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Modelling Monetary and Fiscal Governance in the Wake of the Sovereign Debt Crisis in Europe

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Abstract: This paper analyzes different government debt relief programs in the European Monetary Union. I build a model and study different options ranging from debt relief to the European Stability Mechanism (ESM). The analysis reveals the following: First, patient countries repay debt, while impatient countries more likely consume and default. Second, without ESM loans, indebted countries default anyway. Third, if the probability to be an impatient government is high, then the supply of loans is constrained. In general, sustainable and unsustainable governments should be incentivized differently especially in a supranational monetary union. Finally, I develop policy recommendations for the ongoing debate in the Eurozone.

Keywords: European Monetary Union; debt relief; debt crisis; European Stability Mechanism

JEL Classification: E42; F34; H81; G28; H63; E61

1. Introduction

There is an ongoing debate in the Economic and Monetary Union (EMU) about how to tackle unsustainable public finances of member countries. This situation is defined where the cost of debt maintenance is so great that tax revenues and deficits are not sufficient to continue servicing the debt and essential public services. The European Sovereign Debt crisis, which started with the Greek crisis in 2010, illustrates that situation in a number of countries. The new rescue facilities, such as the European Stability Mechanism (ESM), may help in the short run, however, do not solve the present policy failures in the long run. It is needless to say that overcoming this crisis requires a two-fold plan: new national and European economic governance. Of course, a certain degree of solidarity is needed; however, the current EU-Treaty demands that every country has its own responsibility for public finances. Consequently, any assistance must be limited in size, conditional upon reforms and for a transitory period. Hence, in this paper, I study the optimal strategy of government relief programs in a tractable model.

The model distinguishes two options, namely default and debt restructuring (partial default). Obviously, both options have costs and benefits. I provide a rigorous discussion of both options in general and focus on the fundamental impact of present rescue strategies in the legal and political framework of Europe. Other options, such as exiting the EMU or the introduction of a domestic currency, are possible solutions, as well; however, they are politically unutilized and require further research.

I draw conclusions on how to tackle the European sovereign debt crisis. The main results are as follows: First, the rescue strategy must be designed differently for different types of countries. Sustainable or patient governments with debt problems due to unexpected shocks should be supported immediately. On the contrary, unsustainable or impatient governments need to be subject to more restricted loan conditions and strong conditionalities. Nevertheless, I find that impatient countries

default in almost any situation, except if they have access to European rescue facilities, such as the ESM. Second, countries use emergency loans for consumption purposes if and only if the loan is greater than the productive capacity of the economy. If the loan is below the level of productive capital, they use the money for investments. Third, the optimal loan is dependent on country-specific factors, such as the level of productive capital, the economic recovery or the type of government. Finally, I find evidence that the higher the number of patient countries, the easier it will be to tackle the EMU crisis. Consequently, enforcing existing limits on public finances, such as deficit and debt limits in the 'Stability and Growth Pact' (SGP) or the 'Fiscal Compact', is essential for the future of the EMU. Overall, to my knowledge, this is the first paper that demonstrates the impact of different strategies to tackle the sovereign debt crisis in Europe.

The remainder of the paper is structured as follows. Section 2 presents a brief literature review. In Section 3, I describe the model and discuss my findings. Finally, Section 4 is devoted to a model extension. Section 5 concludes the paper.

2. Literature Review

Since the onset of the European sovereign debt crisis in 2010, there has been an ongoing debate about the future of the Eurozone [1–6]. However, this is not a new debate in the literature of European macroeconomics [7,8]. Rather new are the institutional challenges with respect to a coherent and efficient rule-based economic and fiscal union. The obvious unpreparedness of the Eurozone is a political failure. Furthermore, the flawed incentives in European economic governance have been well known since the onset of the EMU [9]. Given the rules and flaws in the Eurozone, there is no feasible alternative than an enhanced solution within the present institutional setup.

