The Eurozone Needs Exit Rules

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This study argues that the key issue for revamping the stability of the Eurozone (EZ) lies in readjusting the relationship between the center and the periphery of the EZ. To capture the essence of the current sovereign debt crisis we analyze to what extent a 'troubled' periphery member of the EZ may successfully negotiate a bail-out from the center due to the existence of a negative externality arising from its potential default. In particular, we show how establishing 'exit rules' would alter the center-periphery relationship in a way that safe-guard the stability of the EZ. We demonstrate that such institution may help limiting the scope for credible threat strategies within the EZ.

Keywords: Sovereign debt crisis, Eurozone, Euro, exit rules, bail-out, political economics, game theory.

JEL Codes: E62, F33, H77, C70

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1 Introduction

With the sovereign debt crisis spreading across Europe there is no shortage of suggestions on how to save the Eurozone (EZ). The range of suggestions is broad. There are some commentators that focus on long-term challenges (see, e.g., Cooley and Marimon (2011) who advocate for debt rules) and the ones that address short-term stabilization issues (see, e.g., De Grauwe (2010) on the role of the European Central Bank (ECB) in stabilizing government debt markets or Delpla and von Weizsäcker (2010) who opt for a creation of the so called Eurobonds as a way to enlarging the EZ's financial fire power).

What unites many of the proposals is that they focus (predominantly) on economic factors and/or treat the EZ as a monolithic political organism. This paper argues, however, that the key issue for defining and solving the EZ's difficulties lies in readjusting the relationship between the center and the periphery of the European Economic and Monetary Union (EMU). The challenge is to create institutions that shift the EZ's center-periphery relationship in a way that fosters fiscal discipline and stability. We capture the basic finance problem of a center-periphery system by a threat game. This is to say what we expound to what extent a 'troubled' periphery member of the EZ may negotiate a bail-out from the center due to the existence of a negative externality arising from its potential default. At the onset of an exogenous fiscal shock the periphery makes decisions about whether to pursue politically costly austerity or to resort to brinkmanship to pass some of these fiscal costs on to the center. In this respect, we conjecture that the long-term stability of the EMU is a joint public good. We then analyze how establishing 'exit rules', recently advocated also by Jacques Delors (2011), would shift the center-periphery relationship within the EZ.

The outline of the reminder of the paper is as follows. In section 2, we present a short literature overview and show how the paper adds to it. In section 3, we lay down a theoretical threat game, which comprise of a brinkmanship (section 3.1), a Rubinstein bargaining (section 3.2), and 'exit rules' that reshape the center-periphery relationship within the EZ (section 3.3). In section 4, we discuss some policy implications of 'exit rules' and conclude the study.

2 Literature

The EZ is a unique form of a common currency area in the sense that it is a monetary union among sovereign states, and not a federal state with a common fiscal policy, like

the US. It has been recognized early on that the absence of coordination of fiscal policies can be a potential 'hazard area' in the construction of EZ because of the interactions between domestic policies of the members (Bordo and Jonung, 1999). In particular, it has been argued that member governments might be tempted to engage in moral hazard behavior. This is to say that such governments may generate unsustainable debts and push the ECB to inflate them away or run up high levels of debts that would create negative spillovers for others (Baldwin et al., 2010).

The nature of such interactions among members in multi-tiered systems, tracing in internal incentives and macroeconomic consequences, has been first systematically studied in the context of federations and later applied to a problem of monetary unions. For example, Rodden (2004) presents a game to study the role of central government commitment to a no-bail-out clause in the event of a sovereign debt crisis of sub-national officials. In the game, sub-national officials decide whether to purse fiscal adjustment based on their belief about the credibility of the central government's commitment. When the commitment is credible fiscal discipline is enforced by voters and credit markets. But if the central government's commitment is not fully credible sub-national officials face incentives to pursue unsustainable borrowing. In this framework, intergovernmental grants are at the heart of the commitment problem. If sub-national governments were financed purely by local taxes voters and creditors would view the obligations of local government as autonomous. If on the other hand central government's tax capacity is high and sub-units rely on direct intergovernmental grants, one can expect a greater willingness of sub-national units to avoid or delay adjustment, resulting in larger and more persistent deficits. After an empirical investigation of the tax capacity of central units of the European Union (EU), the paper concludes that there is little risk of fiscal indiscipline in the EMU. However, this paper is based on a model that is not a model of a monetary union, but rather of a fiscal federation. Therefore, it does not allow for analyzing the specific effects that a common currency area may have on fiscal outcomes in member states. Similar bail-out problems have also been modeled as a sequential game driven by the central government's incentives by Wildasin (1997), who focuses on the structure of jurisdictions and by Inman (2003) who consider a range of other factors. However, also in these cases the models do not include monetary factors pertinent to monetary unions.

Recent sovereign debt crisis in Europe has, however, sparked attempts to apply game theory in the specific context of monetary unions. For example, Blueschke and Neck (2011) use a dynamic game model of a two-country monetary union to study the impacts

of an exogenous fall in aggregate demand, the resulting increase in public debt, and the consequences of a sovereign debt haircut for a member country or bloc of the union. In their currency area, the governments of participating members pursue national goals when deciding on fiscal policies, whereas the common central bank's monetary policy aims at union-wide objective variables. The union consists of a 'core' with lower initial public debt, and a 'periphery' with higher initial public debt. The 'periphery' may experience a haircut due to high level of its sovereign debt. The authors do not only show that a haircut is disadvantageous for both the 'core' and the 'periphery' of the monetary union, but also provide an argument for coordinated fiscal policies in a monetary union.

While the above line of literature sheds light on the question whether a particular strategy is more preferable in terms of macroeconomic outcomes to other strategies such as 'debt restructuring' or 'no-debt-restructuring', it does not address the issue of the institutional design of a monetary union in the context of the current sovereign debt crisis. This issue is, however, taken up in a recent paper by Suzuki and Tsuranuki (2011). They use a game-theoretic framework to analyze the mechanisms of the EZ financial governance with a focus on centralization vs. decentralization and incentive structures in the EU. Specifically, they construct a Stackelberg game with n ministries of finance within the EZ as the first movers and the ECB as the second mover. They then show that such a set-up creates an incentive to increase public debt (i.e. free-riding on other members). In particular, they show that an increase in the number n of the ministries of finance or the number n of members will lead to a more severe free-rider problem. Within this framework, they analyze a solution to the free-rider problem through the penalty scheme in the Stability and Growth Pact (SGP). According to their analysis 'limited sovereignty' should be optimally imposed on the high marginal cost member for the issuance of public debt.

