

Barbone, Luca; Poniatowski, Grzegorz

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Post-crisis lesson for EMU governance from the principal-agent approach

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Post-Crisis Lesson for EMU Governance from the Principal-Agent Approach

Luca Barbone
Grzegorz Poniatowski

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CASE-Center for Social and Economic Research on behalf of CASE Network
al. Jana Pawła II 61, office 212, 01-031 Warsaw, Poland
tel.: (48 22) 206 29 00, 828 61 33, fax: (48 22) 206 29 01
e-mail: case@case-research.eu
<http://www.case-research.eu>

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Luca Barbone is the President of the CASE Management Board since 2011 and a Senior Fellow at the Institute for the Study of International Migration at Georgetown University (Washington, DC). He received his PhD in economics from the Massachusetts Institute of Technology. He worked for the World Bank from 1988-2011, where he was the Director in the Poverty Reduction and Economic Policy Unit in the Europe and Central Asia Regional Office (2007-2011), World Bank Director for Poverty Reduction (2004-2007), and Regional Director for Ukraine, Moldova and Belarus (2000-2004). Prior to the World Bank, he worked for the Organization for Cooperation and Development (Paris), the International Monetary Fund, The Planning Institute of Jamaica, and the Bank of Italy. He has over 25 years of experience in policymaking and analysis. His main areas of research interest include: (i) economic crisis and growth prospects; (ii) economic consequence of long-term demographic trends; (iii) migration and development; (iv) fiscal institutions, fiscal consolidation; and (v) social cohesion and political economy of reforms in Europe and Central Asia. He has published extensively in these areas.

Grzegorz Poniatowski is a Junior Economist at CASE and a PhD candidate at the Warsaw School of Economics. He holds a joint Master's degree in Economics from the University of Paris-1 Pantheon-Sorbonne and the Autonomous University of Barcelona. He also completed an MA and BA in Quantitative Methods in Economic and Information Systems at the Warsaw School of Economics. His research interests include mathematical modeling, macroeconomics and mechanism design.

Abstract

This paper contributes to the ongoing debate on fiscal consolidation and the questionable effectiveness of the Stability and Growth Pact by addressing the problem of economic governance in the EMU with a game-theoretic principal-agent approach. Following the theory of delegation, we develop a principal-multi agent model where the EMU authorities act as a collective principal that designs contracts for each of two agents that reflect Europe's "South" and "North". We investigate what happens when agents face hidden-information moral hazard problem and when they are able to coordinate their actions. Bearing in mind the applicability of incentive mechanisms, we discuss the optimal contracts for the principal and each of the agents. We prove that the most efficient solution consists of tailor-made contracts, according to which highly indebted countries must be offered strong incentive mechanisms in the form of substantial penalties but also rewards (e.g., preferential loans). We also stress the importance of taking into account positive spillover effects, which could be facilitated by economic integration and fiscal policy coordination between the EMU Members.

1. Introduction¹

The global financial crisis has revealed serious weaknesses in the design of the current economic governance framework in the European Monetary Union (EMU). The weak and in practice unenforceable fiscal rules laid down in the Stability and Growth Pact did not prevent some of the Member Countries from being tempted to free-load by exploiting common credibility. Knowing that the entire Union will share in the burden of their decisions, they can use private information about the condition of their economies to run excessive debts. With the backing of more disciplined countries, the undisciplined put themselves at the edge of bankruptcy - and the EMU at the edge of a precipice.

This paper addresses these problems and, following the theory of delegation, applies a formal principal-multi agent model that provides a useful parable for the current situation in the EMU.

The possibility of reforming EU governance with suggestions stemming from the principal-agent approach has been addressed in a number of political economy articles. According to Hodson (2009), limited progress by some member states in achieving fiscal discipline is due to tensions within the collective principal and the weakness of ex-post sanctions. Promoting alignment of interests between the principal and the agents, as well as encouraging fire-alarm oversight at the member-state level could be a solution to the problem of moral hazard. Schuknecht (2004) finds that self-enforceability of fiscal rules could be achieved with monitoring the public and markets. Moreover, fiscal rules need to be devised to find political support while retaining simplicity and clarity. Escape clauses from the simple 3% deficit threshold are in line with these findings, ensure fine-tuning and implementation of the entire mechanism.

Following the theory of delegation, we apply a more formal approach to the problem and build a principal-multi agent model (for an alternative see Schelkle (2005), where monetary union authorities act as a collective principal that designs contracts for each of two agents that reflect Europe's current "North" and "South" (we adopt this terminology purely for illustrative purposes, and without normative judgements about the effects of geographic location on economic behaviour). Once the contract offered by the principal has been signed, the agents cannot breach it. After signing the contracts, the agents observe current economic market conditions, which are independently distributed among them, and use them as their private information when deciding on the effort they would exert. Since countries are affected by each others

¹ Corresponding author Grzegorz Poniatowski. Email address: grzegorz.poniatowski@case-research.eu

policies in the form of spill-overs, at this stage they play a game, whose results will be crucial for the fiscal consolidation effort they perform.

With this approach we help shed light on the conclusions that can be evince from the ongoing governance crisis: the design of European Fiscal Compact² and the European Stability Mechanism are only partly in line with effective mechanisms for the design of incentives for the EMU Member States that the agency theory suggests.

Keeping in mind the limited applicability of certain types of incentive mechanisms, we develop optimal contracts for each of the agents. We show that by offering the same contracts to all countries, EMU authorities demand less effort than would be required for tailor-made contracts. We prove that countries that find it more painful to limit their debt burden must be offered stronger incentive mechanisms, not only as severe punishments but also in the form of rewards, for instance preferential loans. We analyse what happens when agents are able to coordinate their actions. In this case, in order to take advantage of positive spill-over effects and secure a better position to apply their expansionary tendencies, agents will be more willing to exert less effort once either a positive or negative shocks appears. We show that this will increase the efficiency of contracts, if the principal takes into consideration the fiscal consolidation effort exerted by the other party. In our conclusions, we summarize these observations and we attempt to determine which realistic options could be used to support the current EMU fiscal framework.

