Fiscal federalism, discipline and selection adverse in the EU : Lessons from a theoretical model

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28th December 2003

Abstract

What is the optimal way to stabilize shocks and to take care of fiscal discipline in a fiscal union ? Among the various possible ways, this paper focuses on an inter-countries insurance scheme conditioned by the national preference for the fiscal discipline of each government. We show that the insurance scheme improves significantly the union's social welfare because it enables to cover deviations of the ouptut gap and correct national preferences.

Keywords : inter-countries insurance, fiscal stabilization, fiscal discipline, EU, fiscal federalism, selection adverse.

JEL Classification : E 61, E 62, E 63, H 62, H 77.

Résumé

Fédéralisme budgétaire, discipline et anti-sélection dans l'UE :
Les enseignements d'un modèle théorique

Cet article traite d'une double problématique puisqu'il s'agit de voir comment, au sein d'une union de pays, assurer la stabilisation budgétaire conjoncturelle tout en veillant à la discipline budgétaire. Parmi les différentes voies proposées, nous nous intéressons à la mise en œuvre d'un mécanisme d'assurance hybride inter-pays membres conditionné par la préférence pour la discipline budgétaire des assurés au sein de cette union. Nous montrons alors que la mise en œuvre du mécanisme de transferts entre pays améliore le bien-être social de l'union de façon considérable puisqu'il permet de couvrir les chocs conjoncturels et de corriger les arbitrages nationaux.

Mots clés : assurance inter-pays, stabilisation budgétaire, discipline budgétaire, UE, fédéralisme budgétaire, anti-sélection.

Classification JEL : E 61, E 62, E 63, H 62, H 77

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I would like to thank Jérôme Wittwer for his very useful comments and discussion. All mistakes are mine.

Introduction

The question of introducing an insurance scheme between the member countries of the EMU is particularly acute. Indeed, since the European governments have face difficulties in stabilizing their economic situation because of the fiscal rules which press on their decisions, we have to wonder about the interest of an alternate mechanism which would substitute for the ongoing mechanism.

In the EMU, national fiscal policies are governed by the Stability Pact, intended to secure fiscal discipline within the union, and by the subsidiarity principle, which leaves a large room for initiative to fiscal policies. Nevertheless, the Stability Pact, prohibiting « excessive » public deficits (superior to 3 % of the GDP) at the risk of sanctions[1], seems mainly to have been motivated by the fear of unbearable national debt rather than by the need for flexibility[2]. The main risk is then that it may be an obstacle to the use of national budgets as a stabilizing tool during recessions, making fiscal policies pro-cyclical[3].

Faced with such a situation, several alternatives are offered. Two main ways of research emerge from these works. A first way of research consists in relaxing the current fiscal rule which presses on EU member countries so as to let play the subsidiarity principle fully[4]. A second way of research proposes to set up a centralized stabilization scheme which would come to complement national fiscal policies or to substitute for them[5]. We choose to explore this second way of research.

The literature on the relevance of a centralized stabilization scheme in the EU had a new development with the birth of the EMU since the end of the nineties[6]. Nevertheless, the idea of establishing a specific stabilization mechanism in the EMU intended to smooth asymmetrical shocks is fairly old[7]. More recently, some works tried to study the interest of a centralized stabilization scheme as regards the double requirement of stabilization and of fiscal discipline within a monetary union[8].

Our approach takes place within the framework of these recent works. We consider the introduction of a transfers centralized scheme which would come to substitute for the Stability Pact. The envisaged mechanism will later be considered as a hybrid insurance

[1]This penalty takes the shape of not paid deposits transformed into fine if excessive public deficit is not corrected in two years.

[2]although Villieu (2003) interprets the Stability Pact as an implicit coordination tool of the national fiscal policies which allows to improve the stabilization of important asymmetrical shocks in the union.

[3]See, notably, Eichengreen & Wyplosz (1998) or still Kadareja (2001).

[4]See, for example, Barbier & Villieu (2003) or else Barbier-Gauchard & Blot (2003).

[5]As it's generally the case in a big number of fiscal unions such as the United States, Canada or also Switzerland.

[6]See Bec & Hairault (1997), Beine & Docquier (1997), Huart & Van Aarle (1999), Kletzer & Von Hagen (2000) or still Artus (2003).

[7]See notably the report of Mac Dougall (1977), Van der Ploeg (1991), Majocchi & Rey (1993), or still Hammond & Von Hagen (1995).

[8]See Hougaard Jensen & Van Aarle (1996), Kletzer (1997), Van Aarle (2001) or still Engwerda, Plasmans & Van Aarle (2002).

mechanism as far as it has to fulfil a double mission which distinguishes it from a standard insurance mechanism : it must not only insure countries against random shocks but also take care of fiscal discipline within a union in which member countries differ by their relative preference for deficit stabilization.

In this paper, we consider a fiscal union made of two levels of fiscal power : a central one and a national or sub-central one. In this framework, the central agency offers an insurance contract to countries submitted to random shocks (i.e. a premium to pay and a net compensation to receive). As for the national fiscal governments, they try to stabilize their economic situation as best they can, given their preference for fiscal discipline. We are interested in the shape of the optimal insurance contract within this union made of two types of fiscal authorities : the « virtuous » which present a strong aversion for fiscal imbalance and the « laxists » which, on the contrary, have little worry about the drifting of their fiscal deficits. In this model, the preference for fiscal discipline constitutes the crucial characteristic allowing to differentiate insurance contracts.