The more general literature about currency unions started in the 1970s with the so-called Optimum Currency Area (OCA) theory [10–12]. They developed criteria for the setup of currency unions. Unfortunately, this literature does not make reference to how to organize a supranational monetary union. In Europe, monetary policy is centralized, while fiscal policy retains the majority of sovereignty at the domestic level; in other words, fiscal policy is decentralized [9]. Hence, the onset of the European sovereign debt crisis has launched a new debate on optimal rescue facilities within such an environment. Many organizations propose sometimes far-reaching, but infeasible solutions to the current debt problem in Europe [13,14]. Furthermore, so far, all proposals have been lacking a rigorous scientific analysis on the costs and benefits. This paper starts a somewhat more systematic debate.

In addition, there is some economic literature on sovereign default decisions [15–18]. Aguiar and Gopinath [19], JungJae [20] and Arellano [21] even study sovereign default issues in dynamic quantitative frameworks. However, to my knowledge, this paper addresses for the first time these issues within a tractable model. In addition, my approach is significantly differentiated from the existing literature because I explicitly distinguish between the costs and benefits of the existing rescue strategies in the EMU. So far, in the existing governance literature, you either find pure institutional or public finance approaches. There has been no comprehensive study on the effects of rescue strategies in a supranational currency union. Hence, this paper establishes a new line of research on rescue strategies in the EMU.

3. The Model

I build a model that captures the realities of economic governance in Europe. A special focus is on an answer to how to efficiently tackle the Eurozone crisis, *i.e.*, unsound public finances. The model analysis provides solutions for indebted countries and distinguishes between two options, namely debt relief (= full default) *versus* debt restructuring within the ESM (= partial default). Obviously, the model discusses the economic costs and benefits for both options. Until now, this fact has not been studied in a tractable model.

Next, I describe the model assumptions. Suppose the government discount factor is β^j, where j reflects different types of governments. If $j = l$, the government is labeled as 'impatient', which

reflects a shortsighted government. This government has a short-term horizon about refinancing public debt. On the contrary, if $j = h$, the government is 'patient', *i.e.*, it has a long-term horizon. This government is concerned about the sustainability of public finances and refinances public debt over the long run. Moreover, the latter recognizes the importance of the access to international capital markets to refinance future public debts. Consequently, the discount factors are within a range of $\beta^l < \beta^h < 1$. This assumption presupposes that patient countries discount the future less because β^h is greater than β^l. This idea is in line with Easterly [22], Sachs [23], Arslanalp and Henry [24,25], who analyze international debt relief programs. In addition, I assume that all EMU member countries that support indebted countries have incomplete information about the discount factor. The lender countries just know with probability p that the indebted country is patient or with probability $1 - p$ that it is impatient.

The model consists of two periods: $t = 0, 1$. Each government has an initial endowment equal to w_i, where i denotes the member country. In period $t = 0$, the indebted country i has outstanding debt D_i, which must be serviced in period $t = 1$. In doing so, the government receives credit lines, L_i, from private lenders under normal market conditions. If market financing is difficult due to unsustainable refinancing rates, for instance due to extremely high debt levels, the country either defaults on the debt or receives rescue. Rescue could be either further market loans, L_i, or loans from the European Stability Mechanism (ESM), E_i.

Let me address the first research question: How much should an indebted country invest or consume in period $t = 0$? To study this question, I utilize a country-wide utility function, such as:

$$U_i^j = c_{i,0} + \beta^j c_{i,1} \qquad if \qquad c_{i,0} \geq w_i \tag{1}$$

where w_i denotes initial wealth and $c_{i,0}$ consumption of country i in Period 0. The utility function assumes that only consumption creates utility. Wealth alone does not create utility, because you cannot eat money or wealth in general. Moreover, I assume that the endowment w_i cannot be invested. Hence, the utility function computes the present value of future consumption. Thus, consumption in period $t = 0$ is equal to $c_{i,0} = w_i + E_i + L_i - I_i$, where I_i denotes investments in country i. If a country consumes more than its initial wealth $c_{i,0} \geq w_i$ in $t = 0$, then $E_i + L_i \geq I_i$. The last inequality illustrates that country i must finance the consumption $c_{i,0}$ out of external sources, either E_i or L_i or both. In addition, I assume that the absorptive capacity of indebted countries is limited, *i.e.*, there is an upper bound of beneficial investment projects. This is captured by the following formula with the return on investment:

