The ECB's OMTs: a tale of governments and investors, constitutional judges and the central bank[*]

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Abstract

This paper compares limited international financial assistance via an EU/IMF programme, with an ex post (uncertain) unlimited financial assistance provided via OMTs. The success of international financial assistance depends on its ability to manage expectations and coordinate creditors into rolling over their short-term credit. With sufficient assistance, an EU/IMF programme galvanizes creditors into rolling over their loans, alleviates the liquidity crisis and helps the country to implement structural reforms and correct macroeconomic imbalances. Credible OMTs restore investors' confidence, and achieve the first-best without the actual need for ECB financial support.

Keywords: Outright Monetary Transactions; ECB; IMF; Debtor adjustment; Coordination problems; European sovereign debt crisis

JEL Classification Codes: C72; D82; F33

1 Introduction

Europe has seen two types of responses to the sovereign debt crisis in the period 2010-2013. First, a few European Union (EU) Member States that belong to the euro area adopted macroeconomic adjustment programmes akin to those traditionally proposed by the International Monetary Fund (IMF). These EU/IMF programmes consist of disbursements at the start of and throughout the adjustment programme, together with a set of measures which are intended to promote the consolidation of public finances and structural changes (e.g. labour market reforms) in the country under intervention.[1] Second, the European Union (EU) has designed a novel approach under which the European Stability Mechanism (ESM) and the European Central Bank (ECB) may cooperate in insuring investors against the potential illiquidity of a solvent sovereign. This is ensured through Outright Monetary Transactions (OMTs) by the ECB, which involve unlimited purchases of government securities in the secondary debt market, conditional on the beneficiary country adopting an ESM precautionary programme. There is no agreed theoretical rationale or empirical study that might assist in evaluating these two alternatives, and this work is the first attempt fill this gap.

The international financial crisis that erupted in August 2007, the 2008-2009 worldwide recession and the policy options adopted to respond to the crisis, significantly weakened the fiscal and budgetary positions worldwide. The euro area was not an exception. However, countries where increasing budget deficits had to be re-financed through capital inflows became particularly vulnerable to the fluctuations in the risk appetite of foreign investors. In fact, the severity of the sovereign debt crisis in the euro area, in 2010-2013, has been closely associated with pre-2010 accumulation of current account deficits (relatively large as a proportion of GDP) and persistent reliance on international capital inflows, which was seen, pre-2007, as largely non-problematic given the countries insertion in a single financial and currency area. In some countries (Cyprus, Ireland and Spain) rescuing banks aggravated the fiscal and budgetary po-

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[1] In the European case, the Cypriot, Irish, Greek and Portuguese programmes have been negotiated by the respective government with the intervention of the European Commission and the IMF in liasion with the European Central Bank. Funds were provided by the IMF, the European Financial Stability Facility (EFSF) and the European Financial Stabilisation Mechanism (EFSM). In the Spanish (banking system) programme, the IMF acted as an advisor to the Spanish government as there was no funding from the IMF involved, only from the European Stability Mechanism (ESM). There are important differences between the EU/IMF programmes and the more traditional IMF programs. Unlike in other IMF programmes, currency devaluation is not an option for EU Member States that belong to the euro area; and sovereign debt restructuring was ruled out in the beginning.

sitions and cast doubts about the solvency of the sovereign. In other countries (Greece and Portugal), arguably, bank's solvency was not the main factor contributing to international investor's doubts about the solvency of the sovereign. Moreover, sovereigns in the euro area are vulnerable to sudden liquidity shortages (e.g. roll-over risk). That is to say, while (solvent) banks have a lender of last resort (ECB or national central banks as liquidity providers) governments in the euro area did not have (and still do not have) such a safety net. This is due to the so-called monetary financing prohibition enshrined in Art. 123 of the Treaty on the Functioning of the European Union (TFEU), whereby the ECB and the national central banks are prohibited from purchasing government debt securities in the primary market (albeit not in the secondary market). The objective is to protect the central banks from their governments' pressures to monetize budget deficits. It is believed that giving-in to such pressures would undermine central bank independence and, eventually lead to high inflation in Europe.