The aim of this article is thus to determine the shape and properties of the optimal insurance contract for every government type and to estimate the implications of it on the stabilization of ouput gap, deficit and on the social loss of the union.

Like Hougaard Jensen & Van Aarle (1996), we study various possible configurations for the fiscal policy in the EU and we attempt to shed light on the relevance of a centralized transfers mechanism in terms of stabilization and fiscal discipline. Nevertheless, our analysis differs from theirs for several reasons. First of all, we model explicitly the play between the various levels of fiscal power as a sequential game in which the central agency plays as leader and national fiscal authorities play as follower. Besides, we make endogeneous the determination of the transfers mechanism which results henceforth from the central agency's game. Finally, we raise the hypothesis that countries have the same structural parameters, assuming that fiscal governments differ by their preference for fiscal discipline. From then on, the insurance contract can be conditioned on national specificities.

The rest of the paper is organized as follows. Section 1 sets out the model. In section 2, we study the national reaction functions. In section 3, we characterize the equilibrium with symmetrical information. In section 4, we characterize the selection adverse equilibrium.

1 The model

First, we describe the framework. Then, we present the fiscal authorities' behaviour : the national governments' and the central agency's.

1.1 Framework

We consider a union of N identical countries. Each country i is characterized by the following reduced form according to which the output gap depends on public deficit d_i (where a represents the output gap sensibility to deficit with $0 < \alpha < 1$), on a positive random shock x and on insurance transfers (α_i, β_i) :

$$y_i^M = ad_i^M - x^M + \alpha_i \qquad \text{in the bad state of nature} \tag{1}$$
$$y_i^B = ad_i^B + x^B - \beta_i \qquad \text{in the good state of nature} \tag{2}$$

where the M exponent refers to « bad state of nature » and the B exponent to « good state of nature »

with the following notations :

y_i : level of output gap in country i
d_i: level of public deficit in country i
x: an i.i.d. random shock (x^M in the bad state of nature and x^B in the good state of the nature)
α_i : net of premium compensation received by country i in case of unfavourable shock
β_i : premium paid by country i in case of favourable shock

So, the output gap is explained by three crucial variables :

– public deficit noted d_i, the national governments fiscal tool

– random shock noted x

– insurance contract noted (α_i, β_i), the central agency fiscal tool

Furthermore, the union consists in two levels of fiscal decision :

– the central stage represented by a central agency. Its aim is double : offering to member states a coverage against random shocks and correcting national arbitrages.

– the national stage represented by the national governments of the union. National fiscal authorities try to stabilize at best their economic situation according to their sensitivity for fiscal discipline, their tool being public deficit.

Moreover, there are two types of fiscal authorities which differ by their sensitivity for fiscal discipline noted γ_i :

– n_H type H governments (H stands for « high») characterized by a strong preference for fiscal discipline noted γ_H. Afterwards, type H will correspond to the « virtuous » type as far as it shows a strict budget control. So, in case of a cyclical shock, an H type government will better stabilize their deficit than L type gouvernments, but not as much their economic situation.

– n_L type L governments (L stands for « low ») characterized by a weak preference for fiscal discipline noted γ_L with $\gamma_H > \gamma_L$. Afterwards, the L type will correspond to the « laxists » as far as it presents a more relaxed fiscal discipline. So, in case of a cyclical shock, type L government will stabilize their output gap better at the price of a higher public deficit.

Finally, the game between central agency and national governments is a Stackelberg four-stage game in which the central agency plays as leader and national fiscal authorities play in Nash (that is in a non-cooperative way) as followers :

– First, the central agency plays by proposing a menu of insurance contracts to the national governments. The central agency behaves as a central planner which chooses insurance contracts so as to minimize the union's social expected loss. Then, the governments choose their insurance contract.

– Second, nature plays by determining the state of nature (favourable or unfavourable shock), observed by all the players.

– Third, national fiscal authorities play by determining the optimal fiscal deficit so as to minimize the national loss. Countries have to arbitrate between stabilizing their economic situation at the cost of a high deficit or reducing their deficit at the cost of a lesser stabilization.

– Finally, payments are made between central agency and national governments.

1.2 National governments behaviour

Each type i government (for $i = H, L$) optimizes its objective function with respect to public deficit. The national preferences express toward a quadratic loss function noted L_i depending on the deviation of output gap y_i from its target $y*$ and on the deviation of public deficit d_i from its target d^* :

$$L_i = \frac{1}{2} \left[(1-\gamma_i)\ (y_i - y^*)^2 \ + \ \gamma_i\ (d_i - d^*)^2 \right] \text{ avec } \ 0 < \gamma_i < 1 \tag{3}$$

where $(1 - \gamma_i)$ represents the national preference for the output gap stabilization and γ_i the preference for the public deficit stabilization with $\gamma_H > \gamma_L$.

To simplify, we suppose that the output gap target is strictly positive ($y^* > 0$) whereas the public deficit target is equal to zero ($d^* = 0$). So, the loss function can be written as :

$$L_i = \frac{1}{2} \left[(1-\gamma_i)\ (y_i - y^*)^2 \ + \ \gamma_i\ (d_i)^2 \right] \tag{4}$$

Every government i, playing as follower, is going to minimize its loss given by the equation (3) with regard to the public deficit d_i by considering the behaviour of the central agency as given. Its optimization program spells thus :

$$\begin{cases} \underset{\{d_i\}}{Min}\, L_i \\ \text{sc } (\alpha_i, \beta_i) \ \text{ donné} \quad \Rightarrow d_i = R_i(\alpha_i, \beta_i) \end{cases}$$

The resolution of this optimization program gives us the reaction function of government i which gives the optimal public deficit according to the insurance contract determined by the central agency.

