly, allows a reduction in the probability of crisis at the higher equilibrium and an improvement in the stability of the fixed exchange-rate system.

## 4 Conclusion

This article shows that, in a fixed exchange-rate system with an escape clause, a partial delegation of exchange-rate policy to a more inflation-averse central banker can be an efficient strategy to avoid self-fulfilling crises. This new proposal of partial delegation comes from the idea that there is a cost to the government (in terms of credibility for example) when a realignment occurs. To take this cost into account, the decision as to whether to maintain the peg is left to the government, but the magnitude of any realignment can be delegated to the central banker. Whereas previous “second-generation” models are characterized by the existence of multiple equilibria, the introduction of partial delegation can lead to the existence of a unique equilibrium threshold (the higher equilibrium threshold). At this equilibrium, a crisis occurs

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<sup>6</sup>This forbade EMS countries to realign during the two years prior to the formation of the Union

only if negative shocks substantially reduce the output level. The fixed exchange rate is then easier to maintain as economic agents do not believe it will be abandoned as long as economic fundamentals are consistent with the maintenance of the peg.

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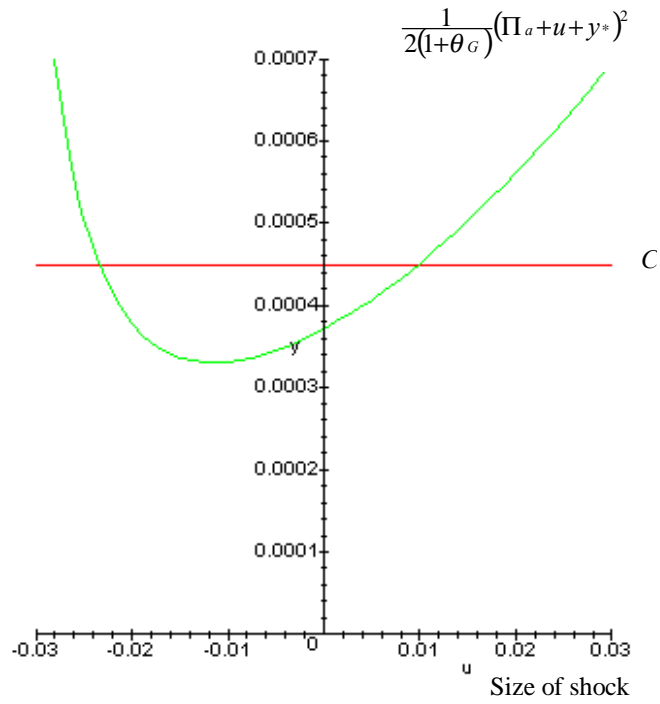