While our paper also addresses the issue of the EZ's institutional design, our approach is somewhat different. First, we explicitly consider a case of a monetary union and assume that the stability of the EZ is a public good for which players have a willingness to pay irrespectively of the nature of fiscal institutions. Second, we specifically focus on a negative externality problem which is central to the current sovereign debt crisis of the EZ, in which refinancing difficulties of a small economy like, for example, Greece that accounts for only 2% of the EZ's GDP can endanger the whole monetary union. The key question is to what extent a 'troubled' EMU member may successfully negotiate a bail-out due to the existence of a negative externality ensuing

from its potential default. Third, we analyze how establishing some sort of 'exit rules' influences the ability of a single EZ member to pursue such a credible threat strategy within the EMU.

3 The game

We consider a game played between the center (CEN) of the EZ which is characterized by current account surpluses and sustainable public debt position (think of Germany, Finland, Luxembourg, and the Netherlands) and the EZ's periphery (PER) which suffers from the twin deficit problem (think of Greece, Ireland, Italy, Portugal, and Spain).[1] Both players are concerned with preserving the smooth functioning of EZ – i.e., 'EMU stability' as a joint public good. The latter feature accounts for both players' accruing the long-term benefits of EZ membership in terms of efficiency gains stemming from lower transaction costs in cross-border trade, increased specialization and competition and so on Beetsma and Guiliodori (see, e.g., 2010, for a survey of the issues).

The game starts with an exogenous shock to the periphery and shows to what extent a single PER may pass some of the 'fiscal adjustment costs' on to CEN. Given that PER's potential default would create a negative externality cost for the rest of the EZ (i.e., contagion in terms of spreading defaults to other PER countries), this particular PER player may resort to a brinkmanship strategy. Such negative externality represents a bargaining chip in the negotiations over redistributing PER's fiscal adjustment costs. Hence, within the scope and limits of such brinkmanship strategy CEN might be credibly threatened to reveal its willingness-to-pay for 'EMU stability' and thus PER may effectively elicit a bail-out. The structure of the game is displayed in extensive form in figure **??**. Specifically, a single PER_i (denoted as player $j = 1$, whereas $i = 1, ..., n$) has complete but imperfect information over a representative CEN (player $j = 2$) willingness-to-pay for 'EMU stability'. The point of departure is that PER_i faces an adverse fiscal shock and an imminent risk of default. At the heart of the game is the haggling between the PER_i and CEN over sharing the 'fiscal adjustment costs' needed to safeguard 'EMU stability'. These costs are denoted as $F_i = (f_i, f_{-i})$ for the case of a specific PER_i, whereas benefits from the EZ membership for PER_i and CEN are denoted as $B_i = (b_i, b_{-i})$. The benefits b_i stand for preserving membership within the EZ and providing access to financial markets and external resources. At

[1] In doing so, we rely on Fahrholz (2007); further, e.g., Fahrholz and Wójcik (2010) and Arghyrou and Tsoukalas (2010) particularly deal with the Greek sovereign debt crisis.

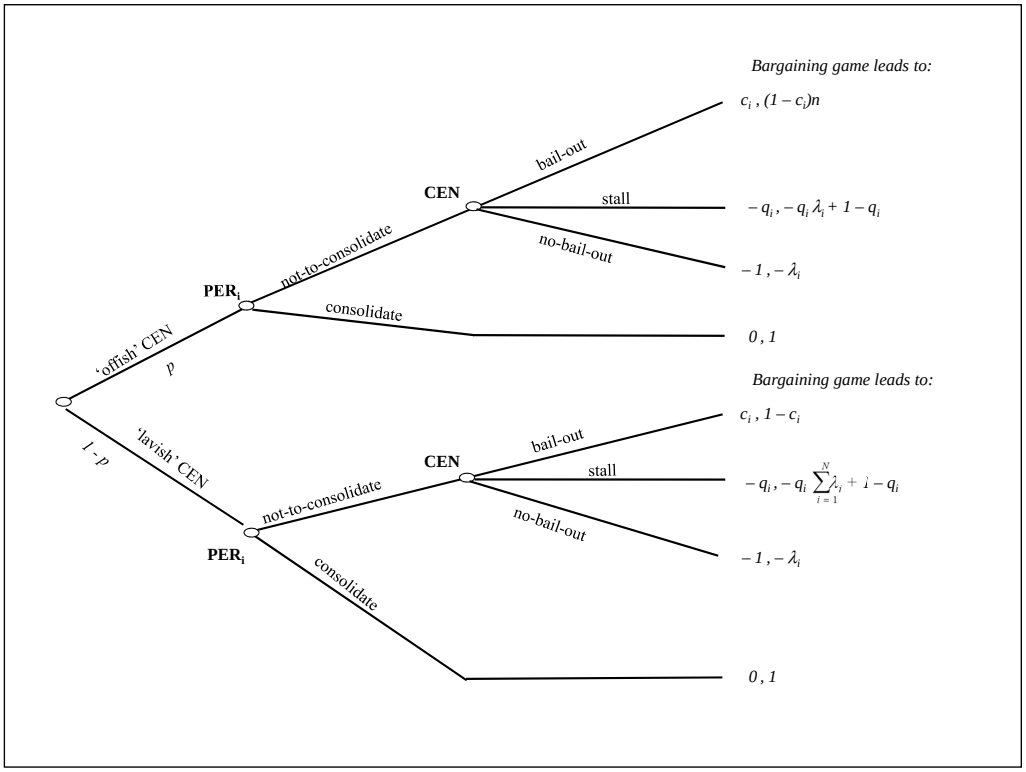

Figure 1: Extensive Form of the Game

the same time, from the perspective of CEN, the according b_{-i} represents the benefits of EZ membership (see above).[2] A deterioration of the public good 'EMU stability' is also costly. The latter costs primarily pertain to defaulting within the EZ and are, henceforth, denoted as 'default costs' $D_i = (d_i, d_{-i})$. Most notably, PER_i will incur such costs. However, CEN will also suffer from PER_i's default as it has a stake in the EZ via trade and other financial asset-liability linkages. The latter characteristics of economic integration prepare the ground for negative externalities, which may constitute the basis of a brinkmanship strategy possibly suited to eliciting a bail-out. In this regard, CEN has a particular subsidiary role: While PER_i will not accept costs higher than its 'fiscal adjustment costs' f_i in exchange for contributing to 'EMU stability', CEN will administer fiscal assistance within the limits of their maximum willingness to pay. Accordingly, CEN will have limited liability amounting to a share θ_i of 'fiscal