1.3 Central agency behaviour

The central agency behaves as a central planner which chooses insurance contracts (α_H, β_H) and (α_L, β_L) so as to minimize the union's social loss.

The union's social loss function noted L is also a quadratic loss function depending on the deviation of output gap y_i from its target $y*$ and on the deviation of public deficit d_i from its target d^*, for every country :

$$L = \frac{1}{2}\Big[(1-\gamma)\ n_H\ (y_H - y^*)^2 + (1-\gamma)\ n_L\ (y_L - y^*)^2 + \gamma\ n_H\ (d_H - d^*)^2 + \gamma\ n_L\ (d_L - d^*)^2\Big] \quad (5)$$

with $\gamma_L < \gamma < \gamma_H$ and $d^* = 0$ thus :

$$L = \frac{1}{2}\Big[(1-\gamma)\ n_H\ (y_H - y^*)^2 + (1-\gamma)\ n_L\ (y_L - y^*)^2 + \gamma\ n_H\ (d_H)^2 + \gamma\ n_L\ (d_L)^2\Big] \quad (6)$$

Parameter γ represents the specific central agency sensitivity for fiscal discipline. We suppose that $\gamma > \gamma_L$ i.e. that the central agency cares more for fiscal discipline than the « laxists » and that $\gamma > \gamma_H$ i.e. that the central agency is less worried by fiscal discipline than the « virtuous ».

So, we can deduct the central agency's expected loss :

$$\begin{aligned} EL = &\frac{p}{2}\ [(1-\gamma)\ n_H\ (y_H^M - y^*)^2 + (1-\gamma)\ n_L\ (y_L^M - y^*)^2 + \gamma\ n_H (d_H^M)^2 + \gamma\ n_L (d_L^M)^2] \\ &+ \frac{1-p}{2}\ [(1-\gamma)\ n_H\ (y_H^B - y^*)^2 + (1-\gamma)\ n_L\ (y_L^B - y^*)^2 + \gamma\ n_H (d_H^B)^2 + \gamma\ n_L\ (d_L^B)^2] \end{aligned} \quad (7)$$

where p is the probability to be hit by a random negative shock x^M and, consequently, $(1-p)$ is the probability to be hit by a random positive shock x^B.

The central agency, acting as a leader, is going to minimize its expected loss given by equation (7) with regard to the menu of insurance contracts under constraint of nul expected profit and of the national reaction functions. This constraint of nul expected profit is frequently used in the insurance litterature. In our framework, it represents a long-term budget-balance constraint. Its optimization program spells thus :

$$\begin{cases} \underset{\{\alpha_H,\ \alpha_L,\ \beta_H,\ \beta_L\}}{Min} \quad EL \\ \\ \text{sc} \ \ -p\, n_H\ \alpha_H + (1-p)\ n_H\ \beta_H - p\, n_L\ \alpha_L + (1-p)\ n_L\ \beta_L = 0 \\ \text{et } d_i = R_i(\alpha_i, \beta_i), \forall i \end{cases}$$

In the symmetrical information situation, the central agency knows the number of countries of every type and knows which type every country belongs to. Indeed, it knows n_H and n_L and observes γ_i i.e. the national sensitivity for fiscal discipline. In other words, the central agency perfectly knows how to distinguish between the « virtuous » and the « laxists ». As a consequence, the central agency can determine a contract adapted for every country type and conditional to the observation of cyclical shocks. Then, there are as many contracts as there are types.

On the contrary, when information is asymmetrical or when the central agency can't use this information to discriminate (for political reasons for example), the central agency can't go on offering the same menu of insurance contracts because a selection adverse problem appears. Indeed, one of the two fiscal types will be tempted to choose the contract intended for the other.

So, the purpose of this article is to determine the form and qualities of the optimal insurance contract for every type according to the informational situation. We can notice that here typically we are within the framework of a principal-agent model as far as the central agency (the principal), which determines the insurance contract, can be in a situation of informational asymmetry concerning the type of national authorities (the agents) to which it offers the contract.

2 National-government reaction functions

To obtain the equilibrium in this Stackelberg game, we must first determine the governments' reaction functions. Indeed, as any game with sequential decisions, the resolution takes place backwards. From then on, we first have to determine the reaction functions of national fiscal authorities to be able to introduce them into the central agency's optimization program. Then, we shall be able to solve the central agency program and so to determine optimal insurance contracts according to the considered informational situation.

The reaction function results from the optimization program of every national authority. In the presence of an insurance scheme and whatever is informational situation, every government i minimizes its loss given by equation (3) with regard to the public deficit d_i

by considering the central agency's behaviour as given. Its program spells then :

$$\begin{cases} \underset{\{d_i\}}{Min}\, L_i \\ \text{sc } (\alpha_i, \beta_i) \ \text{ given} \end{cases}$$

The first order condition of this optimization program allows us to determine the reaction function of a type i fiscal authority in every state of nature. We then obtain the following reaction functions :

$$d_i^M = R_i^M(\alpha_i) = \frac{a\ (1-\gamma_i)\ (x^M - \alpha_i + y^*)}{a^2\ (1-\gamma_i) + \gamma_i} \tag{8}$$

$$d_i^B = R_i^B(\beta_i) = \frac{-\ a\ (1-\gamma_i)\ (x^B - \beta_i + y^*)}{a^2\ (1-\gamma_i) + \gamma_i} \tag{9}$$

where R_i^j indicates the reaction function of a type i government in the state of nature j with $i = H$ or L and $j = G$ or B.