As the crisis of confidence unfolded, sovereigns seen by investors as more fragile faced increasing difficulties to refinancing their debt. The European responses to these difficulties had different impacts on the confidence of investors. While the implementation of EU/IMF programmes in countries like Greece, Ireland and Portugal had an ambiguous effect on the (market) financing costs of sovereigns, the mere announcement of the OMTs reduced the cost of (market) finance for the European countries under difficulties. Figure 1 depicts the daily evolution of ten year bond yields in Greece, Ireland, and Portugal. The three charts in the first column cover the window three months before and three months after the signatures of the EU/IMF adjustment programmes, while the three graphs in the second column cover a similar six months window, but this time around the announcement of the OMTs.[2]

Figure 1 shows that all yields were on an increasing trend before the EU/IMF programmes were signed, and that all yields continued rising in the three months window after the programmes were signed. It is remarkable that all yields declined significantly in the period after the announcement of the OMTs, even though no country formally benefited from the OMTs. The evolution of the yields suggests that investors responded more confidently to the possibility of OMTs, than to the EU/IMF adjustment programmes. The difference in the response of in-

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[2]The President of the European Central Bank vowed "to do whatever it takes to preserve the euro" in a speech on 26 July 2012. The Governing Council of the ECB formally announced the OMTs on 2 August 2012, and the technical features of the OMTs were presented on 6 September 2012. We use the date of the speech by the President of the ECB as the announcement date.
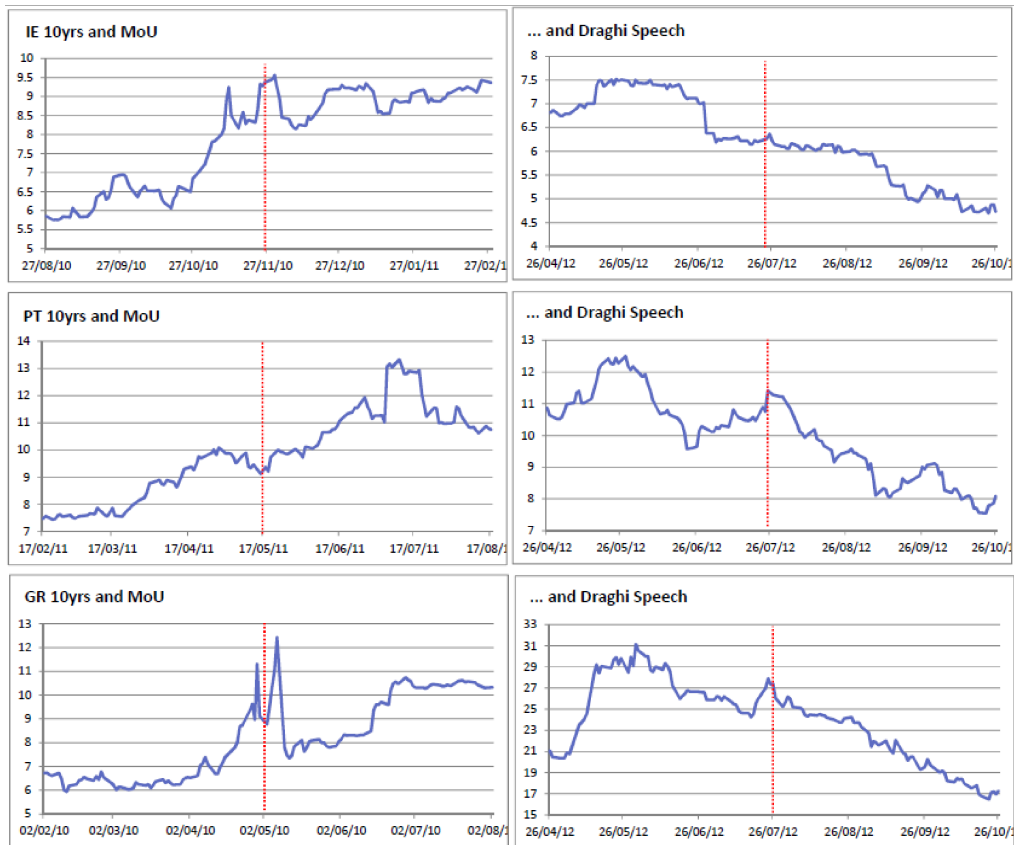
Figure 1: Daily evolution of ten year bond yields for Ireland (IE), Portugal (PT), and Greece (GR) in a six month window around the date of the signature of the Memorandum of Understanding (MoU) for each country, and the date of the speech of the President of the ECB vowing "to do whatever it takes to preserve the euro". Source: Reuters.
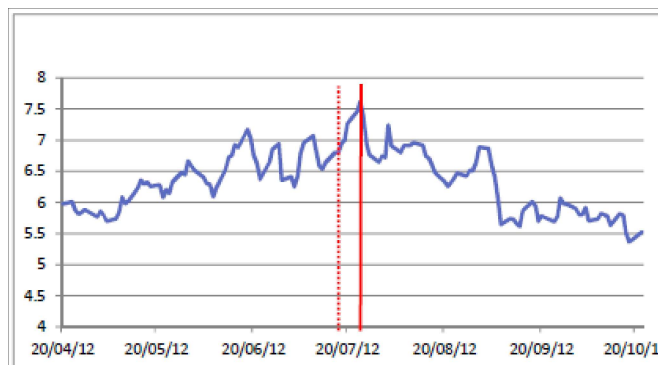
Figure 2: Daily evolution of ten year bond yields for Spain in a six month window around the dates of the signature of the Memorandum of Understanding (dashed line), and of the speech of the President of the ECB vowing "to do whatever it takes to preserve the euro" (solid line). Source: Reuters.