2. Agency perspective in the EMU

Delegation of tasks, conflicting objectives and asymmetric information are basic ingredients of the theoretical principal and agent relationship. The presence of these elements in the relationship between currency area authorities and member countries was identified in the economic literature earlier, but became much more visible after the global financial crisis. Even though EMU authorities are directly or indirectly elected by national governments and to some extent dependent on them, the literature sees the problem of delegation working primarily one-way. The troubled experience of last few years with the functioning of the EMU suggests that when analysing the design of currency areas we might benefit from the principal-agent approach, in which the EMU authorities act as a principal and the Member States are perceived as agents.

² Treaty on Stability, Coordination and Governance in the Economic and Monetary Union

To answer the question on how to design EMU institutions in order to provide good incentives for the Member States we need to identify rationale and characteristics of the principal-agent theory behind the EMU's case. The starting point will be to discuss conflicting objectives, i.e. the reasons why extensive deficits and growing imbalances between the EMU Member States arise.

2.1. Economic reasoning behind extensive deficits

Even without the special incentives that membership in a currency area gives, there are several reasons why countries may run excessive and time-inconsistent deficits. Some of the factors push governments to borrow extensively irrespective to their economic situations, others support either pro-cyclical or counter-cyclical fiscal policy. Selecting those which account for unwanted, time-inconsistent procyclical deficits would be important for building the optimal incentives mechanisms.

One of the reasons for running deficits was diagnosed by Barro (1979) with the so called "tax smoothing model". According to the model, budget deficits and surpluses serve as a cushion that buffers low and high private spending in the economy. Since keeping government tax rates constant increases stability and induces private activity, governments adjust only the amount of their spending. Thus, with constant tax rates budget deficits are higher during negative shocks. But what according to Barro is a reason for running deficits in hard economic times, supports the idea of the optimality of counter-cyclical policies rather than explaining the procyclical tendencies of some EMU Member States.

Why governments are tempted by increased spending during sound economic times is explained partially by the concept of fiscal illusion reexamined in Buchanan and Wagner (1977). According to this idea, the public does not understand government budget constraints and believes in the sustainability of overestimated expenditures and underestimated revenues. A strong desire to be re-elected pushes ruling governments to take advantage of the asymmetry of information to win over voters, thus ending with debts. A ruling government is thus never willing to run surpluses, neither during recessions, nor recoveries. Alesina and Tabellini (2005) go a step further and prove that an environment of corruption and imperfect information leads to favors paid by governments to special interests mostly during the booms. Another political economy factor that can support pro-cyclical fiscal policy is the electoral cycle. Nordhaus (1975) notes that voters reward the politicians that attract them with expansionary policies without bearing in mind that pre-electoral expansionary policies will not be followed by the "necessary" budget surpluses.

Although there exist several factors behind the pro-cyclical tendencies of fiscal authorities, an overall conclusion can be drawn: countries with less developed institutions, larger asymmetries of information between governments and the public and higher levels of debt will find it harder to resist the temptation to run excessive deficits (for empirical results see e.g. Gavin and Perotti (1997)).

2.2. Extensive deficits: the evidence from global financial crisis in EMU

In a currency area the factors leading governments to run excessive deficits are even more numerous. The tendency of countries to increase their debt becomes stronger when they are confronted with common credibility and responsibility for actions. In this case, one of the major concerns is moral hazard, i.e. the temptation to exploit other member states that in any case will have to bear the cost of, e.g. lost reputation and rescue packages while not taking too much advantage of short-term expansionary fiscal policies run by some misbehaving countries.

The second major concern and obstacle that hinders sustainable fiscal policies of currency areas members lies in the imbalances that exist among them. Less wealthy economies, with weaker institutions, find it harder to resist the temptation to run excessive deficits. "Being insured" by the membership in a currency area without a proper incentive mechanisms can only increase such discrepancies.

What might happen when a group of countries with large imbalances faces a "common credibility" incentive in bad times has been clearly shown by the global financial crisis. Greece, Spain and Portugal were the countries whose central government debt rose by over 30 percentage points of GDP during 2007-2011. In fact, these countries not only increased indebtedness during the crisis, but they increased their deficits or kept them at a very high level in sound economic times before 2007. This group includes: Greece, Malta and Portugal. Figures presenting the behaviour of the ratio of central government debt to GDP in the Old and New Member States are presented in Table 1.

Table 1: Central government debt to GDP in the EMU Member States (percentage points)

	2001	2007	2009	2011	$\Delta(2007-2001)$	$\Delta(2011-2007)$
Euro area	68.2	66.4	80	87.3	-1.8	20.9
Old Member States						
Austria	66.8	60.2	69.2	72.4	-6.6	12.2
Belgium	106.5	84	95.7	97.8	-22.5	13.8
Finland	42.5	35.2	43.5	49	-7.3	13.8
France	56.9	64.2	79.2	86	7.3	21.8
Germany	59.1	65.2	74.5	80.5	6.1	15.3
Greece	103.7	107.4	129.7	170.6	3.7	63.2
Italy	108.2	103.3	116.4	120.7	-4.9	17.4
Ireland	35.2	25.1	64.9	106.4	-10.1	81.3
Luxembourg	6.3	6.7	15.3	18.3	0.4	11.6
Netherlands	50.7	45.3	60.8	65.5	-5.4	20.2
Portugal	53.8	68.4	83.2	108.1	14.6	39.7
Spain	55.6	36.3	53.9	69.3	-19.3	33
New Member States (joined EMU after 2001)						
Cyprus	61.2	58.8	58.5	71.1	-2.4	12.3
Malta	60.5	61.9	67.6	70.9	1.4	9
Slovenia	26.5	23.1	35	46.9	-3.4	23.8
Slovakia	48.9	29.6	35.6	43.3	-19.3	13.7

Source: Eurostat (2001:2011)

For fairness' sake, it should be noted that the steady increase of public debt was not limited to "Periphery" Member States but also included France and Germany. This suggests that the geographical pattern of prudent North and imprudent South could be regarded as questionable (see Dabrowski (2012)). On the other hand, there is a difference in the mechanism that has driven debt of the majority of countries of the core. Austria, Belgium, Finland, Luxembourg and the Netherlands give more positive evidence of counter-cyclical policy as they were able to keep their public debt in check before 2007 and to have a buffer for expansionary fiscal policy in the crisis.