So, optimal public deficit presents three components :

- a cyclical component which depends on the random shock (x^M, x^B) : the cyclical deficit is all the more sensitive to shocks as preference for fiscal discipline γ_i is low.
- a structural component which depends on the output gap target y^* : structural deficit is all the more sensitive to the output gap target as preference for fiscal discipline γ_i is low.
- an insurance component : this insurance contract, made of the couple (α_i, β_i), the central agency's tool, negatively affects public deficit in the bad state of nature and positively in the good state of nature. Besides, public deficit is of all the more sensitive to the insurance contract as it presents a low preference for fiscal discipline γ_i.

We can then introduce these reaction functions into the model to obtain the output gap aim[9], the public deficit aim as well as the expected loss depending on the insurance contract (see appendix 1).

Thus, the national fiscal intervention allows, whatever the state of nature is, to improve output gap stabilization. Indeed, output gap becomes less sensitive to cyclical shocks because the sensitivity shifts down from 1 to $\frac{\gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}$. Besides, this sensitivity is all the weaker as γ_i is weak. However, whatever the government type considered is, national fiscal stabilization never allows to completely stabilize cyclical shocks.

[9] Afterwards, we shall indicate by « aim » the deviation of the current variable from its target i.e. $(v_i - v^*)$ where $v = y$ or d.

Besides, fiscal behaviour is differentiated because of the heterogeneousness of national preferences for deficit stabilization. It seems that the « virtuous » stabilize their public deficit better but their output gap less than the « laxists ».

Consequently, the stumbling block of such a system appears. Indeed, it could be accompanied by an explosion of public deficits for some countries and real lack of cyclical stabilization for the others. That's why we are interested in the interest of an insurance sheme intended to improve the output gap stabilization while taking care of fiscal discipline within the union.

We can now consider the central agency's intervention. To do this, we study alternative informational situations because we distinguish a symmetrical information situation from a hidden information situation (selection adverse).

3 Insurance and symmetrical information

In this framework, the central agency's aim is double : it must allow governments to be insured against cyclical shocks but it must also correct the national preferences for fiscal discipline.

3.1 Central agency's intervention

To determine the optimal insurance contracts, the central agency minimizes the expected social loss given by equation (7) with regard to insurance contracts under a long term balanced budget constraint and the national reaction functions constraints[10]. The central agency program can be written as :

$$\left\{ \begin{array}{c} \underset{\{\alpha_H,\ \alpha_L,\ \beta_H,\ \beta_L\}}{Min} \quad EL \\ \\ \text{sc} \ - \ p\ n_H\ \alpha_H + (1-p)\ n_H\ \beta_H - p\ n_L\ \alpha_L + (1-p)\ n_L\ \beta_L = 0 \\ \\ d_i^M = R_i^M(\alpha_i) \ \ \text{et} \ \ d_i^B = R_i^B(\beta_i), \forall i \end{array} \right.$$

Noted Lagrangien $\mathcal{L}$ spells then :

$$\mathcal{L} = EL - \lambda \Big[- \ p\ n_H\ \alpha_H + (1-p)\ n_H\ \beta_H - p\ n_L\ \alpha_L + (1-p)\ n_L\ \beta_L \Big]$$

[10] We put aside participation constraints because, since countries already belong to a union, membership in the implemented insurance mechanism can be considered as an additional degree of integration.

The resolution of this optimization program allows us to determine the optimal insurance contracts expression :

$$\alpha_H = x^M - \frac{n_L \ (A-B)}{n_H \ A + n_L \ B} \ y^* \tag{10}$$

$$\beta_H = x^B + \frac{n_L \ (A-B)}{n_H \ A + n_L \ B} \ y^* \tag{11}$$

$$\alpha_L = x^M + \frac{n_H \ (A-B)}{n_H \ A + n_L \ B} \ y^* \tag{12}$$

$$\beta_L = x^B - \frac{n_H \ (A-B)}{n_H \ A + n_L \ B} \ y^* \tag{13}$$

with $A = \frac{[a^2 \ (1-\gamma_H)+\gamma_H]^2}{{\gamma_H}^2 \ (1-\gamma)+a^2 \ \gamma \ (1-\gamma_H)^2}$ and $B = \frac{[a^2 \ (1-\gamma_L)+\gamma_L]^2}{{\gamma_L}^2 \ (1-\gamma)+a^2 \ \gamma \ (1-\gamma_L)^2}$

Consequently, the insurance contract proposed to every type of fiscal authority depends on the scope the observed cyclical shock and on the output gap target but also on the proportion of every type of government n_H and n_L, on the sensitivity for fiscal discipline of national governments γ_H and γ_L and of the central agency's γ.

So, the insurance contract answers the two raised problems in this economy since each term of the contract presents two components.

An insurantial component, enabling to be covered against random shocks, answer the stabilization problem. It enables to completly stabilize random shocks. This component is identical for each type of government but differs according to the state of nature[11].

A corrective component allows to answer the fiscal heterogeneousness problem. It affects the insurantial component positively or negatively. This component is identical for each state of nature but differs according to government type[12]. We can moreover note that, without the fiscal heterogeneity problem that is if $\gamma = \gamma_H = \gamma_L$, full insurance is the optimal solution.

We then introduce these optimal insurance contracts into the model described in appendix 1 so as to obtain the output gap aim, the deficit aim as well as the expected losses at the equilibrium (see appendix 3).