vestors to the two types of assistance is glaring in the Spanish case. Spain signed an agreement (Memorandum of Understanding; MoU) to obtain financial assistance for the recapitalization of some of its financial institutions. The agreement was sanctioned by the Eurogroup on 20 July 2012, but that event had no visible positive impact on financial markets as bond yields rose further. On the following week, however, the announcement of the OMTs triggered an unambiguous decline in borrowing cost for the Spanish government.[3] Figure 2 shows the daily evolution of 10 year bond yields in Spain over a six month window around the dates of the endorsement of the agreement of financial assistance, and the announcement of the OMTs.

There is no theoretical framework to help us compare the two types of international financial assistance. Assessing the differences is difficult as the choices of investors, international institutions and sovereigns are interdependent and are determined by the specific rules of the assistance programme. Investors will react differently in a programme with "unlimited firepower", or in an EU/IMF programme in which there is a fixed amount of financial assistance. Investors will see default as more likely, if international institutions have few funds to shore up the country or if financial assistance under the OMTs is unlikely.

Our analysis builds up on the model of debt roll-over developed in Morris and Shin (2004, 2006). Investors (which we also call creditors, lenders or international fund managers) choose whether or not to refinance a sovereign with an uncertain capacity to repay. Uncertainty about

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[3]Italy, a country under market stress during summer 2012, and that did not received financial assistance, also benefited from the speech of the President of the ECB. Italian and Spanish government bond yields were highly correlated during that period.

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whether disperse creditors will roll over the short term debt of the sovereign, induces fund managers to refrain from investing, thus creating solvent but illiquid sovereigns. Lenders face a coordination problem, since many refrain from investing even when they are (almost) sure that the sovereign is solvent. Such coordination problem would not exist if there were one single creditor, and the role of international institutions is to sort out the coordination problems faced by dispersed creditors.