$$R_i(I_i) = \rho \min[I_i; K_i], \tag{2}$$

where ρ denotes the gross return on investment. In addition, K_i is the maximum amount of productive investment capital. Note that the return on investment is independent of the sources. Hence, in period $t = 1$, an indebted country has to make a decision whether to default on the debt or to repay the debt burden via a debt restructuring procedure. Let me discuss both scenarios separately:

(i) **Default (D):** If a country decides to default on its obligation, it loses a share $\xi < 1$ of its current output $y_{i,1}$. The loss $\xi y_{i,1}$ is partially carried by the debt holders. Furthermore, the loss of the debt holder is affected by a ratio $\phi \in [0, 1]$. Later, I distinguish two cases: if $\phi \to 0$, there is no recovery in the default country; if $\phi \to 1$, there will be a recovery. In summary, the consumption of the indebted country in the case of default yields in period $t = 1$:

$$c_{i,1} = (1 - \xi)[w_i + \rho \min[I_i; K_i]]. \tag{3}$$

(ii) **Repay or restructuring (no default (ND)):** If a country commits to repay the public debt, it can choose either an ESM loan E_i if eligible or a standard market loan L_i. If the country is eligible for ESM, it finances the outstanding debt obligations fully via ESM because the interest rate is lower than for market loans: $r_{ML} > r_{ESM}$. Hence, the market loan L_i is zero in this case. If the

country is non-eligible for the ESM, it must finance the debt by a market loan L_i. Now, the ESM loan E_i is zero. This rule follows the function: $\max[r_{ML} * L_i; r_{ESM} * E_i]$. Thus, the country has a consumption level in period $t = 1$, as:

$$c_{i,1} = w_i + \rho \min[I_i; K_i] - \max[r_{ML} * L_i; r_{ESM} * E_i] - D_i, \tag{4}$$

where all interest rates r are defined as real gross interest rates, such as r_{ML} the market rate and r_{ESM} the 'reduced' ESM rate. In addition, the risk-free nominal interest rate is in between $r_{ML} > i_{RF} \geq r_{ESM} > 1$. I assume that the lending market is competitive and the lenders are risk-neutral.

Without loss of generality, I utilize the following economically-relevant relationships of Equations (5)–(9) given the case of discussion:

$$\xi w_i < D_i \tag{5}$$

$$\xi\rho < i_{RF} < \rho \tag{6}$$

$$\beta^l \rho < 1 \tag{7}$$

$$\beta^h \min[i_{RF}; (1-\xi)\rho] > 1 \tag{8}$$

$$D_i > i_{RF} K_i \tag{9}$$

Equation (5) states that a country defaults if and only if the outstanding debt is greater than the cost of default. Relationship (6) assumes that the gross return on investment is bigger than the nominal risk-free interest rate. Moreover, the loss of the gross return on investment in case of default is lower than the risk-free interest rate. In other words, a risk-free investment is always beneficial, even if a default is expected. The assumptions in Equations (7) and (8) reflect the usual time preferences of the impatient and patient governments, respectively. Finally, Assumption (9) denotes that the debt stock D_i is greater than the risk-free investment of productive capital. Given these inequalities, I state the following proposition:

Proposition 1. *An impatient government consumes all resources in period $t = 0$. A patient government invests all resources up to K_i.*

Proof of the proposition. First of all, I have to distinguish between the two scenarios default (D) and no default (ND). In addition, I consider the patient and impatient government separately. Let me first discuss an impatient government $j = l$. If the government decides no default (ND), the utility function yields:

$$\begin{aligned} U^l_{i,ND} &= c_{i,0} + \beta^l c_{i,1} \\ &= [w_i + E_i + L_i - I_i] + \beta^l [w_i + \rho \min[I_i; K_i] - \max[r_{ML} * L_i; r_{ESM} * E_i] - D_i] \\ s.t. \quad & E_i + L_i - I_i \geq 0. \end{aligned}$$