3.2 Relevance of the central agency's intervention

The differentiation of insurance contracts takes place through the corrective constituent, intended to correct national arbitrages. This component differs according to the government type.

[11]cThis insurancial omponent rises in x^M in the bad state of nature and in x^B in the good state of nature.

[12]This corrective component rises in $-\frac{n_L \ (A-B)}{n_H \ A+n_L \ B} \ y^*$ or the « virtuous » governments and in $\frac{n_H \ (A-B)}{n_H \ A+n_L \ B} \ y^*$ for the « laxists ».

The determinants of this corrective component are twofold :

- the proportion of every type of government n_H and n_L : if $n_H > n_L$ that is if the virtuous governments are more numerous than the lax governments then the virtuous corrective component is weaker than that of the laxists, and conversely if $n_H < n_L$.
- the sign of $(A - B)$: If $(A - B) > 0$ then the virtuous governments undergo a fine which comes to reduce net compensation and to increase paid premium (compared to the full insurance) whereas the laxists benefit from an additional payment which comes, on the contrary, to increase net compensation and to reduce paid premium, and conversely if $(A - B) < 0$.

Now, we must return on the study of the sign of $(A-B)$. The sign of $(A-B)$ depends on the value of the social preference for deficit stabillization γ. More precisely, it depends on the distance between the social preference for deficit stabilization and national preferences i.e. $\gamma_H - \gamma$ et $\gamma - \gamma_L$. Indeed, we show that [13] :

$$A - B > 0 \Leftrightarrow \quad [a^2\ (1-\gamma_H)+\gamma_H]\ (\gamma-\gamma_L) - [a^2\ (1-\gamma_L)+\gamma_L]\ (\gamma_H-\gamma) > 0$$

$$A - B < 0 \Leftrightarrow \quad [a^2\ (1-\gamma_H)+\gamma_H]\ (\gamma-\gamma_L) - [a^2\ (1-\gamma_L)+\gamma_L]\ (\gamma_H-\gamma) < 0$$

.

So, if γ is high or, more precisely, if γ is close to γ_H and far from γ_L that is if the central agency shows a strong preference for deficit stabilization then virtuous governments undergo a fine whereas the laxists benefit from an additional payment. In that case, social preferences come near the virtuous preferences but fairly far from those of the laxists. Consequently, the central agency has to correct the arbitrages of the laxists. In other words, the only means to correct the laxist preferences for the central agency, given the balanced budget constraint, is to introduce a fine on the virtuous. Besides, the corrective component is all the higher as γ is far from γ_L and close to γ_H.

Furthermore, we have to study the effect of the insurance contract on the expected losses for every country in particular and for the union in general. At the equilibrium, expected losses are expressed thus :

$$EL_i^{\text{II}} = \frac{1}{2}\,\frac{\gamma_i\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\,\left(\frac{X}{n_H\ A+n_L\ B}\right)^2 (y^*)^2 \qquad (14)$$

$$EL^{\text{II}} = \frac{1}{2}\,\frac{1}{n_H\ A+n_L\ B}\,(y^*)^2 \qquad (15)$$

With regard to the equilibrium without insurance scheme, it seems that the introduction of an insurance contract allows to reduce the expected social loss. Nevertheless, we must

[13] Let's remember that $[a^2\ (1-\gamma_L)+\gamma_L] < [a^2\ (1-\gamma_H)+\gamma_H]$ because $\gamma_L < \gamma_H$.

distinguish two cases according to the nature of the corrective component to study the effect on national expected losses.

If $A > B$ then the laxists' expected loss is lower than without insurance whereas the reduction of the virtuous' expected loss is felt only in the presence of strong cyclical shocks, and conversely if $A < B$.

Finally, at the symmetrical information equilibrium, the insurance scheme enables to completely stabilize random shocks but the existence of a heterogeneousness of national preferences for fiscal discipline introduce a corrective component in every insurance contract. For every government type, the effect of this component depends on the distance between the central preference and national preferences for deficit stabilization. So, if social preferences are relatively close to the virtuous preferences (the case if $A > B$) then the virtuous undergo a fine whereas the laxists get an additional payment. Whatever happens, the insurance sheme reduces the social expected loss.

4 Insurance and selection adverse

However, it is unlikely that the central agency perfectly knows national preferences or can use this information to discriminate between governments (for political reasons for example). So, it seems relevant to tackle the situation in which the type of fiscal authorities constitutes a hidden characteristic for the central agency. We are then in a frame of selection adverse. The central agency can not distinguish the virtuous from the laxists. By continuing to propose the contracts obtained above, one of the two types of government is going to be tempted to choose the insurance contract intended for the other type. From then on, the central agency is going to have to propose incentive contracts.

4.1 Central agency's intervention

Firstly, we have to shed light on the incentive problem. To this end, we express the expected loss of each government type with each insurance contract.

If $A - B > 0$ then the virtuous get a weaker expected loss with the laxists' contract than with their contract whereas the laxists get a weaker expected loss with their contract. Consequently, the virtuous are going to prefer the laxists' contract. Indeed, we obtain that :

$$\begin{aligned} EL_H^{\text{II}}(\alpha_H, \beta_H) &> EL_H^{\text{II}}(\alpha_L, \beta_L) \\ EL_L^{\text{II}}(\alpha_L, \beta_L) &< EL_L^{\text{II}}(\alpha_H, \beta_H) \end{aligned}$$

Conversely, if $A - B < 0$ then the laxists are going to prefer the virtuous's contract. Indeed, we obtain that :

$$\begin{aligned} EL_H^{\text{II}}(\alpha_H, \beta_H) &< EL_H^{\text{II}}(\alpha_L, \beta_L) \\ EL_L^{\text{II}}(\alpha_L, \beta_L) &> EL_L^{\text{II}}(\alpha_H, \beta_H) \end{aligned}$$

From then on, when information is asymmetrical, the central agency minimizes the expected social loss given by equation (7) with regard to insurance contracts under a long-term balanced-budget constraint, the reaction functions constraints and incentive-compatibility constraints. Indeed, the incentive-compatibility constraints allow to verify that every type of government gets a lower expected loss with its contrat than with the contract intended for the other type.