We abstract from moral hazard problems, as we assume an economy without bargaining power, for which adjustment can be credibly enforced by the international institutions.[4] We consider two types of financial assistance. First, we consider an EU/IMF programme which implies the immediate provision of cash to the country. We find a trade-off between the level of adjustment effort of the country and the amount of financial assistance. Adjustment effort is recessionary and reduces the amount of cash available to the government, raising questions about the ability of the sovereign to roll over its debt in the short run.[5] International financial assistance coordinates fund managers into rolling over their loans, thus alleviating the liquidity crisis. Without enough financial assistance, illiquid countries are unable to choose the optimal level of adjustment effort.

Second, we consider an ESM precautionary programme, in which there could be ex post intervention with OMTs after fund managers take their roll-over decisions. The international institutions lend cash to the sovereign if there is insufficient roll-over, thus preventing default triggered by illiquidity. We consider the extreme case in which the international institutions commit to intervene, if needed, with probability one. Perfect commitment restores investors' confidence and induces them to invest, so that the international institutions do not need to intervene ex post. A solvent country will never be illiquid.

We also consider the less extreme case in which the international institutions intervene ex post with probability lower than one. Uncertainty about the use of OMTs impairs the ability

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[4]Morris and Shin (2006) deal in detail with moral hazard issues, and suggest that international financial assistance will sometimes improve the incentives for sovereigns to take costly adjustment effort, thus reducing moral hazard problems. The reinforcement of the economic governance in the EU has reduced the moral hazard problem (see the institutional details in Section 2), but it is not clear whether EU/IMF programmes suffer from more, or less, moral hazard problems than ESM/OMTs programmes.

[5]There are two dimensions in the adjustment program. First, "fiscal consolidation" measures aimed at reducing imbalances in public accounts. Second, "structural reforms" aiming at boosting long term growth prospects. In our paper, these dimensions show up under the name "adjustment effort". Adjustment effort is very likely recessionary in the short-term, as a result of fiscal consolidation and because some structural reforms (e.g. labour market reforms) may also be recessionary in the short-term. Recessionary effects lead to a reduction in tax revenues and to an increase in government transfers, thereby reducing the amount of cash available to the government in the short run.

to coordinate investors and, as a result, the international institution intervenes ex post with positive probability. Still, there is a range for the fundamentals in which the country benefits from the OMTs without receiving any material financial assistance. Moreover, the ESM/OMTs programme is the only option available to prevent an illiquidity triggered default if the EU/IMF programme has insufficient official funds to assist a country.

From all available policy options, including the EU/IMF programme, the best option is ESM/OMTs assistance in which there is no uncertainty about the ex post intervention. This option achieves the first-best, without the actual need for cash injection. The critique to the OMTs that the ECB will be providing unlimited financing to countries is not warranted for solvent countries. With perfect commitment, there is no need for ECB ex post financial help.

Finally, we relate the results of the model with the limited interpretation on the legality of OMTs made by the German Constitutional Court. The suggestions made by the German court to limit the size of the OMTs would severely undermine their impact, as it would make assistance with OMTs similar to EU/IMF programmes.

Relationship to the literature. There is a close formal relationship between our model and the Diamond-Dybvig (1983) simple model of bank runs. Diamond and Dybvig (1983) observed that a credible lender of last resort solves the problem of indeterminacy of equilibria. The literature has focused on the trade-off between ex post incentives to provide assistance to prevent crises, and the ex ante moral hazard caused by the anticipation of such policies. Like our paper, Rochet and Vives (2004), Morris and Shin (2006) and Corsetti, Guimarães and Roubini (2006) use global games to perform comparative statics. Still, the focus of our paper is not on moral hazard issues, but rather on the incentives provided to private creditors by the specific rules of the assistance programme. We want to understand how these rules sort out the coordination problems of dispersed creditors. In this vein, De Grauwe and Li (2013) test the hypothesis that government bond markets in the euro area are more fragile and more susceptible to liquidity crises than those of countries that issue debt in their own currencies, and De Grauwe (2011, 2012) presents the strengths and weaknesses of the several options available to the euro area.