[2] We assume that the benefits are the same for both players as it renders the game simpler to solve. One may rightly argue that benefits can be different for, say, a big economy like Germany or France and, say, a small one such as Greece or Portugal. However, assuming that the benefits were not symmetric would not change the general tone of our results.

adjustment costs' with $0 < \theta_i \leq 1$. In other words, CEN will at most transfer funds to PER_i amounting to f_{-i}. The reason is that beyond that point CEN's willingness to pay for preserving 'EMU stability' would be exhausted. By the same token, PER_i may at maximum pass all 'fiscal adjustment costs' on to the CEN, though never more than the currently required amount for averting an immediate default. From this follows that whatever the 'default costs' $D_i = (d_i, d_{-i})$, there is never more to redistribute between the center and the periphery than the incipient 'fiscal adjustment costs' $F_i = (f_i, f_{-i})$. The following proposition can be derived from these considerations:

$$\theta_i = \begin{cases} 0 & \text{if } f_{-i} \geq d_{-i} \\ 0 \leq \theta_i < 1 & \text{if } f_{-i} < d_{-i} < f_{-i} \\ 1 & \text{else} \end{cases} . \tag{1}$$

Bearing the entire F_i reflects each player's maximum willingness to pay for preserving 'EMU stability', i.e. each player's cost tolerance in escalation processes of brinkmanship. The rationale of such brinkmanship is that PER_i incrementally threatens to realize the overall worst outcome. In doing so, it can under identifiable conditions pass a share of the 'fiscal adjustment costs' F_i on to the rest of the EZ members.

If a credible brinkmanship evolves, then both players will not maximize their piece of the pie, but minimize their respective share of 'fiscal adjustment costs' F_i during negotiations. The inherent bargaining problem is thus characterized by the tuple (F_i, D_i) where $F_i \subset \mathbb{R}_+^{*2}$ is a vector combination of feasible (dis)utility allocations. A particular 'disagreement' is the bargaining outcome if both parties' negotiations break down. If PER_i and CEN cannot agree on an appropriate policy solution for PER_i, i.e. providing fiscal assistance for safe-guarding 'EMU stability', a default will be triggered. In this regard, the 'disagreement' is congruent with the occurrence of 'default costs' D_i. Summarily, the following costs arise in this game $G(F_i, D_i \mid \theta_i)$: There are 'fiscal adjustment costs' F_i, around which the negotiations bargaining revolves; if the according haggling on distributing F_i were to break down, then a default will occur and both players will be stuck with the 'disagreement' outcome equivalent to the 'default costs' D_i contingent on the 'limited liability' θ_i.

Some caveats regarding the delineated basic structure of this threat game may apply: On the one hand, the question arises whether PERs should form a cartel to strengthen their brinkmanship vis-à-vis other EZ members. On the other hand, the center of EZ might announce in advance that they will punish the first member, which dares to prac-

tice brinkmanship. This is to say that they might pursue an enter-deterrence game.[3] We exclude both corner solutions, as coordination problems and competition between all EZ members render both scenarios unlikely. If PERs try to coordinate their brinkmanship, then this may lead financial markets to discriminate more between both group of countries, PERs and CENs. Also, since only PER is facing an imminent default risk, other PERs will not be willing to join as it might signal the financial markets that they are also on the brink of a default. By the same token, a coordination problem within CEN arises because of uncertainty regarding their future potential need for financial assistance.

In such a set-up, successful brinkmanship is dependent on two probabilities ϕ and ψ_i that are independent of each other and are endogenously determined. The latter say depicts the fact that the cost structure shapes the according figures. From the perspective of PER_i, ϕ denotes the probability of encountering an 'offish' CEN or a 'lavish' one with a probability $1 - \phi$. The more 'offish' the CEN, the lower is the probability of executing successful brinkmanship. Given that PER_i is a member of the EMU that is economically not fully disconnected from the rest of the EMU, we assume $\phi < 1$. At the same time $\phi > 0$ because 'EMU stability' is a joint public good and CEN has at least some willingness to pay for it as encompassed in the benefits b_{-i}. Hence, we reject according corner solutions of ϕ, so that $0 < \phi < 1$. Moreover, both players are concerned with the expected electoral consequences of their policy decisions. Thus, the probability ψ_i describes the likelihood of negative externalities (i.e. spreading defaults within the EZ) triggered by voter alienation towards fiscal consolidation processes within PER_i (i.e. when incurring the electorate with 'fiscal adjustment costs'). Uncertainty regarding the constituency's reaction to stipulated fiscal retrenchment processes may buttress PER_i's bargaining position in negotiations vis-à-vis CEN. If the electorate was completely 'Europhile', then there would be no room for the government for incurring other EZ members with 'fiscal adjustment costs' as imposed fiscal austerity would not havoc any political upheaval and subsequently negative externalities within the EZ. In fact, the according probability ψ_i would be zero in such circumstances. At the same time, we expect that voters as well as their delegated governments must also rank the benefits b_i as valuable. Otherwise, any efforts towards fiscal consolidation within PER_i would be

[3] The scope for an enter-deterrence game is limited also by the fact that due to problems of effective monitoring, assessing fiscal policy and identifying deliberate infringement to fiscal rules within the EZ is a complicated issue. For example, Jaeger and Schuknecht (2007) discuss this issue in the context of pro-cyclical fiscal positions and boom-bust phases. As regards boom-bust cycles within the EZ please also refer to Backé and Wójcik (2008).

unacceptable and a government would be unable to craft consensus towards its contribution to safe-guarding 'EMU stability'. Hence, we exclude according corner solutions so that $0 < \psi_i < 1$. There accordingly exist some political resources on the national level, which a government in PER_i may play off against CEN in intergovernmental negotiations on the European level. If the conditions for successful brinkmanship are met, then CEN will dance obligingly to PER_i's tune and share some 'fiscal adjustment costs' F_i in terms of providing financial assistance. In the following section, we determine the Nash strategies, i.e. the mutually best responses which will eventually constitute a sub-game perfect Nash equilibrium of the brinkmanship game $G(F_i, D_i \mid \theta_i)$.