Generally speaking, the program of the central agency can be spelt thus :

$$\begin{cases} \underset{\{\alpha_H,\ \alpha_L,\ \beta_H,\ \beta_L\}}{Min} \quad EL \\ \text{sc} \ - \ p\ n_H\ \alpha_H + (1-p)\ n_H\ \beta_H - p\ n_L\ \alpha_L + (1-p)\ n_L\ \beta_L = 0 \\ d_i^M = R_i^M(\alpha_i) \ \text{ et } \ d_i^B = R_i^B(\beta_i), \forall i \\ EL_H(\alpha_L, \beta_L) \geq EL_H(\alpha_H, \beta_H) \\ EL_L(\alpha_H, \beta_H) \geq EL_L(\alpha_L, \beta_L) \end{cases}$$

The Lagrangien can be written as :

$$\mathcal{L} = EL - \lambda\Big[-\ p\ n_H\ \alpha_H + (1-p)\ n_H\ \beta_H - p\ n_L\ \alpha_L + (1-p)\ n_L\ \beta_L\Big]$$
$$-\lambda_H\big[EU_H(\alpha_L, \beta_L) - EU_H(\alpha_H, \beta_H)\big] - \lambda_L\big[EU_L(\alpha_H, \beta_H) - EU_L(\alpha_L, \beta_L)\big]$$

As a consequence, four cases can be studied :

(1) $\lambda_H = \lambda_L = 0$

(2) $\lambda_H > 0$ et $\lambda_L > 0$

(3) $\lambda_H > 0$ et $\lambda_L = 0$

(4) $\lambda_H = 0$ et $\lambda_L > 0$

In case (1), no incentive-compatibility constraint is saturated. Thus, each government type get a weaker expected loss with its contract than with the contract intended for the other type. In this case, the selection adverse problem is not solved so we exclude this case from the analysis. In case (2), all incentive-compatibility constraints are saturated. It means that each government type gets the same expected loss with its contract and with the contract intended for the other type. In case (3), only the virtuous incentive-compatibility constraint is saturated i.e. only the virtuous get the same expected loss with their contract and with the contract intended for the laxists. Conversely, the laxists get a weaker expected loss with their contract than with the contract intended for the virtuous. Finally, in case (4), laxists are indifferent between the two contracts whereas the virtuous strictly prefer the contract intended for them.

Then we show (see appendix 2) that, in our framework, either $\lambda_H = 0$ et $\lambda_L = 0$ or $\lambda_H > 0$ et $\lambda_L > 0$. It means that either all incentive compatibility constraints are simultaneously tight or none of them. Under no circumstances, only one constaint is saturated. Afterwards, we favour the case where $\lambda_H > 0$ and $\lambda_L > 0$ in order to solve our incentive problem.

After simplifications, we show that the central agency program can express as :

$$\begin{cases} \underset{\{\alpha_H,\ \alpha_L,\ \beta_H,\ \beta_L\}}{Min} \quad EL \\ \text{sc} \ - \ p\, n_H\, \alpha_H + (1-p)\, n_H\, \beta_H - p\, n_L\, \alpha_L + (1-p)\, n_L\, \beta_L = 0 \\ d_i^M = R_i^M(\alpha_i) \ \text{ et } \ d_i^B = R_i^B(\beta_i), \forall i \\ p\big[(x^M - \alpha_L + y^*)^2 - (x^M - \alpha_H + y^*)^2\big] + (1-p)\big[(x^B + \beta_L - y^*)^2 - (x^B - \beta_H - y^*)^2\big] = 0 \end{cases}$$

The Lagrangien becomes :

$$\begin{aligned} \mathcal{L} \ &= \ EL - \lambda\Big[-\ p\, n_H\, \alpha_H + (1-p)\, n_H\, \beta_H - p\, n_L\, \alpha_L + (1-p)\, n_L\, \beta_L\Big] \\ &- \ \delta\Big[p\big[(x^M - \alpha_L + y^*)^2 - (x^M - \alpha_H + y^*)^2\big] + (1-p)\big[(x^B + \beta_L - y^*)^2 - (x^B - \beta_H - y^*)^2\big]\Big] \end{aligned}$$

The resolution of this optimization program allows us to determine the expression of the optimal insurance contract such as :

$$\alpha_H \ = \ \alpha_L = \alpha = x^M \tag{16}$$
$$\beta_H \ = \ \beta_L = \beta = x^B \tag{17}$$

Consequently, we are in the presence of a pooling insurance contract, which means that, in the presence of selection adverse, the central agency can no longer offer dividing contracts to governments.

We then introduced the optimal insurance contracts into the model described in appendix 1 so as to obtain the output gap aim, the deficit aim and the expected losses at the equilibrium with selection adverse (see appendix 3).

4.2 Relevance of the central agency's intervention

Once the optimal insurance contracts are determined, we must study the effects of the insurance contract in comparison with the equilibrium without insurance but also in comparison with the equilibrium with insurance and symmetrical information. In other words, we have to analyze how the presence of a hidden information modifies the equilibrium.