2.3. The need for proper rules

Economic theory suggests two kinds of solutions to the free-rider problem in a collective action and hidden information environment. Because in such a problem participants' individual gains are matched by common losses, a first type of solution should consist of an incentive mechanism that prevents exploiting the group's utility if losses are to be minimized. Incentive mechanisms in the form of rewards and punishments could prevent agents from performing undesirable actions. Such incentives, however, must be applicable, enforceable and credible.

Discretionary actions might not meet these tests, and in real life agents might have to be forced to obey strict and simple rules.

Since the main problem lies in the fact that the activity of the participants in the action cannot be verified, reducing asymmetry of information is a second type of solution that could be a tool to support the efficiency of such rules. In the optimal outcome a contract offered by the principal must exploit all available information about agents. In the agency framework, when either a type (e.g. how costly it is for country's government to employ contractionary fiscal policy) or the level of effort of relevant agents is unknown, the principal may implement investigation mechanisms. These mechanisms provide additional information and increase the chance of discovering agents' private information. In EMU economic governance the obligation to report, national accounting standards or Macroeconomic Imbalance Procedure could be regarded as such surveillance mechanisms.

The evidence of the global financial crisis shows that in a currency area we may face a typical free-rider problem of a collective action and hidden information environment that could be analysed in the principal-agent framework. We may assume that EMU institutions act as a collective principal whose goal is to ensure the smooth working of the entire union.³ Institutions, however, do not have a good knowledge about the state of the economy in the Member States. This is why the 'principal' does not know how much effort each of their agents should exert. The knowledge of the EMU institutions is limited to observing the overall economic situation in Member States. On the other hand agents, i.e. governments of the Member States, tend to exert as little effort as possible when not being punished by the principal. Prudent fiscal policy could be thought as the costly work that agents want to limit.

The current EMU governance envisages a policy that resembles the first solution to the free-rider problem described at the beginning of this section. The most important role, next to surveillance mechanisms, in the existing incentives framework in the EMU governance in preventing countries from excessive indebtedness, is played by the incentives mechanisms laid down in the Stability and Growth Pact (SGP). Hodson (2009, p. 460) describes this pact as a 'framing agreement' that includes not only government debt and deficit limits, but also the circumstances under which budget deficits may temporarily exceed Maastricht thresholds. The aim of the SGP, through both police-patrol oversight and sanctions, is to ensure that fiscal policy is conducted in a sustainable manner over economic cycles. Non-compliance with the Pact can in principle lead to sanctions on offending EMU Member States. Countries placed in

³ However, the fact that most of the EMU Member States have breached Maastricht fiscal criteria without being penalized is an evidence that because of inappropriateness of the concept of EMU institutions and their powers, the European Commission may not always be interested in the enforcement of rules (i.e. ensuring the smooth working of the entire union).

the so called Excessive Debt Procedure are given a deadline to comply with recommendations of the European Commission. Euro area Member States in non-compliance may face a sanction in the form of a non-interest-bearing deposit of 0.2% of GDP. Further imposition or strengthening of sanctions may take form of a fine of 0.2% of GDP and temporary suspension of financing from Cohesion Funds.

Since the inception of the financial crisis of 2008, the economic situation in the Eurozone has focused the attention on the need for proper incentive mechanisms, leading to the strengthening of the preventive and corrective arms of the Pact in 2011. Nevertheless, although the majority of countries did not comply with Maastricht criteria before and during the crisis, serious sanctions were never applied to any Member State. What is more, when the financial crisis evolved into fiscal crisis in the "Periphery" countries, the European Financial Stabilization Mechanism and European Financial Stability Facility offered substantial financial assistance to those countries that had breached the fiscal rules.

It seems obvious that such a governance framework is unlikely to provide incentives for fiscal probity, and might in fact be at the root of the current problems of the EMU. At a time when a new mechanism of EU economic governance is being implemented, it is then appropriate to evaluate possible advantages and disadvantages of the new solution. The European Fiscal Pact, which has been ratified by most of the Member Countries, puts into force new and stricter fiscal rules: a 3% limit to the general budget deficit to GDP, 1% for a structural deficit and 60% for debt. Stronger rules assume stricter enforceability of sanctions of breaching the rules. In the new framework, financial penalties are envisaged for rule-breaking, and they can amount to 0.1% of countries' GDP. Support to adhere to stricter fiscal rules will be given by the conditionality of the new European Stability Mechanism. EMU Member States that ratified European Fiscal Compact will be eligible for financial support only when obeying fiscal rules.

Can this governance framework create a sufficient incentive to reduce imbalances and assure sustainable fiscal policy in the Member States? What is the framework of the contracts that the formal principal-multi agent suggests? Could we benefit from the approach and figure out implementable amendments to the current mechanism?

3. The model

3.1. Timing scheme and moral hazard

For simplicity of results we apply the classical way of representing moral hazard (Holmstrom, 1979). Since the moral hazard in the EMU arose from both lack of information between EMU authorities and also from ineffectiveness of sanction and correction mechanisms, we do not analyse agents' expectations on credibility of these mechanisms. In our opinion the problem of unreliability of sanctioning must be solved unconditionally to the solution of the moral hazard arising due to informational asymmetry, which is analysed in the presented framework.