The remainder of the paper is organized as follows. The next section puts the OMTs in the context of the new economic governance of the EU. Section 3 sets up the model of debt roll-over, and characterizes the equilibrium without international financial assistance. Section 4 incorporates an EU/IMF assistance programme. Section 5 analyses the case of an EMS/OMTs

programme, and compares the results obtained with the two types of financial assistance. Section 6 links our results to the decision of the German Constitutional Court of 7 February 2014, and Section 7 concludes.

2   The Outright Monetary Transactions framework

As a response to the financial and sovereign debt crisis, the European Commission and EU Member States launched a comprehensive set of initiatives aimed at reinforcing the economic governance in the EU and, in particular, in the euro area. These initiatives are broad ranging and include a new set of rules that strengthen the Stability and Growth Pact (SGP) and the creation of the European Stability Mechanism (ESM) to promote financial stability in the euro area. The final goal of these initiatives is to create a new governance framework which safeguards financial stability in the EU, ensures that Member States make sustained progress towards fiscal consolidation, and implement the growth enhancing structural reforms that are needed, for each Member State to reach the objectives set out in the Europe 2020 strategy. In addition, all euro area countries and six non-euro area EU Member States agreed, in March 2011, to improve the competitiveness of their economies by making specific commitments each year published in National Stability and Reform Programmes that are discussed and approved by the European Council and the Eurogroup (Euro Plus Pact).[6]

In this section we briefly summarize what is more relevant to put the OMTs into the broader context of the governance changes in the euro area after 2011.

Among the new rules, the so called Six-pack strengthens compliance with the SGP benchmarks (ratios of government deficit to GDP lower than 3%, and government debt to GDP lower than 60%) through the setting of medium-term budgetary objectives (MTO; the preventive arm of the SGP) and the reinforcement of its corrective arm, the Excessive Deficits Procedure (EDP). The EDP has been reinforced by stricter compliance rules. The Six-pack also includes an alert mechanism for macroeconomic imbalances. A scoreboard of eleven economic indicators is maintained and monitored by the European Commission. If the indicators cross certain critical thresholds in-depth reviews of the economic circumstances of the Member States are

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[6]For full account of the various initiatives the reader is invited to visit http://ec.europa.eu/index_en.htm (general information) and
http://register.consilium.europa.eu/doc/srv?l=EN&t=PDF&gc=true&sc=false&f=ST%2010%202011%20INIT (Euro Plus Pact).

triggered that may lead to the implementation of counteracting measures (the Excessive Imbalances Procedure, EIP). In addition, the Fiscal Compact (only binding for euro area countries) further reinforces the SGP through the implementation of quasi-automatic correcting mechanisms when significant and repeated deviation from the MTO, and the adoption of balanced (structural) budget rules enshrined in the national legislation of euro area countries.

The new rules share two key features. On the one hand, they strengthen the enforcement of the rules (preventive arm) and, on the other hand, they foster the early implementation of adjustment measures (corrective arm). For example, EU Member States that deviate from the SGP rules are steered towards its compliance through the MTOs, and significant and persistent deviations must be corrected or otherwise penalized. These measures aim at preventing future crises as well as mitigating the moral hazard associated with ex post financial assistance.

The ESM complements the measures introduced at the EU level. It is an important component in the strategy to promote financial stability within the euro area also endowing the euro area with a crisis management tool (due to its EUR 500 billion effective lending capacity). Another financial stability enhancing element was the decision to centralize the banking supervisory responsibilities, in the euro area, and give it to the ECB (the Single Supervisory Mechanism). Despite the new rules and their preventive nature it cannot be excluded that a country belonging to the euro area may still require financial assistance. In that case, the ESM can use its resources and act as a financial backstop so as to prevent a sovereign debt liquidity crisis.[7]

One financial assistance instrument available to the members of the ESM is the Precautionary Financial Assistance in the form of a credit line, which guarantees access to ESM funding before the country loses access to financial markets. As stated in the ESM guidelines,

"precautionary financial assistance aims at helping ESM Members whose economic conditions are still sound to maintain continuous access to market financing by reinforcing the credibility of their macroeconomic performance while ensuring an adequate safety-net."