The optimal investment is given by the F.O.C.[1] of the utility function with respect to I_i, as:

$$\frac{\partial U^l_{i,ND}}{\partial I_i} = -1 + \beta^l \rho < 0 \qquad \text{if} \qquad I_i \leq K_i \qquad \forall i.$$

[1] F.O.C. denotes the first-order condition. The optimization problem with the inequality constraint is solved with Kuhn–Tucker. However, the economically-meaningful assumption, $I_i \leq K_i$, simplifies the problem (*i.e.*, $\lambda = 0$).

Due to Assumption (7), the first-order condition is negative. Thus, increasing investments, I_i, reduce the utility of the impatient government in the case of no default. Hence, investments are not beneficial, and the impatient government inordinately consumes in $t = 0$. If the government decides to default (D), the utility maximization problem yields:

$$U^l_{i,D} = c_{0,i} + \beta^l c_{1,i} = [w_i + E_i + L_i - I_i] + \beta^l(1-\xi)[w_i + \rho \min[I_i; K_i]]$$
$$s.t. \qquad E_i + L_i - I_i \geq 0.$$

Again, the computation of the F.O.C. obtains:

$$\frac{\partial U^l_{i,D}}{\partial I_i} = -1 + \beta^l(1-\xi)\rho < 0 \qquad if \qquad I_i \leq K_i \qquad \forall i.$$

This is smaller than zero because $\xi \in (0,1)$ and $\beta^l \rho < 1$. Consequently, the impatient government always prefers to consume anything in period $t = 0$. Next, I show the behavior of the patient government $j = h$. Similarly, I obtain the first-order conditions:

$$\frac{\partial U^h_{i,ND}}{\partial I_i} = -1 + \beta^h \rho > 0 \qquad \text{if} \qquad I_i \leq K_i \qquad \forall i$$
$$\frac{\partial U^h_{i,D}}{\partial I_i} = -1 + \beta^h(1-\xi)\rho > 0 \qquad \text{if} \qquad I_i \leq K_i \qquad \forall i.$$

Both first-order conditions are greater than zero. Consequently, the patient government obtains higher utility with investments, as long as $I_i \leq K_i$. In case of $I_i > K_i$, the inequality constraint results in $L_i \geq I_i - E_i > K_i - E_i \; \forall i$. In this case, the patient government invests only the minimum $I_i = K_i$ and consumes the rest $E_i + L_i - K_i > 0$ in period $t = 0$ because the loans are greater than the productive capital K_i. Therefore, the patient government invests up to the productive capital K_i and consumes the remaining part. □

The behavior of governments in the case of $E_i + L_i > K_i$ provides new insights on the difference of ESM loans, E_i, and market loans, L_i.

Proposition 2. *If $E_i > K_i - L_i$, there is a crowding-out effect with respect to private investors $\Longleftrightarrow L_i = 0$.*

Proof of the proposition. Due to the fact that ESM loans are subject to conditionalities, such as (supply-side) reforms and austerity measures, the consumption of money above the productive capital K_i, (*i.e.*, $E_i > K_i - L_i$) is prohibited and non-beneficial. First, the impatient government consumes all in $t = 0$ and, thus, does not get money from the market, $L^l_i = 0$. The patient government is the only one that invests market loans, $L^h_i \neq 0$. However, if the patient government gets funding from a European facility $E_i > K_i - L_i$, such as the ESM, the market loan would be zero. The reasons are: (i) an investor would never give loans above the productive capital $L_i > K_i - E_i$, even to a patient government (Proposition 1); (ii) the private investor has no legal rights to enforce conditionalities, such as reforms alongside ESM loans, E_i. Thus, if $E_i + L_i > K_i$, the patient government would consume all above K_i, whose value is determined solely by L_i because market loans are unconditional, unlike E_i. Consequently, there is a crowding-out of private investors. In this case, the optimal level of market loans is equal to zero ($L_i = 0$). Thus, I obtain $E_i \geq K_i$, which is a crowding-out of private investors. □