At the equilibrium, the expected losses express as :

$$EL_i = \frac{1}{2} \frac{\gamma_i (1-\gamma_i)}{a^2 (1-\gamma_i)+\gamma_i} (y^*)^2 \tag{18}$$

$$EL = \frac{1}{2} \frac{n_L A + n_H B}{A B} (y^*)^2 \tag{19}$$

Compared with the equilibrium without insurance, it also seems also that the introduction of an insurance contract reduces the expected social loss as well as the expected national losses.

In comparison to the equilibrium with insurance and symmetrical information, it appears that the expected social loss is higher. To study the effect on national expected losses, it is necessary to distinguish two cases according to the nature of the incentive problem.

If $A > B$ that is if the virtuous are tempted to cheat then the selection adverse equilibrium improves their situation. On the contrary, the laxists see their expected loss increase and conversely if $A < B$.

Concluding remarks

In a union of countries subjected to cyclical shocks, the implementation of an insurance scheme can be very relevant. Indeed, countries trying to stabilize their economic situation have to arbitrate between stabilizing their economic situation at the cost of a high deficit or reducing their deficit at the cost of a lesser stabilization. Also, the question is how to insure a better stabilization of the activity while taking care of a certain fiscal discipline. Then, several alternatives are possible such as pressuring countries on their deficit by leaving sufficient room for manoeuvre to let automatic stabilizers play (such is the main purpose of the Stability and Growth Pact within the European Union) or implementing an inter-country insurance mechanism conditional to the national sensitivity for fiscal discipline.

This paper focuses on this second possibility. Indeed, we consider an inter-country insurance scheme in a selection adverse context. Even though the modelization remains extremely simplistic, this study enables to find out some significant results as to the relevance of such a mechanism within a union of countries. Furthermore, these results correspond to results highlighted in the traditional insurance literature.

We build a simplified union model with two power stages. In this union, a stabilization problem arises. This problem is likely to be solved by an insurance mechanism. The national stage determines its optimal deficit whereas the central stage determines an insurance contract adapted to every country type. Crucial information concerns the national sensitivity for fiscal discipline and the central agency conditions its insurance contracts on this information.

We show that, whatever the informational situation, the introduction of an hybrid insurance sheme allows to reduce the expected social loss.

Moreover, if the central agency can perfectly discriminate between governments then the stabilization problem is solved by full insurance whereas the problem of heterogeneousness of national preferences is solved by a payment/fine system. This corrective mechanism which depends on the number of governments of every type and on the dimension of the heterogeneousness of national preferences. If social preferences are close to the virtuous preferences then the virtuous have to pay a fine whereas the laxists benefit from an additional payment. Furthermore, the corrective component is all the higher as national preferences are heterogeneous, and conversely otherwise. Generally speaking, the correction of the national arbitrages of some can be made only by punishing the others because of the budget balanced constraint of the central agency.

On the contrary, if the central agency can not perfectly discriminate between governments then only the problem of stabilization is solved. Again, shocks are totally stabilized by full insurance. Nevertheless, the problem of the heterogeneousness of national preferences is not solved any more as far as the central agency can no longer distinguish the virtuous from the laxists. In a general way, we can't hope to correct national arbitrages by an hybrid insurance scheme when information is asymmetrical. So, it would be preferable to consider that the transfers centralized scheme would come to complement the Stability Pact rather than to substitute for it.

Appendices

Appendix 1 : Equilibrium after introducing the reaction functions

After introducing the national reaction functions in the equilibrium, we can obtain the output gap aim and the deficit aim according to random shock, insurance contract and output gap target :

$$(y_i^M - y^*) = \frac{-\gamma_i}{a^2(1-\gamma_i)+\gamma_i}\,(x^M - \alpha_i + y^*) \tag{20}$$

$$(y_i^B - y^*) = \frac{\gamma_i}{a^2(1-\gamma_i)+\gamma_i}\,(x^B - \beta_i - y^*) \tag{21}$$

$$(d_i^M) = \frac{a(1-\gamma_i)}{a^2(1-\gamma_i)+\gamma_i}\,(x^M - \alpha_i + y^*) \tag{22}$$

$$(d_i^B) = \frac{-a(1-\gamma_i)}{a^2(1-\gamma_i)+\gamma_i}\,(x^B - \beta_i - y^*) \tag{23}$$

Besides, we can get the expression of the national and the central expected loss :

$$EL_i = \frac{\gamma_i(1-\gamma_i)}{a^2(1-\gamma_i)+\gamma_i}\left[\frac{p}{2}\,(x^M - \alpha_i + y^*)^2 + \frac{1-p}{2}\,(x^B - \beta_i - y^*)\right] \tag{24}$$

$$\begin{aligned} EL &= \frac{n_H}{A}\left[\frac{p}{2}\,(x^M - \alpha_H + y^*)^2 + \frac{1-p}{2}\,(x^B - \beta_H - y^*)\right] \\ &+ \frac{n_L}{B}\left[\frac{p}{2}\,(x^M - \alpha_L + y^*)^2 + \frac{1-p}{2}\,(x^B - \beta_L - y^*)\right] \end{aligned} \tag{25}$$

$$\text{with : } A = \frac{[a^2\ (1-\gamma_H)+\gamma_H]^2}{{\gamma_H}^2\ (1-\gamma) + a^2\ (1-\gamma_H)^2\ \gamma}$$

$$B = \frac{[a^2\ (1-\gamma_L)+\gamma_L]^2}{{\gamma_L}^2\ (1-\gamma) + a^2\ (1-\gamma_L)^2\ \gamma}$$