3.1 Brinkmanship

Given that each players' maximum willingness to pay for 'EMU stability' in terms of still reaping the benefits B_i from smooth operation of the EZ corresponds each time to the total of F_i, we can normalize $f_{ij} = b_{ij} = 1$. Hence, we can transform thethreat game $G(F_i, D_i \mid \theta_i)$ to the form of $\tilde{G}(\tilde{F_i}, \tilde{D_i} \mid \theta_i)$ with $0 \leq \tilde{f_{ij}} \leq 1$, $\tilde{f_{ij}} \in \tilde{F_i}$, $\tilde{F_i} \subset \mathbb{R}^2$. The standard assumption holds that $\tilde{f_{ij}} = (\tilde{f_{i1}}, \tilde{f_{i2}})$ is a non-empty, convex and compact set. In this game $\tilde{G}(\tilde{F_i}, \tilde{D_i} \mid \theta_i)$ a single PER_i quasi maximizes the counter-party CEN's share of 'fiscal adjustment costs' for safe-guarding 'EMU stability'. The subsequent bargaining (see section 3.2) may lead to an outcome, at which PER_i elicits a bail-out amounting to $\tilde{f_i}$ and, in turn, saddles CEN with the share $\tilde{f_{-i}} = 1 - \tilde{f_i}$. Accordingly, the players' continuous utility functions $u_{(i)j}(\tilde{f_{(i)j}})$ are $u_{i1}(\tilde{f_{i1}}) = \tilde{f_{i1}} = \tilde{f_i}$ and $u_2(\tilde{f_{i2}}) = \tilde{f_{i2}} = (1 - \tilde{f_i})$. The following paragraphs deal with the structure of players' strategies and pay-offs.

Considering a brinkmanship strategy, PER_i faces two different sub-games of $\tilde{G}(\tilde{F_i}, \tilde{D_i} \mid \theta_i)$ due to complete but imperfect information. First, PER_i does not know whether it will encounter an 'offish' (ϕ) or a 'lavish' ($1 - \phi$) CEN. In this context, negative externalities have to be considered: On the one hand, a single sovereign debt crisis has the potential to trigger further defaults of all $n\,PER_i$ via contagion. This would be the overall worst pay-off from the vantage point of CEN. Therefore, fearing such exorbitant costs the primary goal of CEN would be to sustain the support in each PER_i for safe-guarding 'EMU stability'. From this perspective, it may be more beneficial to be'lavish'. Second, CEN may display a rather reluctant attitude towards providing bail-outs because any obvious generosity would intensify moral hazard behavior which possibly requires transferring n-times of $\tilde{f_i}$. Due to CEN's ambiguous attitude towards providing extra funding, PER_i's pay-offs have to be weighted with a probability ϕ for encountering an 'offish' and $1 - \phi$ for a 'lavish' CEN, i.e. the two different sub-games.

PER_i's feasible set of strategies consists of two choices: 'consolidate' or 'not-to-consolidate'. The latter strategy consists of practicing brinkmanship on the basis of the premise that its constituency would possibly not accept strict fiscal retrenchment. If PER_i, for instance, is very confident about controlling the risk that a fiscal consolidation process will trigger voter resistance to an extent, the government may resort to such hazardous strategy.[4] When further exploring the scope of its brinkmanship opportunity, the government might craft consensus among a pivotal share of the constituency that favors departing from the EZ, then this will credibly put the entire 'EMU stability' at risk. In this respect, the brinkmanship relies on a negative externality stemming from this profligate EZ member's potential default that may inflict the rest of the EZ via trade and other financial asset-liability linkages. Choosing 'not-to-consolidate' may, eventually, help eliciting financial assistance from CEN, i.e. redistributing 'fiscal adjustment costs'. If PER_i chooses to 'consolidate' (i.e., practicing no brinkmanship), it forgoes the opportunity to pass a share $\tilde{f}_i$ of 'fiscal adjustment costs' on to CEN. This would be the best choice from the viewpoint of CEN. When PER_i relies on a strategy of choosing 'not-to-consolidate', the outcome ultimately depends on the reaction of CEN. The latter player can choose a strategy of 'bail-out', 'stall' or 'no-bail-out'. This is to say that CEN's retaliation may take the form of providing fiscal assistance respectively a financial rescue package. However, CEN may also attempt to withhold funding by practicing a strategy of 'stall' (i.e., negotiating 'fiscal adjustment costs' with PER_i). Moreover, CEN may also choose a strategy of 'no-bail-out' which would imply to cut only PER_i out of the EZ. This outcome is congruent with the breaking off of negotiations and an immediate default of PER_i as depicted by the 'disagreement' respectively the 'default costs' D_i.

The pay-offs are as follows: If PER_i chooses a strategy of 'consolidate', then it receives zero, whereas CEN receives the entire benefits of secured 'EMU stability' amounting to 1. If PER_i chooses to 'not-to-consolidate' and CEN reins in PER_i's prospective default, then PER_i receives the aspired alleviation of 'fiscal adjustment costs' in amount of $\tilde{f}_i$. In this case, CEN receives a pay-off $(1 - \tilde{f}_i)$, though it may possibly also have to deal with transferring payments to all PER_i amounting to n-times the size of $\tilde{f}_i$ – for instance, via some kind of a special purpose vehicle (think of all EZ bail-out facilities currently in place). If CEN chooses to 'stall', PER_i may be stuck with 'default costs' amounting to $-\psi_i$. This pay-off hinges upon PER_i's likelihood of losing public support for fiscal

[4] For the sake of the argument, we do not distinguish between 'deliberate' and 'accidental' brinkmanship. Whether it is fiscal negligence or 'blackmailing', does not affect the results of our analysis.

retrenchment and consequently defaulting. Simultaneously, CEN receives the pay-off $(-\psi_i\theta_i + 1 - \psi_i)$ or $(-\psi_i \sum_{i=1}^{n} \theta_i + 1 - \psi_i)$ in the case of possibly spreading defaults via contagion among all PERs. If CEN is able to shut off the case of a 'troubled' PER_i from the rest of the EZ and, hence, chooses 'no-bail-out' then both players will encounter a country-specific default scenario and will forgo the according mutual benefits of 'EMU stability'. In this respect, both players would suffer from the realization of 'default costs' $\tilde{D}_i$, where the pay-off is $(-1, -\theta_i)$ in line with the aforementioned proposition (see equation 1).