So far, I find evidence that as long as indebted countries have access to market loans, they are similarly disciplined as under the ESM program. The ESM loan contains artificially-subsidized interest rates together with strong reform conditionalities. However, this type of loan reduces the incentive to repay and reform soon. Thus, it increases moral hazard. Consequently, an ESM loan does not effectively discipline future debt, such as a higher market interest rate would do. In addition, a country

under the ESM program is automatically excluded from markets, because investors are neither willing to lend to unsound countries due to the seniority of rescue facilities, nor are they able to offer such low rates. On the contrary, a market loan disciplines countries due to higher interest rates and, in particular, the countries expectations to get further loans only if the country has complied with previous loan conditions. The last aspect is crucial in free markets. The buildup of market reputation can only be achieved with a long history of back-payment. It is difficult to build up this reputation, but easy to lose it. This reputation mechanism, however, is switched off under the ESM program.

Proposition 3. *In the case of unsustainable public debt levels and the absence of European loans ($E_i = 0$), both types of governments default on the debt obligations.*

Proof of the proposition. For $j = l$, I have already shown that the impatient government consumes all resources in $t = 0$. Hence, the impatient government is going to default if:

$$\underbrace{(1-\xi)w_i}_{\text{wealth after default}} > \underbrace{w_i - \max[r_{ML} * L_i; r_{ESM} * E_i] - D_i}_{\text{wealth after no default}}$$
$$\Leftrightarrow \max[r_{ML} * L_i; r_{ESM} * E_i] + D_i > \xi w_i$$

This inequality is true due to inequality Equation (5). Consequently, the impatient government defaults at all times, even if there is a European rescue facility. Next, for the patient government $j = h$, it has been previously proven that the patient government invests all resources up to K_i in $t = 0$, and hence, $I_i = E_i + L_i \leq K_i$. In the absence of ESM loans, $E_i = 0$, even the patient government prefers default. This is demonstrated by:

$$\begin{aligned}(1-\xi)[w_i + \rho \min[I_i; K_i]] &> w_i + \rho \min[I_i; K_i] - \max[r_{ML} * L_i; r_{ESM} * E_i] - D_i \\ \Leftrightarrow \qquad D_i + (r_{ML} - \xi\rho)L_i &> \xi w_i \quad \text{if} \quad E_i = 0 \quad \forall i.\end{aligned}$$

The last inequality is true because of the assumptions $\xi w_i < D_i$ and $\xi\rho < i_{RF} < r_{ML}$. In the case of $I_i = E_i + L_i > K_i$, Proposition 1 demonstrates that the government invests only K_i. Hence, if $E_i = 0$, I obtain $D_i + (r_{ML}L_i - \xi\rho K_i) > \xi w_i$. This is, again, true because of the assumptions $\xi w_i < D_i$, $\xi\rho < i_{RF} < r_{ML}$ and $L_i \geq K_i$. Consequently, the governments prefer default if there is no ESM loan. □

If the cost of default is sufficiently high, *i.e.*, $\xi w_i > D_i + \epsilon$ for $\epsilon > 0$, countries do not default. In this case, I find maximum loan amounts.

Proposition 4. *The maximum market loan L_{ML}^{max} or ESM loan E_{ESM}^{max} is determined by the country-specific productive capital K_i, the initial wealth w_i and the debt level D_i, if $L_i > K_i$. Unless $L_i \leq K_i$, the maximum loans are determined only by the initial wealth w_i and the debt level D_i.*