Informational problems arises in the model from the fact that after a contract is set, only the agents can observe the state of "nature". As an example, we can think of income shocks randomly experienced by economies. We assume that neither agents nor principal can influence the nature of these idiosyncratic shocks. Because of the information problem and assumption that shocks influence the effort that agents exert, the principal cannot verify directly what action has been performed by agents. We assume that the principal observes only the overall state of public finance of the agents, i.e. the sum of exerted effort and random shocks. The timing scheme of the model is presented in Figure 1.

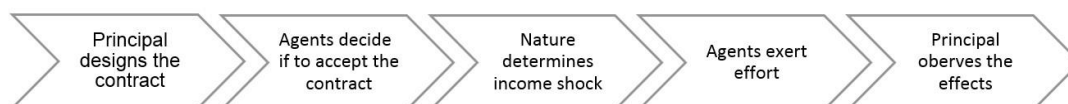


Figure 1: Timing scheme of the model

First, the principal - the European Commission (EC)- draws contracts for each of two agents: prudent "North" and imprudent "South". Since it does not know what will be the state of the nature, it can only design a contact contingent on the overall future state of public finance. The information the EC has is imperfect but, since it is aware of the reputation of the agents, it is not incomplete. The principal knows what might be the influence of shocks and what effects exerted effort may have on public finance. Thus, the EC may attempt to design a contract that enforces compliance with the desirable effort. In the next step, agents, without knowledge of the future state of their economies, decide if to accept the contract or not. What follows is realization of shocks and, contingent to this, the effort exerted by agents. In the final stage the principal observes the outcome and agents' pays-off.

3.2. Assumptions

We assume that there are two types of shocks that may influence each of the agents separately, positive (ϕ^G) and negative ($\phi^B, \phi^G > \phi^B$). We also presume that desirable effort exerted in a good state (e_*^G) is more than the one that is required during the negative shock (e_*^B). This assumption reflects counter-cyclical policy, i.e. tightening budgets in sound economic times and loosening them during periods of stress. The overall effect on public finances might be expressed by the equation: $E = e + \phi$. We use classical method of risk-averse agent utility representation - increasing concave utility function ($u'(x) > 0, u''(x) < 0$). The utility of agents is due to rewards given by the principal - the EMU institutions. We assume that the utility function has the same form for all of the agents. On the contrary we assume that "bad" agents find it harder to perform effort than "good ones" ($\forall e, v_S(e) > v_N(e), \forall e, v'_S(e) > v'_N(e)$). Without losing generality properties of the effort function are as follows: $v'_*(e) > 0$ (increasing) and $v''_*(e) = 0$ (linear) (for similar representation see e.g. Macho-Stadler and Perez-Castrillo (2001), Laffont (2002)).

In the model we employ spill-over effects between economies. These, spillovers either support or hinder effort performed by other agents. They stem from the fact that expansionary fiscal policy equivalent to low fiscal effort generates additional demand in neighboring open economies. That is why, we assume that spill-over effects are an element of effort function of other agents. It is such that: $v_N(e_N, E_S)$ (for agent N) and $v_S(e_S, E_N)$ (for agent S). The effort function is positive on the entire domain, decreasing and linear with respect to observed effort of the other agent. For simplicity, we assume that gains from spill-over effects for particular policy of neighbor country ("country B") are the same no matter what effort "Country A" performs. This is equivalent to $v_N^{e_N, E^S}(e_N, E_S) = 0$ and $v_S^{e_S, E^N}(e_S, E_N) = 0$

3.3. The optimal contract

The problem of the principal is following:

$$\begin{aligned} \max \{ & qp(e_N^G + \phi^G - w_N^G; e_S^G + \phi^G - w_S^G) \\ & + (1-q)(1-p)(e_N^B + \phi^B - w_N^B; e_S^G + \phi^B - w_S^B) \\ & + q(1-p)(e_N^G + \phi^G - w_N^G; e_S^B + \phi^B - w_S^B) \\ & + p(1-q)(e_N^B + \phi^B - w_N^B; e_S^G + \phi^G - w_S^G) \} \quad (1) \end{aligned}$$

where q and p denote probabilities of positive shocks respectively for the North and South.

The equation says that a risk neutral principal wants to maximize the expected economic soundness of both agents having the same share in the maximization function. The equation assumes that agents will apply policy contingent to the expectation of the principal - fiscal effort e^G when shock ϕ^G and e^B when ϕ^B .

The principal must however assure that agents will accept the contract. When deciding whether to sign the contract or not agents will judge by the expectation of their final utility. If it exceeds their reservation utilities, contract will be signed. This constraint might be perceived as a political applicability of the mechanism. Equations describing participation constraint for the North (2) and South (3) take the form:

$$\begin{aligned}
 & qp(u(w_N^G) - v_N(e_N^G, E_S^G)) + (1-q)(1-p)(u(w_N^B) - v_N(e_N^B, E_S^B)) \\
 & + q(1-p)(u(w_N^G) - v_N(e_N^G, E_S^B)) + p(1-q)(u(w_N^B) - v_N(e_N^B, E_S^G)) \\
 & \geq \bar{U}_N \quad (2)
 \end{aligned}$$

$$\begin{aligned}
 & qp(u(w_S^G) - v_S(e_S^G, E_N^G)) + (1-q)(1-p)(u(w_S^B) - v_S(e_S^B, E_N^B)) \\
 & + q(1-p)(u(w_S^B) - v_S(e_S^B, E_N^G)) + p(1-q)(u(w_S^G) - v_S(e_S^G, E_N^B)) \\
 & \geq \bar{U}_S \quad (3)
 \end{aligned}$$

$\bar{U}_N$ and $\bar{U}_S$ represent respectively reservation utility of the North and South.

As mentioned in the previous section, since agents are rewarded according to the economic situation they face, for some remuneration schemes they will face incentives to cheat the principal, i.e. to lie about the type of shock they experienced. To be sure of that, the principal must apply incentive compatibility constraints (ICC) in the design of rewards. She must take care of incentives for both agents and for two types of possible shocks. Because of the interdependence of agents, the decision of the agents on which policy to apply (low or high effort) is a game of two. Since agents know their economic situation before they apply policies, it might be perceived as a possibility of four deterministic games for all the possible "nature" outcomes. These games in normal form are presented in Appendix A.