A brinkmanship strategy has to meet some conditions. A successful brinkmanship has to be effective and acceptable. The effectiveness condition of such brinkmanship rests on the extent of PER_i's default: As CEN is increasingly affected by negative externality costs, a PER_i's threat gains more credibility. Whether PER_i is able to coerce CEN into the provision of funding by threatening to incur the latter player with negative externality costs arising from spreading defaults within the EZ is subject to a critical threshold: If the respective probability is too small, PER_i will not be able elicit fiscal assistance. By the same token, the credibility of the brinkmanship strategy is also dependent on whether the prospective outcome is acceptable to PER_i. If the probability of triggering its own default is too high and, hence, the acceptability condition cannot be accomplished, then PER_i will have to 'consolidate'. In turn, this player will entirely incur the envisioned 'fiscal adjustment costs' for sustaining 'EMU stability'.

PER_i's brinkmanship will be successful, which means eliciting the desired extra funds amounting to $\tilde{f}_i$, if it constitutes a credible threat strategy. In this regard, PER_i's brinkmanship may be effective, if at least the expected pay-off of CEN from providing funds is higher than from a decision to 'stall' concomitantly running the risk of triggering spreading defaults within the EZ.[5] Therefore, it has to be valid that

$$(1 - \tilde{f}_i) > -\psi_i \sum_{i=1}^{n} \theta_i + 1 - \psi_i.$$

[5] Please note that fiscal assistance amounting to $\tilde{f}_i$ for a single PER_i is always better than n-times $\tilde{f}_i$ as is, for instance, the case with the currently existing EZ bail-out schemes, i.e. the European Financial Stability Facility (EFSF) and the European Financial Stabilisation Mechanism (EFSM), as well as the envisioned European Stability Mechanism (ESM). The attentive reader realizes that according to our game-theoretic modeling framework it is no so called 'firewall' but the probability of triggering negative externalities that affects players' calculus and the occurrence of bail-outs.

Accordingly, the minimum probability for effective brinkmanship $\psi_{i,min}$ has to be

$$\psi_{i,min} > \frac{\tilde{f}_i}{\sum_{i=1}^{n} \theta_i + 1}. \tag{2}$$

The probability $\psi_{i,min}$ is a minimum threshold of the brinkmanship for PER_i. Below this level CEN would choose a strategy of 'no-bail-out', even if it is 'lavish'. However, with a probability of ϕ PER_i may feel that the strategy 'not-to-consolidate' is too risky with regard to encountering an 'offish' CEN. At the same time, PER_i will encounter a 'lavish' CEN with a probability of $(1 - \phi)$, which may indulge in the provision of pecuniary assistance effectiveness condition (2) holds. Contingent on $0 < \psi_i < 1$ PER_i will pose a probabilistic threat, if its expected pay-off is higher than a zero pay-off from choosing to 'consolidate', so that

$$-\psi_i p + \tilde{f}_i(1 - \phi) > 0,$$

resolving of which results in

$$\psi_{i,max} < \tilde{f}_i \frac{1 - \phi}{\phi}. \tag{3}$$

Accordingly, the acceptability hinges on values for ϕ. Therefore, values for ϕ have to be below a critical threshold. Otherwise, $\psi_{i,max}$ in inequation (3) would have to be even smaller than $\psi_{i,min}$ in inequation (2) for some high values of ϕ. That would render any brinkmanship fruitless as it indeed becomes effective but not acceptable. From the proposition $\psi_{i,min} < \psi_{i,max}$ it follows that the maximum probability ϕ_{max} has to be

$$\phi_{max} < \frac{\sum_{i=1}^{n} \theta_i + 1}{\sum_{i=1}^{n} \theta_i + 2} < 1. \tag{4}$$

Besides, this acceptability condition exhibits another interesting feature: If the probability ϕ for encountering an 'offish' CEN is very small, PER_i will always find the brinkmanship acceptable.[6] This holds when

$$\tilde{f}_i \frac{1 - \phi}{\phi} \geq 1.$$

[6] If we, for the sake of the argument, think of the probability ϕ for encountering, for instance, 'offish' EZ members being inversely related to the economic size of a particular member inclined to fiscal profligacy, then big economies would be the first to bend fiscal rules of such a multi-tiered system. Whether the infringement of the SGP by Germany and France in 2003 really fits into this line of reasoning is dedicated to future research.

Hence, 'not-to-consolidate' is always acceptable for critical values

$$\phi_i^0 \leq \frac{\tilde{f}_i}{\tilde{f}_i + 1}.$$

If the probability ϕ for an 'offish' CEN satisfies the acceptability condition, then the following proposition must be valid:

$$\phi^* \in \Phi^*, \qquad \Phi^* := \{\phi^* \,|\, \phi^* \leq \phi_{max} < 1,\, \phi^* \in \mathbb{R}_+^*\} \tag{5}$$

Regarding $\psi_{i,min}$, the probability ψ_i in a brinkmanship strategy has to remain below the critical threshold $\psi_{i,max}$. Above that value PER_i will refrain from a strategy of 'not-to-consolidate' because it fears mutual detrimental effects. Therefore, for every given probability $0 < \phi < 1$ the probabilistic threat is credible when a country-specific ψ_i^* is an element of the finite set Ψ_i^*. The according proposition is:

$$\psi_i^* \in \Psi_i^*, \qquad \Psi_i^* := \{\psi_i^* \,|\, \psi_{i,min} \leq \psi_i^* \leq \psi_{i,max},\, \psi_i^* \in \mathbb{R}_+^*\} \tag{6}$$

When the endogenous effectiveness and acceptability conditions for the parameters ϕ and ψ_i are satisfied, PER_i will resort to brinkmanship. CEN's response to PER_i's brinkmanship is to immediately transfer 'fiscal adjustment costs' amounting to the share $\tilde{f}_i$. This is equivalent to PER_i passing the respective portion of 'fiscal adjustment costs' on to CEN, i.e. the bail-out in face of negative externalities.