Proof of the proposition. Of course, only the lending to patient governments, $j = h$, is of interest. Impatient governments consume all resources at $t = 0$ and default anyway at $t = 1$. The utility of the patient government, however, increases provided that $E_i + L_i \leq K_i$. The utility function in the case of no default yields:

$$\begin{aligned}U_{i,ND}^h &= [w_i + E_i + L_i - I_i] + \beta^h[w_i + \rho \min[E_i + L_i; K_i] - \\ &\quad - \max[r_{ML} * L_i; r_{ESM} * E_i] - D_i] \\ \Rightarrow \qquad \frac{\partial U_{i,ND}^h}{\partial L_i} &= 1 + \beta^h[\rho - r_{ML}] > 0 \qquad \forall i,\end{aligned}$$

where $\rho \geq r_{ML}$ due to common sense; return on investment ρ must be greater than the interest rate on market loans r_{ML}; otherwise, nobody would finance future investments. In the case of default and if $L_i \geq K_i - E_i$, the utility function and F.O.C. obtain:

$$U^h_{i,D} = [w_i + E_i + L_i - I_i] + \beta^h(1-\xi)[w_i + \rho K_i] \Longrightarrow \quad \frac{\partial U^h_{i,D}}{\partial L_i} = 1 > 0 \qquad \forall i.$$

Consequently, the patient government increases the utility from market loans in any circumstance. The maximum market loan is derived from the following condition, which makes the patient government indifferent between the two options of repay and default in period $t = 1$: $w_i + \rho K_i - \max[r_{ML} * L^{max}_{LM}; r_{ESM} * E^{max}_{ESM}] - D_i = (1-\xi)(w_i + \rho K_i)$ for all i. After rearranging, I obtain:

$$L^{max}_{ML} = \frac{1}{r_{ML}}[\xi(w_i + \rho K_i) - D_i].$$

The same is obtained for an ESM loan: $E^{max}_{ESM} = \frac{1}{r_{ESM}}[\xi(w_i + \rho K_i) - D_i]$. Consequently, the loan amount is dependent on w_i, K_i and D_i. For $L_i \leq K_i$, I obtain the following condition: $(1-\xi)[w_i + \rho(L_i + E_i)] = w_i + \rho(L_i + E_i) - r_{(.)}(L_i + E_i) - D_i$. Solving either for L_i if $E_i = 0$ or E_i if $L_i = 0$ results in:

$$L^{max}_{ML} = \frac{\xi w_i - D_i}{r_{ML} - \xi\rho} \qquad \text{and} \qquad E^{max}_{ESM} = \frac{\xi w_i - D_i}{r_{ESM} - \xi\rho}.$$

Consequently, the maximum loan is solely dependent on w_i and D_i. □

Intuitively, higher initial wealth and lower initial debt enable higher market or ESM loans. In an economic sense, this is self-explanatory, because countries with high wealth and low public debt are more resilient against shocks and, thus, more sustainable.

4. Modeling European Governance

So far, the model has been focusing on the different options under full information. However, in the EMU, there is no common fiscal policy and bond market. Thus, every interest rate is country specific. Therefore, I extend the model in the previous section and study the rescue options under asymmetric information. I find that debt restructuring under the European Stability Mechanism (ESM) allows both types of governments to obtain market loans again. I do not discuss mixed rescue strategies in this paper. This is a topic for future research.

Under asymmetric information, even the impatient government invests. However, the market loan has a higher interest rate, especially for patient governments than under full information. This is due to the unobservable solvency conditions of patient and impatient countries under asymmetric information. In short, I find a typical adverse selection problem.

Proposition 5. *If $1 - p$ denotes the probability of default, the break-even interest rate, r_{BE}, is given by $r_{BE} = \frac{r_{ML}\tilde{L}^{max}_{ML} - (1-p)\phi\xi w_i}{p\tilde{L}^{max}_{ML}}$.*