The tables in the Appendix I present payoffs of agents performing particular policies in each of the types of shocks. To be sure that agents would perform the desired policy the principal must ensure with its wage scheme that a Nash equilibrium obtains in N(true)/S(true). Our

assumptions however reduce strongly the difficulty of the problem. We presumed that spillovers contribute to agent's policy with the same strength no matter what shock it faces ($v_*^e, E(e, E) = 0$) and that North is more willing to cheat when providing more effort and South for providing it less. We ended up with two (ICC) constraints for each of the agents:

$$u(w_{N/S}^G) - v_{N/S}(e_{N/S}^G, *) \geq u(w_{N/S}^B) - v_{N/S}(e_{N/S}^B - \phi^G + \phi^B, *) \quad (4)$$

$$u(w_{N/S}^B) - v_{N/S}(e_{N/S}^B, *) \geq u(w_{N/S}^G) - v_{N/S}(e_{N/S}^G + \phi^G - \phi^B, *) \quad (5)$$

All in all, the optimal contract is a solution to maximization problem with six constraints that could be solved with use of Karush-Kuhn-Tucker conditions (KKT). The set of KKT conditions is presented in Appendix B.

3.4. Solution

The problem of finding the optimal contract has one solution, in which only one ICC is binding. The optimal contract must consider binding only the incentive assuring that the South would be willing to exert less effort than the principal requires ($\mu_4 > 0$).

The following set of equations describe the optimal solution:

$$\begin{aligned} & (v_N^{eN}(e_N^B, *) - v_N^{eN}(e_N^B - \phi^G + \phi^B, *)) \left(\frac{q}{u'(w_N^G)} - \frac{q}{u'(w_N^B)} \right) \\ & + \frac{v_N^{eN}(e_N^B, *)}{u'(w_N^B)} + \left(p + \frac{(1-p)u'(w_S^G)}{u'(w_S^B)} \right) v_S^{eN}(*, E_N^G) = 1 \end{aligned} \quad (6)$$

$$\begin{aligned} & (v_S^{eS}(e_S^B, *) - v_S^{eS}(e_S^B - \phi^G + \phi^B, *)) \left(\frac{p}{u'(w_S^G)} - \frac{p}{u'(w_S^B)} \right) \\ & + \frac{v_S^{eS}(e_S^B, *)}{u'(w_S^B)} + \left(q + \frac{(1-q)u'(w_N^G)}{u'(w_N^B)} \right) v_N^{eS}(*, E_S^G) = 1 \end{aligned} \quad (7)$$

$$\frac{v_N^{eN}(e_N^G, *)}{u'(w_N^G)} + \left(p + \frac{(1-p)u'(w_S^G)}{u'(w_S^B)} \right) v_S^{eN}(*, E_N^G) = 1 \quad (8)$$

$$\frac{v_S^{eS}(e_S^G, *)}{u'(w_S^G)} + \left(q + \frac{(1-q)u'(w_N^G)}{u'(w_N^B)} \right) v_N^{eS}(*, E_S^G) = 1 \quad (9)$$

Equation (6) and (7) describe how much effort should be required from the agents when negative income shock appears. Because all three components of the sum in each of the equations must be positive, we know that $v_{N/S}^{e_{N/S}}(e_{N/S}^B, *) < u'(w_{N/S}^B)$.

This inequality shows that the wage of the contract is inefficient with respect to the performed effort. If agents' effort were perfectly verifiable and there were no spill-over effects we would be able to require more effort with lower wage ($v_{N/S}^{e_{N/S}}(e_{N/S}^B, *) = u'(w_{N/S}^B)$). From the equation we conclude that it must be true that the contract is less efficient for the South. The larger the difference between cost of the effort for the agents and probability of positive shocks higher, the less efficient contracts are.

Equations (8) and (9) determine effort of optimal contracts during negative income shocks. For these periods, if there were no spill-overs, contracts would be efficient with respect to the effort. Because of spill-overs we have that $v_{N/S}^{e_{N/S}}(e_{N/S}^G, *) < u'(w_{N/S}^G)$. Thus, the required effort must concern additional disruptions caused by economies dependence. Factor that influences inefficiency of contracts is probabilities of positive shocks. The higher they are, the less effort could be exerted.

An illustration of the solution to the problem is presented in Figure 2. *NS* and *PS* stand for, respectively, 'negative' and 'positive shock'. These lines show optimal

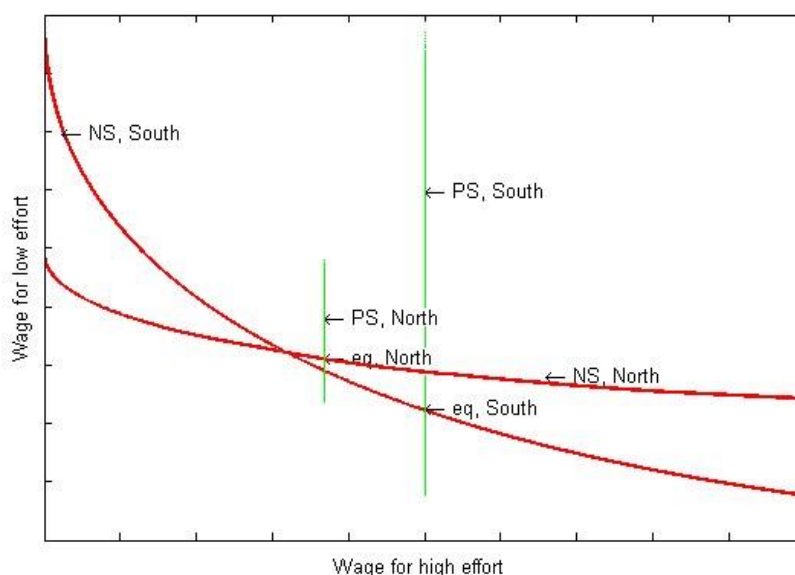


Figure 2: Illustration of the optimal contract

wage for high and low effort in both bad and good economic conditions that optimize utility of the principal. The green lines reflecting optimal contracts for positive shocks are perpendicular to the axis of wage for high effort. Since by assumptions EMU authorities (the principal) are

risk neutral and EMU Member States (the agents) are risk averse, without presence of moral hazard red and green lines would be straight as well and perpendicular to red ones. Because of the presence of moral hazard during negative shocks illustrated by red lines wages for different levels of effort negatively depend on each other. This is due to the distortion - necessary incentive that prevents agents from "lying" that they experienced a negative shock. Namely, it would not be optimal for the principal to e.g. simultaneously reduce payment for low effort and not increase for high if he knew that this change would encourage agents to start lying.