Still, the resources of the ESM are limited, and generally seen as insufficient to stabilize the financing needs of large euro area countries such as Spain or Italy.

Precautionary Financial Assistance is limited to countries which are fundamentally sound (the eligibility criteria is monitored by the European Commission and the ECB), and is condi-

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[7]For further information about the ESM visit http://www.esm.europa.eu/

tional on the beneficiary country maintaining or adopting a programme of sound policies so as to guarantee access to financial markets. In particular the country must be in full compliance with the MTO and corrective measures contained in the EDP or in the EIP.

Precautionary Financial Assistance may be provided via an Enhanced Conditions Credit Line that may be drawn via primary market purchases of government bonds. Only in this special case could the Governing Council of the ECB consider OMTs, reserving the right to intervene in full discretion (and acting in accordance with the monetary policy mandate of the ECB). OMTs consist of purchases of sovereign bonds that mature in one to three years. The ECB accepts the same treatment as private creditors with respect to those bonds. Albeit there are no limits to the size of OMTs, the total outstanding debt stock in the relevant maturities (one to three years) puts a natural limit to the potential purchases by the ECB. The purchases would never be "unlimited" ex post.

3 The model

The model builds on Morris and Shin (2004, 2006). A sovereign government needs funds to pay its creditors, so as to fulfill its obligations in international sovereign debt markets. The government has an outstanding amount of debt that equals 1 and is about to mature. The government has available cash equal to θ, which is the realization of a random variable with mean $y - e$.

- The variable y represents the strength of the underlying economic fundamentals.

- The variable $e \geq 0$ stands for "adjustment effort" undertaken by the government. Unlike Morris and Shin (2006), we assume that more adjustment effort reduces the amount of money available to the government in the short run. Adjustment effort is needed for the correction of macroeconomic imbalances as well as to implement structural reforms, which are beneficial in the long run but take time to produce effects.

There is a continuum of international fund managers of mass 1, each with one unit of funds, and willing to lend to the government only short term.

For simplicity, we assume the borrower's finances are viable in the long run as long as $\theta \geq 0$. If $\theta < 0$, the country is not solvent. When $\theta \geq 1$, the debtor country faces no liquidity problems

because the sovereign has enough funds to meet the maturing debt. In the intermediate range $0 \leq \theta < 1$, the fate of the country lies in the hands of fund managers, and it will default if it is unable to convince them to buy short term sovereign debt.

The sequence of decisions can be summarized as follows.

1. Nature draws the fundamental y; y is common knowledge.

2. The government chooses adjustment effort e; e is common knowledge.

3. Nature draws the available cash θ from a normal density with mean $y - e$ and variance $1/\alpha$. No one observes θ.

4. Each investor i observes the realization of his signal $x_i = \theta + \frac{1}{\sqrt{\beta}} \varepsilon_i$ where ε_i is standard normal, independent and identically distributed across investors and independent of θ. Private information introduces heterogeneity in market expectations about the amount of cash available and may be read as heterogeneity in the reading and interpretation of available information.

5. Based on the information y, e, and his private signal x_i, each investor individually decides whether or not to invest his unit of debt. Define $a_i \in \{0, 1\}$ as individual investment.

Let $A = \int_0^1 a_i di$ denote the aggregate level of short term investment. The debtor country defaults on its debt if it is unable to fulfill its short term promises

$$\theta + A < 1.$$

The payoff of short term creditors is given by

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\begin{cases}
R & \text{if} \quad a_i = 1 \text{ and } \theta + A \geq 1 \\
R - \Delta & \text{if} \quad a_i = 1 \text{ and } \theta + A < 1 \\
1 & \text{if} \quad a_i = 0
\end{cases}
$$

where R and Δ are constants with $0 < R - 1 < \Delta < R$. Provided the mass of investors A is large enough, the country will repay R on sovereign debt; otherwise the country repays $R - \Delta$, where Δ measures loss given default. In order to normalize the creditors' payoffs, we subtract