Proof of the proposition. If $L_i < K_i$ and EMU member countries have an average market interest rate, r_{ML}, and the break-even interest rate, r_{BE}, is country-specific according to the deficit and debt levels, then the break-even interest rate is given by:

$$p * r_{BE} * \tilde{L}^{max}_{ML} + (1-p)\phi\xi w_i = r_{ML}\tilde{L}^{max}_{ML}$$
$$r_{BE} = \frac{r_{ML}\tilde{L}^{max}_{ML} - (1-p)\phi\xi w_i}{p\tilde{L}^{max}_{ML}}$$

where ϕ is the recovery rate of the economy. □

Proposition 6. *The break-even loan is smaller than a market loan if the initial debt is zero, $D_i = 0$; i.e., $\tilde{L}_{BE}^{min} < \tilde{L}_{ML}^{max}$. For $D_i \neq 0$, the break-even loan is additionally dependent on p and D_i. For $p = 1$, all countries are patient, and the range of break-even loans starts at zero, $\tilde{L}_{BE}^{min} = 0$. For $p = 0$, all countries are impatient and default. Hence, the smallest break-even loan is greater than zero; however, the biggest break-even loan is still smaller than the market loan.*

Proof of the proposition. First, I assume $D_i = 0$. Using the break-even interest rate r_{BE} in Equation (3) gives:

$$\frac{\xi w_i}{r_{ML} - \xi\rho} = \frac{\xi w_i}{r_{BE} - \xi\rho} = \frac{\xi w_i p \tilde{L}_{ML}^{max}}{r_{ML}\tilde{L}_{ML}^{max} - (1-p)\phi\xi w_i - \xi\rho p\tilde{L}_{ML}^{max}}.$$

Solving for $\tilde{L}_{ML}^{max}$ yields the break-even loan:

$$\tilde{L}_{BE}^{min} = \frac{\xi\phi w_i}{r_{ML}}.$$

Comparing both loans easily demonstrates the proposition $\tilde{L}_{ML}^{max} > \tilde{L}_{BE}^{min}$.
Next, I assume $D_i \neq 0$. The break-even loan is equal to:

$$\tilde{L}_{BE}^{min} = \frac{(1-p)\xi\phi w_i(\xi w_i - D_i)}{(1-p)\xi w_i r_{ML} + (\xi\rho p - r_{ML})D_i}.$$

Consequently, it is significantly dependent on p and D_i. For $p = 0$ and $D_i = 0$, again, I obtain $\tilde{L}_{BE}^{min} = \frac{\xi\phi w_i}{r_{ML}}$. For $p = 1$ and $D_i \neq 0$, the lower bound of the break-even loan equals zero; $\tilde{L}_{BE}^{min} = 0$. □

The economic interpretation of the proposition is as follows: if the probability of default is high, $p \to 0$, the pool of available borrowers is bad. Thus, the lower bound of the break-even loan is non-negative. However, if the probability of default is low because all countries are patient, $p \to 1$, then an expansion of credit is beneficial. Now, the supply of break-even loans starts at the lower bound of zero. This effect demonstrates the investors' problem under asymmetric information.

Next, I assume that a guarantor maximizes a consumption function V of indebted countries, defined as the change of consumption in period $t = 1$, with and without intervention. For simplification, but standard in the literature, I assume that the costs function is quadratic, which captures the costs of rescue. Hence, I have:

$$\max V = \frac{pc_1^h + (1-p)c_1^l}{r} - C^2, \tag{10}$$

where r is a real gross interest rate. I study the present values of the two policy options and compare the levels. From Propositions 1 and 2, I already know that both governments default in the absence of ESM loans under full information. Thus, I obtain a present value of $D_{i,t} = \frac{\phi\xi w_i}{r}$. The right-hand side represents the present value of resources that creditors allocate or lose in the case of a default. The relevant functions of costs are:

$$C_{ESM} = \sqrt{\frac{\alpha}{2}\left[\frac{\phi\xi w}{r_{ESM}}E\right]} \quad \text{and} \quad C_{ML} = \sqrt{\frac{\alpha}{2}\left[\frac{\phi\xi w}{r_{ML}}L\right]}. \tag{11}$$

Without loss of generality, I assume that the initial wealth w_i and the debt D_i are the same in both cases.[2] Moreover, the economically-interesting case is $E + L < K$, and for comparison, I assume that

[2] Hence, I skip the subscript i.