At the intersection of these two lines, when wages optimizing behaviour in positive and negative shocks are equal, participation and incentive constraints are satisfied and principal utility is optimized. The graphical illustration in Figure 2 presents the case when the same level is required from both agents. The coordinates of these points show that 'bad' agents need stronger incentive mechanisms to comply with the rules. In a typical situation, when comparing to North, South receives in a good economic conditions and as less in bad ones. As this creates more incentive for 'bad' agent not to mislead the principal, the difference of wages for a good and low effort is higher for South. Because the graph illustrates only positive rewards for the same effort required, the optimal incentive mechanism for a monetary union would have to be different. For the purpose of maintaining a sufficiently strong incentive mechanism and keeping union's budget in track, the principal should penalize for low effort and reward when it is high. Less efficient agents should be subject to more drastic penalties and higher rewards.

3.5. Coordination between agents

We show how the optimal solution changes when agents are able to coordinate their actions. We might assume different extent of coordination, which could be seen in the model by agents either:

- sharing common participation constraint,
- sharing common utility and effort function,
- experiencing the same type of shock by both agents (either both agent experience a negative or positive shocks),
- being able to choose Nash equilibrium that maximizes sum of payoffs for both agents.

Bearing in mind that in practice perfect coordination would require transfers of payoffs from one country to another when experiencing different types of shocks, we assume the highest possible extent of coordination. For simplicity we take example in which agents share common participation constraint, utility and effort functions. We assume that either two agents receive a positive shock or a negative one. This is equivalent to the case of principal-single agent version of non-coordination with two possible types of shocks affecting "common" economy. In such case the optimal solution would be:

$$(v'(e^B) - v'(e^B - \phi^G + \phi^B)) \left(\frac{P}{u'(w^G)} - \frac{P}{u'(w^B)} \right) + \frac{v'(e^B, *)}{u'(w^B)} = 1 \quad (10)$$

$$\frac{v'(e^G, *)}{u'(w^G)} = 1 \quad (11)$$

where P stands for probability of a positive shock, e exerted effort, ϕ income shock and w - payment from the principal for the entire-two countries economy.

In the optimal contract for payment in a good state characterized by equation (11) demanded effort is efficient with respect to common payment. In bad state principal must still require less than efficient common effort. However, comparing to the situation in which economies were treated separately it requires even higher incentives payments from the principal during both positive and negative shock. This directly stems from the comparison of solutions in non-coordinated and coordinated environment and due to assumption:

$$v'(e) = v_N^{eN}(e_N, *) + v_S^{eS}(e_S, *) + v_N^{eS}(*, E_S) + v_S^{eN}(*, E_N). \quad (12)$$

Such a mathematical form of coordination could represent a situation in which countries have very close economic relations and condition each other's fiscal policies. Strong economic cooperation might be seen as e.g. strong common market or substantial amount of Foreign Direct Investment. On the other hand, fiscal policy coordination requires political cooperation of ruling governments.

4. Conclusions and policy implications

In this paper we have addressed the problem of moral hazard among EMU Member States and how it affects the efforts required to contain or reduce debt and apply sustainable counter-cyclical fiscal policy. A formal principal-multi agent model that illustrates the current situation in the EMU, shows that there is need for further reform of EU governance. Our model shows how the relationship between European Commission and EMU Member States fits very well a

simplified principal-multi agent framework. We thus review some of the current European Commission's macroeconomic policies as incentive schemes and surveillance mechanisms. With this approach, we point out some of the reasons for the current problems of the EMU and contribute to the ongoing debate on the fiscal consolidation and questionable effectiveness of the Stability and Growth Pact.

The formal principal-multi agent analysis of the incentives mechanisms in the EMU suggests that the Member States should be given continuous, strong and credible encouragement to overcome the temptations of moral hazard.

The model shows how valuable information about actual states of individual economies is in the agency framework. Delegation of tasks to agents who have different objectives than the principal is easier to optimize when agents have only different objective functions. If this is the case and agents have no private information, the principal could design a contract which perfectly controls the agent. However, if the agents have private information, designing such contract is no longer possible without loss of efficiency. In the EMU design strong measures should be taken to reduce asymmetry of information between the central and local institutions. This could be achieved by further development of control and surveillance mechanisms like such as the Macroeconomic Imbalance Procedure.

We also argue that the EU institutions should focus on giving much stronger and more credible incentives to reduce deficits during sound economic times. As the principal-multi agent model shows, the incentives should be executable without delays. At present, the Excessive Debt Procedure and Macroeconomic Imbalance Procedures take very long and hinder punishing countries when such needs appear. Therefore, the current policy is both too weak and time-inconsistent. Strict rules should imply that breaching them must cause direct consequences. Our model suggests that countries that find it more difficult to reduce their debt should be given stronger incentives mechanisms: Member States with higher government debt burdens should be subject to separate incentive schemes. Such incentives would include significantly higher rewards and stronger punishment.

As far as rewards are concerned, preferential loans and guarantees already assumed in the European Stability Mechanism seem to be an efficient solution. When it comes to punishment, the EMU Member States should be subject to financial losses in form of, e.g., EU funds.