After laying down the Nash strategies, we now focus on the on-cooperative Rubinstein bargaining solution (RBS) for distributing PER_i's 'fiscal adjustment costs' $\tilde{F}_i$. This is to say that we ascertain each player's portion of 'fiscal adjustment costs', which are prerequisite for safe-guarding 'EMU stability'.

3.2 Bargaining

Moving and negotiating on the brink of economic and political devastation is a fickle maneuver. However, we may presume that the longer the negotiations on a bail-out take, the more it becomes obvious from the perspective of financial markets that both parties are unable to agree on an appropriate policy response. By the same token, both players are aware that markets may finally sanction their fierce bargaining and that time is, thus, not on their side. This modeling part particularly refers to Rubinstein (1982). Contrary to the general association of the RBS as a 'shrinking pie' (i.e. utility) over

time, here the 'pie of costs' inflates over time and will leave its mark on both parties upon collapsing – i.e. both are incurred with 'default costs'. In this regard, the RBS makes use of players' 'patience', so that despite an infinite time horizon the impeding risk of a breakdown makes both parties agree on the distribution of the 'fiscal adjustment costs' in finite time. The settlement of the bargaining is especially dependent on each players' negotiating skills in terms of 'patience'. The latter are inversely proportional to the players' bargaining power coefficients μ_i and ν_{-i}, i.e. both camps talent for negotiating (Nash, 1953). In this respect, the player who can longer convincingly conceal his fear of being faced with the 'default costs' in the case of a negotiation breakdown is better off. In line with this rationale, the obvious see-sawing in a run-up to a bail-out within the EZ – in terms of stipulating fiscal retrenchment on the 'tumbling' economies within the periphery and deliberating upon financial assistance by the center – represents a preparatory stage. This portion of the game-theoretic analysis still pertains to the game $\tilde{G}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i)$ and only invokes the RBS to shed light on the relevance of negotiating a redistribution of 'fiscal adjustment costs'. In this respect, the game $\tilde{G}$ is completed by a bargaining on the non-empty, convex, and compact set comprising any convex combination of the aforementioned vector $\tilde{F}_i \in \mathbb{R}^{*2}_{+}$. In order to craft a RBS we have to assume that the players are well-informed, i.e. the assumptions of complete information and common knowledge apply to the RBS.

The negotiations proceed as follows: At the outset of its brinkmanship strategy PER_i makes a particular offer k in $t = 0$. Such offer consists of demanding the 'fiscal adjustment costs' $\tilde{f}_{i2}$ sufficient to keep it from further brinkmanship. The CEN can accept or refuse. When CEN rejects the offer, it can make a counter-offer l in $t = \tau$, where $\tau > 0$ denotes the length of the interval between two successive offers. In turn, PER_i can refuse or accept. As no player refuses once and for all – in that case the outcome would be the 'disagreement' comprising of the 'default costs' $\tilde{D}_i$ – but makes counter-offers, the bargaining is infinite. In line with previous considerations $u_{(i)j}(0, t) = 0$, $u_{(i)j}(1, 0) = 0$, and $\lim_{t\to\infty} u_{(i)j}(\tilde{f}_{ij}, t) = 0$ when the game would go on forever. Moreover, the RBS concept requires amending the original players' utility functions $u_{(i)j}(\tilde{f}_{ij})$ to $v_{(i)j}(\tilde{f}_{ij}, t) = u_{(i)j}(\tilde{f}_{ij})\delta^t_{(i)j}$ where $\delta_{(i)j}$ is a player's time-preference. In this respect, stationary strategies are of particular interest. Strategies are stationary when a player's history is of no interest. That is every player j always plans to make the same offer – which is here a specific share $\tilde{f}_{ij}$ of 'fiscal adjustment costs' – every second round regardless of any previously rejected offers and counter-offers. Only an equilibrium offer makes the responding player indifferent between refusing and accepting. Accordingly,

CEN always accepts an offer k (or anything better) and rejects anything worse, whereas the same goes for PER_i as regards the offer l. The offers are represented by the vectors $a = u_{(i)j}(k,t)$ and $b = u_{(i)j}(l,t)$. As the RBS assumes common knowledge and perfect foresight backward induction is allowed. Hence, both players anticipate the final bargaining outcome in the first round. Generally, in equilibrium the players are indifferent between accepting and rejecting, so that for every arbitrary interval τ between alternating offers

$$a_2 = \delta_2^\tau b_2 \quad \text{and} \tag{7}$$

$$b_1 = \delta_{i1}^\tau a_1. \tag{8}$$

We can replace the discount rates by $\delta_{(i)j} = e^{-\rho_{(i)j}}$, with $\rho_{(i)j}$ as the players' time-preferences rates, so that we can also write $\mu_i = \frac{1}{\rho_i 1}$ and $\nu_2 = \frac{1}{\rho_{-i}}$. From equations (7) and (8) then follows

$$\left(\frac{a_2}{b_2}\right)^{\beta_{-i}} = \left(\frac{b_1}{a_1}\right)^{\alpha_i} = e^{-\tau},$$

which implies that

$$a_1^{\mu_i} a_2^{\beta_{-i}} = b_1^{\mu_i} b_2^{\nu_{-i}}$$

coincide.

We are particularly concerned with the impact of negotiation time on financial market reactions possibly triggering a default, as a result of which the outcome $\tilde{D}_i$ occurs. Hence, the case of $\tau \to 0$ is of particular interest to our game $\tilde{g}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i)$. This implies for $\lim_{\tau \to 0} e^{-\tau} = 1$ it holds true that

$$a_2 = b_2 \quad \text{and} \quad a_1 = b_1.$$

This is to say that both players' offers really correspond to each other for $\tau \to 0$. At the same time, the particular shares $\tilde{f}_{i1} = \tilde{f}_i$ of 'fiscal adjustment costs' that PER_i can pass on to CEN, such that the latter player carries the share $\tilde{f}_{i2} = 1 - \tilde{f}_i$, represent the bargaining outcome.