Appendix 2 : The incentive-compatibility constraints

The virtuous incentive-compatibility constraint can be expressed as :

$$EL_H(\alpha_L,\beta_L) - EL_H(\alpha_H,\beta_H) =$$

$$\frac{\gamma_H}{a^2(1-\gamma_H)+\gamma_H}\left[\frac{p}{2}\left[(x^M-\alpha_L+y^*)^2- \quad (x^M-\alpha_H+y^*)^2\right]+\tfrac{1-p}{2}\left[(x^B+\beta_L-y^*)^2-(x^B-\beta_H-y^*)^2\right]\right]$$

The laxists incentive-compatibility constraint can be expressed as :

$$EL_L(\alpha_H,\beta_H) - EL_L(\alpha_L,\beta_L) =$$

$$\frac{\gamma_L}{a^2(1-\gamma_L)+\gamma_L}\left[\frac{p}{2}\left[(x^M-\alpha_H+y^*)^2- \quad (x^M-\alpha_L+y^*)^2\right]+\tfrac{1-p}{2}\left[(x^B+\beta_H-y^*)^2-(x^B-\beta_L-y^*)^2\right]\right]$$

Consequently, if the incentive-compatibility constraint of one type is saturated, then the constraint of the other type is also saturated. Indeed :

$$EL_H(\alpha_L,\beta_L) - EL_H(\alpha_H,\beta_H) = 0 \Leftrightarrow EL_L(\alpha_H,\beta_H) - EL_L(\alpha_L,\beta_L) = 0$$

$$\Leftrightarrow \quad p\left[(x^M-\alpha_L+y^*)^2-(x^M-\alpha_H+y^*)^2\right]+(1-p)\left[(x^B+\beta_L-y^*)^2-(x^B-\beta_H-y^*)^2\right]=0$$

Appendix 3 : Synthesis of the different equilibria

Table 1 gathers the main characteristics of the various studied equilibria :

TABLE 1: SYNTHESIS OF THE DIFFERENT EQUILIBRIA

	Without insurance	Insurance and symmetrical information	Insurance and selection adverse
α_H	0	$x^M + \left[1 - \frac{A}{n_H\ A+n_L\ B}\right]\ y^*$	x^M
α_L	0	$x^M + \left[1 - \frac{B}{n_H\ A+n_L\ B}\right]\ y^*$	x^M
β_H	0	$x^B - \left[1 - \frac{A}{n_H\ A+n_L\ B}\right]\ y^*$	x^B
β_L	0	$x^B - \left[1 - \frac{B}{n_H\ A+n_L\ B}\right]\ y^*$	x^B
$(y_i^M - y^*)^2$	$\left(\frac{-\ \gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ (x^M + y^*)\right)^2$	$\left(\frac{-\ \gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ \frac{X}{n_H\ A+n_L\ B}\ y^*\right)^2$	$\left(\frac{-\ \gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ y^*\right)^2$
$(y_i^B - y^*)^2$	$\left(\frac{\gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ (x^B - y^*)\right)^2$	$\left(\frac{-\ \gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ \frac{X}{n_H\ A+n_L\ B}\ y^*\right)^2$	$\left(\frac{-\ \gamma_i}{a^2\ (1-\gamma_i)+\gamma_i}\ y^*\right)^2$
$(d_i^M)^2$	$\left(\frac{a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ (x^M + y^*)\right)^2$	$\left(\frac{a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ \frac{X}{n_H\ A+n_L\ B}\ y^*\right)^2$	$\left(\frac{a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ y^*\right)^2$
$(d_i^B)^2$	$\left(\frac{-\ a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ (x^B - y^*)\right)^2$	$\left(\frac{a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ \frac{X}{n_H\ A+n_L\ B}\ y^*\right)^2$	$\left(\frac{a\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\ y^*\right)^2$
EL_i	$\frac{1}{2}\frac{\gamma_i(1-\gamma_i)}{a^2(1-\gamma_i)+\gamma_i}\left[p\ (x^M)^2 + (1-p)\ (x^B)^2 + (y^*)^2\right]$	$\frac{1}{2}\frac{\gamma_i\ (1-\gamma_i)}{a^2\ (1-\gamma_i)+\gamma_i}\left(\frac{X}{n_H\ A+n_L\ B}\right)^2\ (y^*)^2$	$\frac{1}{2}\frac{\gamma_i(1-\gamma_i)}{a^2(1-\gamma_i)+\gamma_i}(y^*)^2$
EL	$\frac{1}{2}\ \frac{n_L\ A+n_H\ B}{A\ B}\ \left[p\ (x^M)^2 + (1-p)\ (x^B)^2 + (y^*)^2\right]$	$\frac{1}{2}\ \frac{1}{n_H\ A+n_L\ B}\ (y^*)^2$	$\frac{1}{2}\frac{n_L\ A+n_H\ B}{A\ B}\ (y^*)^2$

with $A = \frac{[a^2\ (1-\gamma_H)+\gamma_H]^2}{{\gamma_H}^2\ (1-\gamma)+a^2\ \gamma\ (1-\gamma_H)^2}$ and $B = \frac{[a^2\ (1-\gamma_L)+\gamma_L]^2}{{\gamma_L}^2\ (1-\gamma)+a^2\ \gamma\ (1-\gamma_L)^2}$

with $X = A$ for the virtuous and $X = B$ for the laxists

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