In recent years there were several reforms proposed to facilitate the EMU problem of reducing the debt of the Member States. To these kind of solutions belongs e.g. the Blue Bond Proposal by Delpla and von Weizsaecker (2010). According to this proposal, sovereign debt in euro area countries is to be split into two parts: guaranteed (blue) and with a high interest rate burden

(red). Overcoming short-term problems is very important, although there is a need to introduce measures which will create stronger incentives to solve the problem in long-term. We claim that the implementation of efficient, tailor-made incentive schemes would strongly support such necessary solutions focused mostly on short-term. Such solution would be also more efficient than current country-specificity in excessive debt procedures. Although the intuition of these procedures might seem similar assuring compatible effort, such screening hinders automatic imposition of penalties and is time-inconsistent with the moment of verified fiscal effort.

Importantly, EMU governance has been significantly reinforced after the year 2011. The thrust of the reforms that have been implemented is however only partially in line with our findings. According to the assumptions of our model, time consistency of reward mechanism and credibility of rewards scheme are a necessary assumption to obtain full-efficiency of contracts between a principal and agents. After the introduction of the "six-pack", EU governance has substantially gained in this scope. The time period of possible appearance of first sanctions for non-compliance with fiscal rules was significantly reduced. Member States can now be punished with non-interest bearing deposit after just one year after reporting (comparing to 4 years in the previous framework). The automaticity that is crucial for the credibility of the scheme was improved by introducing reversed qualified majority voting. On the other hand, by the corrective regulations countries are obliged to reduce their debt in excess of 60% of GDP by one twentieth per year. For fiscally weaker countries it creates a necessity to exert more effort than for prudent Member States while penalties are maintained the same costly for all. Such solution contradicts results presented in this paper.

There are obvious difficulties in implementing our recommendations on tailor-made contracts first and foremost the cherished principle of equal treatment among EU members. We also keep in mind another problematic issue - difficulty of implementing country-specific solutions. This problem could be solved by negotiations carried out in a similar manner to the negotiations on the EU budget perspectives, but political feasibility and tactics are outside the purview of our paper.

With the model we also arrived at some secondary observations. We show that it would increase the level of necessary rewards if coordination between North and South was improved (coordination of fiscal policies, stronger common market and inter-linkages of economies). In a way economic integration may incite some groups of countries to perform even more expansionary policy than they would perform without integration. Member States with common political and economic goals will prefer building coalitions against the EC, as it has happened several times with some EMU Member States obtaining an extra waiver from the Excessive

Deficit Procedure. Thus, the stronger the bilateralism, the more incentives shall be given to Member States to keep their public finance in track.

Appendix A

Table A.1

A normal form of game between agents when both agents experience a positive shock

	S(true)	S(lie)
N(true)	$N) u(w_N^G) - v_N(e_N^G, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G, E_N^G)$	$N) u(w_N^G) - v_N(e_N^G, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B - \phi^G + \phi^B, E_N^G)$
N(lie)	$N) u(w_N^B) - v_N(e_N^B - \phi^G + \phi^B, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G, E_N^B)$	$N) u(w_N^B) - v_N(e_N^B - \phi^G + \phi^B, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B - \phi^G + \phi^B, E_N^B)$

Table A.2

A normal form of game between agents when the North faces a negative and the South a positive shock

	S(true)	S(lie)
N(true)	$N) u(w_N^B) - v_N(e_N^B, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G, E_N^B)$	$N) u(w_N^B) - v_N(e_N^B, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B - \phi^G + \phi^B, E_N^B)$
N(lie)	$N) u(w_N^G) - v_N(e_N^G + \phi^G - \phi^B, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G, E_N^G)$	$N) u(w_N^G) - v_N(e_N^G + \phi^G - \phi^B, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B - \phi^G + \phi^B, E_N^B)$

Table A.3

A normal form game between agents when the North experiences a positive shock, while the South face a negative one

	S(true)	S(lie)
N(true)	$N) u(w_N^G) - v_N(e_N^G, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B, E_N^G)$	$N) u(w_N^G) - v_N(e_N^G, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G + \phi^G - \phi^B, E_N^G)$
N(lie)	$N) u(w_N^B) - v_N(e_N^B - \phi^G + \phi^B, E_S^B)$ $S) u(w_S^G) - v_S(e_S^G, E_N^B)$	$N) u(w_N^B) - v_N(e_N^B - \phi^G + \phi^B, E_S^G)$ $S) u(w_S^B) - v_S(e_S^B + \phi^G - \phi^B, E_N^B)$

Table A.4

A normal form game between agents when both are in bad economic situation

	S(true)	S(lie)
N(true)	$N) u(w_N^B) - v_N(e_N^B, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B, E_N^B)$	$N) u(w_N^B) - v_N(e_N^B, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G + \phi^G - \phi^B, E_N^B)$
N(lie)	$N) u(w_N^G) - v_N(e_N^G + \phi^G - \phi^B, E_S^B)$ $S) u(w_S^B) - v_S(e_S^B, E_N^G)$	$N) u(w_N^G) - v_N(e_N^G + \phi^G - \phi^B, E_S^G)$ $S) u(w_S^G) - v_S(e_S^G + \phi^G - \phi^B, E_N^G)$