1 and divide by Δ, so that

$$u(a_i, \theta, A) \equiv \begin{cases} 1 - c & \text{if} \quad a_i = 1 \text{ and } \theta + A \geq 1 \\ -c & \text{if} \quad a_i = 1 \text{ and } \theta + A < 1 \\ 0 & \text{if} \quad a_i = 0 \end{cases}.$$

with $c = 1 - \frac{R-1}{\Delta} \in (0, 1)$. The payoff of the sovereign government equals

$$u_G(\theta, A) \equiv \begin{cases} \psi_1(e) & \text{if} \quad \theta + A \geq 1 \\ 0 & \text{if} \quad \theta + A < 1 \end{cases}.$$

Function $\psi_1(e)$ represents the present value of the long term benefits of carrying out structural reforms and addressing macroeconomic imbalances. We assume that function $\psi_1(.)$ is twice differentiable, concave, with $\psi_1(0) = 0$, and reaches its maximum at $e = e^* > 0$. The marginal benefits of adjustment effort decrease with the level of effort, and there is an optimal level of adjustment effort equal to e^*. The payoff from default is null, and we assume that the debtor country sets $e = 0$ if it anticipates that it will default.

3.1 Short term investors

The model is solved by backward induction and we start by short term creditors. Conditional on private information, the posterior distribution of cash θ is normal with the following mean and variance:

$$\begin{aligned} E_i[\theta] &= E[\theta|x_i] = E[\theta] + \frac{Cov[\theta, x_i]}{Var[x_i]}[x_i - E[\theta]] = \\ &= y - e + \frac{Cov[\theta, x_i]}{Var[x_i]}[x_i - (y - e)] = \frac{\alpha(y - e) + \beta x_i}{\alpha + \beta} \end{aligned} \tag{1}$$

$$Var_i[\theta] = Var[\theta|x_i] = Var[\theta] - \frac{(Cov[\theta, x_i])^2}{Var[x_i]} = \frac{1}{\alpha + \beta}. \tag{2}$$

We focus on a special class of strategies called *switching strategies*, in which a creditor rolls over if and only if his signal x_i is higher than some threshold level x^*. Two conditions characterize the problem.

Default threshold condition. The country is on the edge of a crisis when $\theta + A = 1$,

where A is the mass of investors who have received a signal above the threshold x^*. With a continuum of individuals, A is equal to the probability that an individual investor receives a signal higher than x^*. Denote by θ^* the critical state θ which separates those states in which default occurs from those states in which the sovereign continues servicing its debt, that is $\theta^* + A = 1$. When $\theta = \theta^*$, the distribution of x_i is normal with mean θ^* and precision β. Hence $A = 1 - \Phi\left(\sqrt{\beta}\left(x^* - \theta^*\right)\right)$, where $\Phi\left(.\right)$ is the cumulative distribution function of the standard normal. Since $\theta^* + A = 1$, we obtain

$$\theta^* = \Phi\left(\sqrt{\beta}\left(x^* - \theta^*\right)\right) \Leftrightarrow x^* = \theta^* + \frac{\Phi^{-1}\left(\theta^*\right)}{\sqrt{\beta}} \tag{3}$$

Indifference threshold condition. At the switching point x^*, a fund manager is indifferent between investing and not investing. Not investing yields zero, while the individual expected payoff of rolling over depends on the subjective probability that the country does not default, and the returns with and without default. Since the sovereign avoids default whenever $\theta \geq \theta^*$, fund manager i invests whenever $prob_i\left[\theta \geq \theta^*\right]\left(1 - c\right) - prob_i\left[\theta < \theta^*\right]c \geq 0$. The value of $prob_i\left[\theta < \theta^*\right]$ is the probability that investor i attaches to θ being lower than θ^*. Investor i believes that θ has a normal distribution with mean $\frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}$ and precision $a + \beta$ - see expressions (1) and (2). Hence, the probability that investor i attributes to default is equal to $prob_i\left[\theta < \theta^*\right] = \Phi\left(\sqrt{\alpha+\beta}\left(\theta^* - \frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right)$. For the marginal investor who is indifferent between investing or not,