The RBS is subject to the following maximization problem:

$$\max_{\tilde{f}_{ij}} (\tilde{g}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i)) = (u_{i1}(\tilde{f}_{i1}) - u_{i1}(\tilde{d}_{i1}))^{\mu_i} (u_2(\tilde{f}_{i2}) - u_2(\tilde{d}_{i2}))^{\nu_{-i}}. \tag{9}$$

Given the players' utility functions, the maximization problem in light of $\tilde{D}_i = (-1, -\theta_i)$ is

$$\max_{\tilde{f}_{i1}, \tilde{f}_{i2}} \tilde{g}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i) = (\tilde{f}_i + 1)^{\mu_i}((1 - \tilde{f}_i) + \theta_i)^{\nu_{-i}}.$$

Given that $\mu_i + \nu_{-1} = 1$, the subsequent first-order condition implies that in equilibrium

$$\tilde{f}_i^{\,*} = \begin{cases} \text{not defined} & \text{if } (1 + \theta_i)\mu_i - \nu_{-i} \leq 0 \\ 0 < \tilde{f}_i < 1 & \text{if } (1 + \theta_i)\mu_i - \nu_{-i} \leq 1 \\ 1 & \text{else} \end{cases} . \tag{10}$$

With respect to the completed (transformed) threat game $\tilde{G}$, the RBS comprises the equilibrium outcome tuple

$$\tilde{F}_i^{\,*} = (\tilde{f}_i^{\,*}, (1 - \tilde{f}_i^{\,*})). \tag{11}$$

for successful brinkmanship. The 'not defined' outcomes represent corner solutions, at which the 'default costs' exceed the sum of players' willingness-to-pay for safe-guarding 'EMU stability'. The interpretation is obvious: 'too-big-to-be-bailed-out' would result in a de facto default, turning the incipient sovereign debt crisis into a case of public insolvency. By definition, this would annul the joint public good of 'EMU stability' and, hence, result in an alteration of the underlying political-economic configuration of EZ. However, we still confine ourselves to a discussion of an incipient sovereign debt crisis, allowing for a successful brinkmanship strategy.

The equilibrium solution (equation (11)) constitutes the unique sub-game perfect Nash equilibrium, incorporating a specific RBS of the transformed threat game $\tilde{G}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i)$ and contingent on valid conditions for successful brinkmanship (see the propositions in inequations (5) and (6)). This is to say that CEN's response to PER_i's credible brinkmanship strategy is to burden itself with 'fiscal adjustment costs' amounting to the share of $(1 - \tilde{f}_i)$. Thus, PER_i passes the respective 'fiscal adjustment costs' on to other EZ members. When obtaining a share $\tilde{f}_i$ of 'fiscal adjustment costs', PER_i will abstain from further attempts to promote a hazardous fiscal policy stance. This is because CEN's willingness to pay for securing the joint public good 'EMU stability' is exhausted at the point.[7]

[7] In this respect, another caveat might be in order: As our modeling framework calculates a single PER_i's brinkmanship vis-à-vis CEN, such a threat at an incipient sovereign debt crisis may only represent one particular round in a 'boxing match' of a series of incipient sovereign debt crises. Insofar, one may expect that newly incipient but random sovereign debt crisis within the EZ to mark the starting point for another round of the outlined threat game. In this regard, the institutional set-up of EZ prepares the ground for brinkmanship. In this contribution, we confine ourselves

3.3 Exit rules

The transformed threat game $\tilde{G}(\tilde{F}_i, \tilde{D}_i \,|\, \theta_i)$ demonstrates in which way and to what extent a 'troubled' periphery member may successfully negotiate fiscal assistance from the center of the EZ. The reason is the existence of a negative externality costs arising from a potential default of a specific periphery member possibly spilling over to other EZ members and deteriorating the joint public good 'EMU stability'. Having shown that bail-outs are inevitable under identifiable conditions, the remainder of the analysis expounds how 'exit rules' may alter the center-periphery relationship. This is to say that we demonstrate to what extent enacting 'exit rules' will mitigate members' brinkmanship behavior within the EZ and safe-guard 'EMU stability'.

The main distortion characterizing the set-up of EZ is the enforcement problem in a monetary union among sovereign members. We conjecture that a commitment to 'exit rules' may represent an enforcement mechanism that mitigates the negative externality problem. Such institution may unfold deterrence when it incurs a profligate member with noticeable costs, though without running the risk of inflicting other periphery members with sovereign debt crisis, i.e. the negative externality. The design of 'exit rules', possibly encompassing, for example, sovereign debt restructuring regime, is likely to shape the outcomes. For the time being, however, we are just interested in a general direction of how allowing for departing from the EZ would change the center-periphery relationship. Another caveat, however, may be in order: Panizza et al. (2009), for instance, argue that particularly costs in terms of trade reduction and other domestic costs such as output decline strengthen the credibility of enforcement mechanisms. In this manner, we contend that a shift to noticeable costs particularly pertains to a future output decline in the case of a 'troubled' EZ member eventually leaving the EZ. To mitigate the negative externality we think of a single-case deficit procedure with an explicit option for orderly exiting the EZ at the final stage of such procedure. A multi-stage procedure, representing some sort of a dynamic deterrence, is demanded as departing from the EZ in the course of solely accidental fiscal problems would constitute a too intrusive enforcement mechanism and would only undermine the credibility of such device.

When establishing these kind of 'exit rules', this will allow for separating a particular fiscal profligate member (i.e. PER_i) from other 'troubled' EZ members. The flipside of this argument is that it will proof much more difficult for PER_i to accidently threaten to trigger spreading defaults, i.e. again, the negative externality. Rather, it will experience

to analyzing the mere occurrence of a bail-out and how 'exit rules' reshape the center-periphery relationship of the EZ.

solely a country-specific default without plummeting other periphery EZ members into the abyss, as well. This is to say that 'exit rules' will make other members less susceptible to contagion via trade and particularly other financial asset-liability linkages. As a result, the chance of inflicting CEN with extra-ordinary costs in the course of spreading defaults across the entire EZ will be lower.