the market loan, L, is equal in size to the ESM loan, E. I obtain the following utility functions from a lender's perspective:

$$V_{ESM} = \frac{p}{r_{ESM}}[(\rho - r_{ESM})E] - \frac{\alpha}{2}\left[\frac{\phi\xi w}{r_{ESM}}E\right]^2 \tag{12}$$

$$V_{ML} = \frac{p}{r_{ML}}[(\rho - r_{ML})L] - \frac{\alpha}{2}\left[\frac{\phi\xi w}{r_{ML}}L\right]^2. \tag{13}$$

Proposition 7. *(i) If the probability p to be a patient country is high and costs α are low, the optimal program is ESM; (ii) if the probability p to be a patient country is low and costs α are high, the utility from ESM rescue is lower than that of market loans. However, the latter is infeasible due to Proposition 2, and thus, debt default (or exit from the monetary union) should be optimal.*

Proof of the proposition. First of all, note that the first-term in Equation (12) is greater than in Equation (13). This is due to a subsidy mechanism, which (artificially) is lowering the loan interest rate in the ESM program. Consequently, for $p \to 1$ and $\alpha \to 0$, I immediately obtain $V_{ESM} > V_{ML}$. Thus, the ESM program is optimal and creates more utility. Otherwise, if $p \to 0$ and $\alpha \to 1$, and after trivial computation[3] of $V_{ESM} - V_{ML}$, I obtain $p\rho E\frac{r_{ML}-r_{ESM}}{r_{ML}r_{ESM}} > C_{ESM} - C_{ML} \geq 0$. Thus, $\lim_{p\to 0} p\rho E\frac{r_{ML}-r_{ESM}}{r_{ML}r_{ESM}} = 0$, and this yields $0 > C_{ESM} - C_{ML} \geq 0 \Leftrightarrow C_{ESM} = C_{ML}$. However, this is a contradiction to the cost function (Equation (11)). The cost of a ESM loan is greater than that of a market loan from a lender's perspective due to the subsidizing mechanism, $r_{ESM} < r_{LM}$. Thus, the ESM program is not optimal in this parameter constellation, and I obtain $V_{ESM} \leq V_{ML}$. However, impatient countries always default without ESM loans according to Proposition 2. Consequently, impatient countries cannot be rescued with the existing institutional strategy. □

It follows from this proposition that for impatient countries, debt default and exit from the EMU remain the optimal strategy. Thus, we need a new institutional procedure in European economic governance soon, especially an 'exit option' and an 'insolvency' arrangement for EMU member countries [26,27].

The intuition of this proposition is straightforward: for the EMU as a whole, rescue is utility-maximizing only for patient governments. If the pool of indebted countries consists mainly of impatient countries, the European rescue facility is not utility maximizing, because countries prefer default and the costs of rescue are too high. In this case, optimal economic governance ought to let countries go into default and exit the Economic and Monetary Union.

5. Conclusions

Since the onset of the European sovereign debt crisis, a lively debate has been going on about efficient rescue strategies for indebted countries. This paper provides a theoretical model for studying different government relief programs in Europe. Of course, a limitation of my model is the two-period structure; however, this is utilized due to tractability. The major contributions are as follows: First, I find evidence that sustainable and unsustainable countries should be treated differently. Second, sustainable countries commonly invest loans and enforce reforms, while unsustainable countries commonly default. Third, impatient countries need loans from the ESM; otherwise, they default anyway. Fourth, if the probability to be a patient government is above a certain threshold, the supply of loans ought to be less restricted. Consequently, the current EMU relief strategy is not really balanced and diversified. Until today, this finding has been overlooked. Finally, I confirm that unsound countries, defined as countries with high public deficit and debt levels over the long run, should be

[3] Computation is available upon request from the author.

either supported politically by aid loans with strong conditionalities (partial loss of sovereignty) or exit the EMU. Otherwise, unsound governments default on the costs of tax payers' money without enforcing sufficient (supply-side) reforms. Hence, this study contributes to the current debate about the re-design of European economic governance. Efficient and new economic governance requires more distinguishing features, especially an 'exit option' for unsound member countries and an 'insolvency' arrangement for all Eurozone countries.

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