Fig. 1. *Obstfeld's case (2 interior equilibria)*

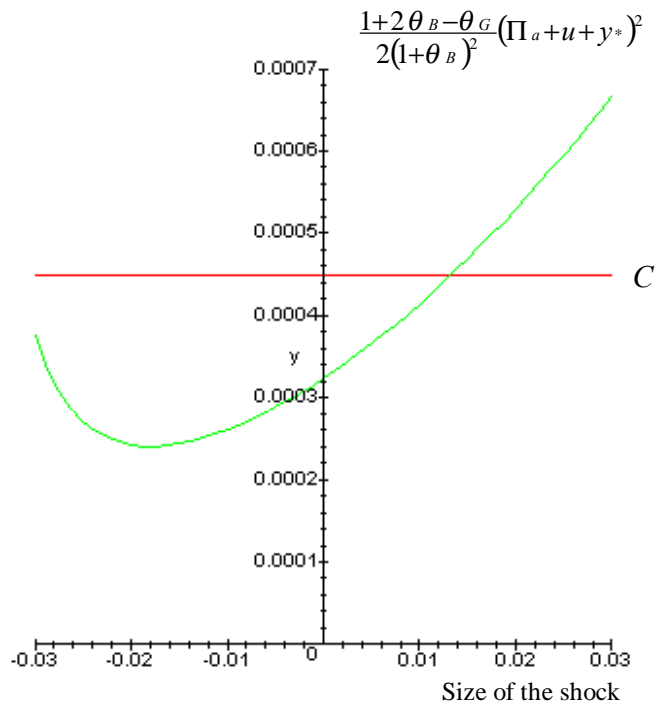


Fig. 2. *With delegation to a central banker*

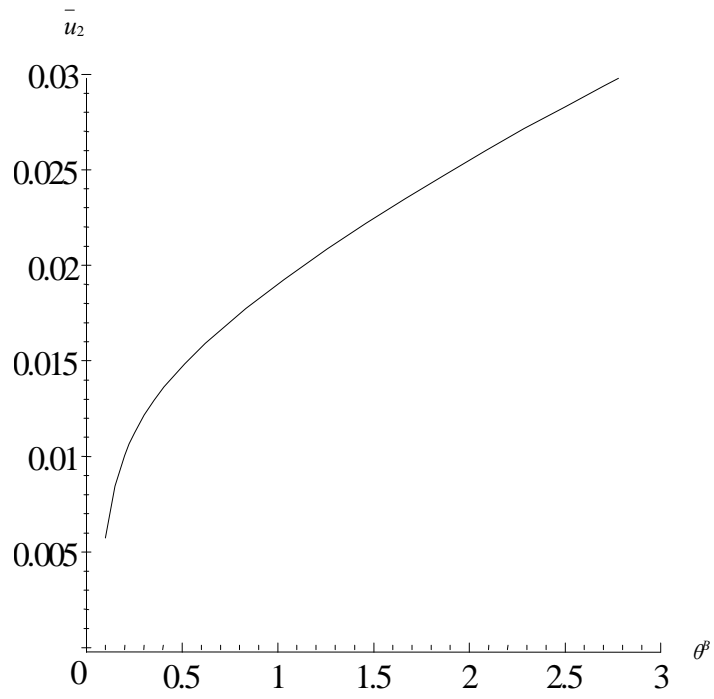


Fig. 3. Impact of  $\theta^{\beta}$  on the higher equilibrium

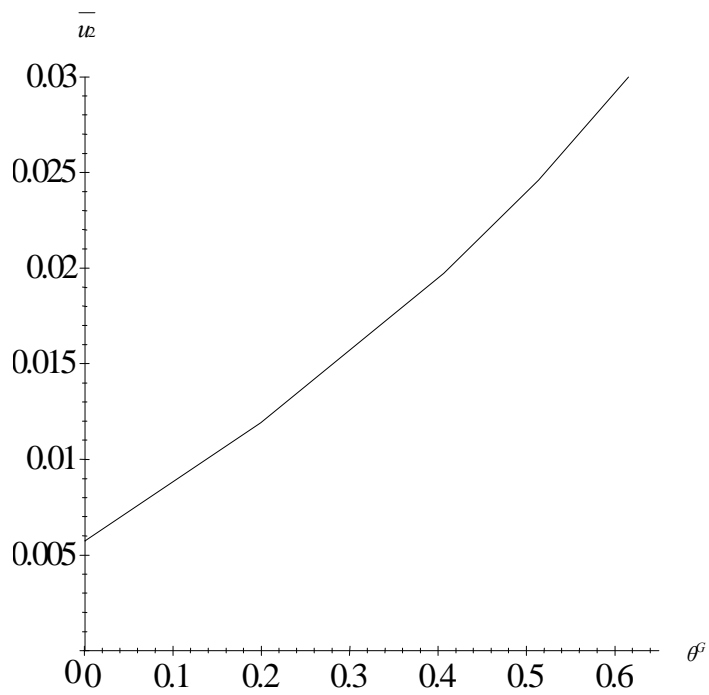


Fig. 4. Impact of  $\theta^G$  on the higher equilibrium