Technically, 'exit rules' endogenously limit the scope for successful brinkmanship. This will be the case when establishing 'exit rules' increases the critical threshold for the effectiveness condition (inequation (2)) and decreases the critical threshold for the acceptability condition (inequation (4)). This is because both thresholds constitute critical limits to possibly successful brinkmanship. The analysis in sections 3 comprises of a world without 'exit rules'. The latter situation is now compared with an EZ set-up that incorporates 'exit rules'. In such a world, there is an explicit non-zero probability that an EZ member such as PER_i will leave. At such instance, the re-assembled monetary union would consist of a smaller number of members, M, where $M < N$. Given that exiting the EZ is now possible, both PER_i and CEN will attach some probability to such a scenario. Even if such probability is very small, the resulting change of the expected pay-off structure leads to an endogenous change of the critical thresholds (see inequations (2) and (4)). Indeed, the threshold for the 'adjusted' effectiveness condition (denoted by a superscript $exit$) increases, so that

$$0 < \psi_{i,min} < \frac{\tilde{f}_i}{\sum_{i=1}^{n} \theta_i + 1} < \psi_{i,min}^{exit} < \frac{\tilde{f}_i}{\sum_{i=1}^{m} \theta_i + 1} < 1 \qquad \forall\, n > m \geq 1. \tag{12}$$

The effectiveness condition for successful brinkmanship shifts upward when enacting 'exit rules'. By the same token, the threshold for the 'adjusted' acceptability condition in conjunction with inequation (3) decreases to

$$0 < \phi_{max}^{exit} < \frac{\sum_{i=1}^{m} \theta_i + 1}{\sum_{i=1}^{m} \theta_i + 2} < \phi_{max} < \frac{\sum_{i=1}^{n} \theta_i + 1}{\sum_{i=1}^{n} \theta_i + 2} < 1 \qquad \forall\, n > m \geq 1. \tag{13}$$

This is to say that the critical threshold for acceptable brinkmanship shifts downwards. Obviously, the scope for credible brinkmanship decreases in a monetary union with 'exit rules'. The latter enforcement mechanism will unfold deterrence by limiting the negative externality problem. This is to say that CEN may be in a position to insulate PER_i from all other potentially 'troubled' EZ members. Notwithstanding, PER_i may still be very confident about controlling the risk that enacting strict fiscal legislation within the domestic arena will lead to voter alienation probably resulting in a departure from the

EZ and a deterioration of 'EMU stability'. PER_i might still be tempted to practise brinkmanship. In an EZ with explicit 'exit rules', such a profligate member can hardly threaten to cause havoc across the entire EZ as it is separated from the rest of the EZ in the course of a multi-stage deficit procedure (i.e. 'exit rules'). Therefore, enacting 'exit rules' within the EZ will shrink the range of credible brinkmanship and will, thus, be conducive to 'EMU stability'.

4 Conclusions

In this contribution, we have presented a formal game-theoretic framework to analyze the political economics of the occurrence of bail-outs within context of the European sovereign debt crisis. We have based our study on a political-economic analysis that helps comprehend why and how the parties involved arrive at bail-outs and on what conditions this outcome depends. In doing so, we have formally taken account of the negative externality problem that is central to policy debates related to the EZ's institutional design. Contrary to the existing literature, we have not only focused on the economic aspect of such a negative externality, but also looked at how it arises and interacts with the dynamics of the political process of the center-periphery relationship within the EZ.

Our analysis suggests that in future discussions of a possibly reformed EZ more weight should be given to policies that address the political-economic sources of negative externalities tracing in inadequate fiscal policy formation within the EZ. Against this background, the analysis suggests that policy alternatives for a reform of the EZ's institutional setting should aim at moderating negative externalities as much as possible. By its very nature monetary unions are apt to fiscal profligacy and required to address the inherent negative externality problem. In this regard, 'exit rules' would serve as a deterrent to brinkmanship in terms of mitigating the inherent negative externality problem within the EZ. By the same token, such device would also decrease the amount of the perceived mutual guarantee within a common currency area and thus reduce the scope for moral hazard in domestic fiscal affairs. Moreover, if departing from the EZ were openly allowed, external discipline will possibly intensify as financial markets would have no choice but to price the non-zero probability of one's exit into their risk assessment and thus better differentiate – not only in 'crisis times', but also in good times – country risk among EZ members. Furthermore, 'exit rules' would possibly also enhance domestic discipline because such institution would alter internal political-economic incentives. In this respect, multi-stage 'exit rules' would incrementally increase the electorate's per-

ceived costs of leaving (now largely hidden) in relation to the short-term costs of fiscal adjustment. Besides, 'exit rules' are likely to provide also an added benefit of decreasing market uncertainty, which would support the political and economic adjustment process in sovereign debt crisis. Currently, nobody knows what the legal procedure for leaving could be, what the costs would be, and how they would be distributed. Clarifying these issues by invoking a regime of 'exit rules' would mitigate financial market uncertainty with all its detrimental effects on the real economy.

In our analysis, we have formally shown that the current difficulties within the EZ do not only ensue from its members' fiscal problems alone, but from the interactions of these problems with the actual political configuration of the EZ. Differences in effective decision-making procedures within the political sphere may help explain differences in scenarios of sovereign debt crises across various currency areas. The political leverage of members within the US currency area –, for example, California whose fiscal woes do not wreak such havoc as is the case with the EZ – is seemingly much lower relative to economies within the EZ. In order words, it confirms that the sheer fact that countries share the same currency does not necessarily have to lead to negative externalities between them. Some commentators may contend that there are also no 'exit rules' in the US monetary union. Although this is true, such view overlooks the unique nature of the EZ, i.e. that it is a monetary union among sovereign states and not a federal state with a common fiscal policy like the US.

We conjecture that a deficiency in any one of a number of key institutions – such as the lack of 'exit rules' – dooms an endeavor like the EZ to failure. Obviously, a pertinent policy question concerns the feasibility of establishing 'exit rules'. Opponents towards 'exit rules' may argue that merely initiating a discussion on 'exit rules' would open up a Pandora's Box at a moment when Europe is badly in need of solidity. However, quite the opposite might in fact be true: Opening up such a discussion would possibly help stabilizing today's mess because the EZ's profligate members would receive the clear signal that there is a limit to other EZ members' willingness to pay for their negligence. This would increase the pressure to deliver and to adhere to future fiscal prudence. By the same token, the current inadequate resolutions schemes for sovereign debt crisis on the European level may eventually come into conflict with the immovable object of national politics. In this regard, it may turn out that 'crisis' also acts as a catalyst to reform. A reform of the EZ should put more weight on the incentives for fiscal responsibility that the current institutional set-up generates. 'Exit rules' may constitute a device for adequately readjusting the EZ's framework, which may help

safe-guarding 'EMU stability' and bringing the EZ to fruition – otherwise the EZ is doomed to its failure.

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