Appendix B

Karush - Kuhn-Tucker conditions for the optiman contract:

$$(g_1, \mu_1) : -u(w_N^B) + v_N(e_N^B, *) + u(w_N^G) - v_N(e_N^G + \phi^G - \phi^B, *) \leq 0 \quad (B1)$$

$$(g_2, \mu_2) : -u(w_S^B) + v_S(e_S^B, *) + u(w_S^G) - v_S(e_S^G + \phi^G - \phi^B, *) \leq 0 \quad (B2)$$

$$(g_3, \mu_3) : -u(w_N^G) + v_N(e_N^G, *) + u(w_N^B) - v_N(e_N^B - \phi^G + \phi^B, *) \leq 0 \quad (B3)$$

$$(g_4, \mu_4) : -u(w_S^G) + v_S(e_S^G, *) + u(w_S^B) - v_S(e_S^B - \phi^G + \phi^B, *) \leq 0 \quad (B4)$$

$$\begin{aligned} (g_5, \mu_5) : & -qp(u(w_N^G) - v_N(e_N^G, E_S^G)) - (1-q)(1-p)(u(w_N^B) - v_N(e_N^B, E_S^B)) \\ & - q(1-p)(u(w_N^G) - v_N(e_N^G, E_S^B)) - p(1-q)(u(w_N^B) - v_N(e_N^B, E_S^G)) \\ & + \bar{U}_N \leq 0 \quad (B5) \end{aligned}$$

$$\begin{aligned} (g_6, \mu_6) : & -qp(u(w_S^G) - v_S(e_S^G, E_N^G)) - (1-q)(1-p)(u(w_S^B) - v_S(e_S^B, E_N^B)) \\ & - q(1-p)(u(w_S^G) - v_S(e_S^G, E_N^B)) - p(1-q)(u(w_S^B) - v_S(e_S^B, E_N^G)) \\ & + \bar{U}_S \leq 0 \quad (B6) \end{aligned}$$

$$\mu_1 \geq 0 \quad (B7)$$

$$\mu_2 \geq 0 \quad (B8)$$

$$\mu_3 \geq 0 \quad (B9)$$

$$\mu_4 \geq 0 \quad (B10)$$

$$\mu_5 \geq 0 \quad (B11)$$

$$\mu_6 \geq 0 \quad (B12)$$

$$g_1(e, w, \phi)\mu_1 = 0 \quad (B13)$$

$$g_2(e, w, \phi)\mu_2 = 0 \quad (B14)$$

$$g_3(e, w, \phi)\mu_3 = 0 \quad (B15)$$

$$g_4(e, w, \phi)\mu_4 = 0 \quad (B16)$$

$$g_5(e, w, \phi)\mu_5 = 0 \quad (B17)$$

$$g_6(e, w, \phi)\mu_6 = 0 \quad (B18)$$

$$\begin{pmatrix} q \\ 1-q \\ -q \\ -(1-q) \\ p \\ 1-p \\ -p \\ -(1-p) \end{pmatrix} + \mu_1 \begin{pmatrix} u'(w_N^G) \\ -u'(w_N^B) \\ -v_N^{e_N^G}(e_N^G + \phi^G - \phi^B, E_S^B) \\ v_N^{e_N^B}(e_N^B, E_S^B) \\ 0 \\ 0 \\ 0 \\ v_S^{e_N^B}(e_N^B, E_S^B) - v_N^{e_N^B}(e_N^G + \phi^G - \phi^B, E_N^G) \end{pmatrix} \\
 + \mu_2 \begin{pmatrix} 0 \\ 0 \\ 0 \\ v_S^{e_S^B}(e_S^B, E_N^B) - v_S^{e_N^B}(e_S^G + \phi^G - \phi^B, E_N^B) \\ u'(w_S^G) \\ -u'(w_S^B) \\ -v_S^{e_S^G}(e_S^G + \phi^G - \phi^B, E_N^B) \\ v_S^{e_S^B}(e_S^B, E_N^G) \end{pmatrix} \\
 + \mu_3 \begin{pmatrix} u'(w_N^G) \\ -u'(w_N^B) \\ v_N^{e_N^G}(e_N^G, E_S^G) \\ -v_N^{e_N^B}(e_N^B - \phi^G + \phi^B, E_S^B) \\ 0 \\ 0 \\ v_N^{e_N^G}(e_N^G, E_S^G) - v_N^{e_N^B}(e_N^B - \phi^G + \phi^B, E_S^G) \\ 0 \end{pmatrix} \\
 + \mu_4 \begin{pmatrix} 0 \\ 0 \\ v_S^{e_S^G}(e_S^G, E_N^G) - v_S^{e_S^B}(e_S^B - \phi^G + \phi^B, E_N^G) \\ 0 \\ -u'(w_S^G) \\ u'(w_S^B) \\ v_S^{e_S^G}(e_S^G, E_N^G) \\ -v_S^{e_S^B}(e_S^B - \phi^G + \phi^B, E_N^G) \end{pmatrix}$$

$$\begin{aligned}
 & + \mu_5 \begin{pmatrix} -qu'(w_N^G) \\ -(1-q)u'(w_N^B) \\ qp v_N^{e_N^G}(e_N^G, E_S^G) + q(1-p)v_N^{e_N^G}(e_N^G, E_S^B) \\ (1-q)(1-p)v_N^{e_N^B}(e_N^B, E_S^B) + (1-q)pv_N^{e_N^B}(e_N^B, E_S^G) \\ 0 \\ 0 \\ qp v_N^{e_N^G}(e_N^G, E_S^G) + (1-q)pv_N^{e_N^G}(e_N^B, E_S^G) \\ (1-q)(1-p)v_N^{e_N^B}(e_N^B, E_S^B) + (1-p)qv_N^{e_N^B}(e_N^G, E_S^B) \end{pmatrix} \\
 & + \mu_6 \begin{pmatrix} 0 \\ 0 \\ -qp v_S^{e_N^G}(e_S^G, E_N^G) + q(1-p)v_S^{e_N^G}(e_S^B, E_N^G) \\ (1-q)(1-p)v_S^{e_N^B}(e_S^B, E_N^B) + (1-q)pv_S^{e_N^B}(e_S^G, E_N^B) \\ -pu'(w_S^G) \\ -(1-p)u'(w_S^B) \\ qp v_S^{e_S^G}(e_S^G, E_N^G) + p(1-q)v_S^{e_S^G}(e_S^G, E_N^B) \\ (1-q)(1-p)v_S^{e_S^B}(e_S^B, E_N^B) + (1-p)qv_S^{e_S^B}(e_S^B, E_N^G) \end{pmatrix} = 0 \quad (\text{B19})
 \end{aligned}$$

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