$$\left[1 - \Phi\left(\sqrt{\alpha+\beta}\left(\theta^* - \frac{\alpha\left(y-e\right)+\beta x_i}{\alpha+\beta}\right)\right)\right]\left(1 - c\right)$$
$$-\Phi\left(\sqrt{\alpha+\beta}\left(\theta^* - \frac{\alpha\left(y-e\right)+\beta x_i}{\alpha+\beta}\right)\right)c = 0.$$

This indifference condition applies for $x_i = x^*$, and can be rewritten as $\theta^* - \frac{\alpha(y-e)+\beta x^*}{\alpha+\beta} = \frac{\Phi^{-1}(1-c)}{\sqrt{\alpha+\beta}}$. Since $\Phi^{-1}\left(1 - c\right) = -\Phi^{-1}\left(c\right)$,

$$\theta^* - \frac{\alpha\left(y-e\right)+\beta x^*}{\alpha+\beta} = -\frac{\Phi^{-1}\left(c\right)}{\sqrt{\alpha+\beta}} \tag{4}$$

Critical value of θ. Equilibrium in the short term debt market is identified with a joint

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solution to conditions (3) and (4). Substituting (3) into (4) yields

$$\theta^* = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\theta^* - (y-e) + \frac{\sqrt{\alpha+\beta}}{\alpha}\Phi^{-1}(c)\right)\right). \tag{5}$$

When $0 \le \theta < \theta^*$, the country defaults even though it is fundamentally sound; when $\theta \ge \theta^*$ there is no default. The critical state θ^* is obtained as the intersection between a cumulative normal distribution with a straight line of slope one. Equation (5) has a unique solution, if the expression in the right hand side has a slope that is less than one everywhere. The slope of the right hand side is given by $\phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\theta^* - y + e + \Phi^{-1}(c)\frac{\sqrt{\alpha+\beta}}{\alpha}\right)\right)\frac{\alpha}{\sqrt{\beta}}$ where $\phi(.)$ is the density of the standard normal distribution. Since $\phi(.) \le \frac{1}{\sqrt{2\pi}}$, a sufficient condition for a unique solution for θ^* is given by

$$\frac{\alpha}{\sqrt{\beta}} \le \sqrt{2\pi}.$$

This bound guarantees that the precision of *private information* (measured by β) is large enough when compared with the precision of *public information* (measured by α). It turns out that this inequality is also sufficient for uniqueness of equilibrium in any class of strategies - not simply the switching strategies (see Morris and Shin, 2004).

3.1.1 Limiting case

In order to keep the analysis tractable, we are interested in the limiting case when information becomes very precise. Specifically, let $\alpha \to \infty$ and $\beta \to \infty$ such that $\frac{\alpha}{\sqrt{\beta}} \to 1 < \sqrt{2\pi}$. From equation (5), the default threshold satisfies

$$\theta^* = \Phi\left(\theta^* - (y-e) + \Phi^{-1}(c)\right) \tag{6}$$

In the limiting case,

$$\theta \to y - e,$$

and the sovereign defaults if and only if $y - e < \theta^*$.

Remark. There is a unique equilibrium, and the sovereign defaults if and only if $y - e < \theta^*$.

The threshold θ^* defines the critical value for $y - e$, above which there is no default. Replacing $y - e$ by θ^* in equation (6), we obtain $\theta^* = c$, and the next result.

Proposition 1 *In the limiting case, the sovereign defaults if and only if $y - e < c$.*

3.1.2 Efficiency and the case of one single creditor

It is instructive to compare the case of disperse investors with the case in which there is one single creditor. A single creditor would not face a coordination problem, and would invest whenever the country is solvent, that is when $\theta > 0$. We consider this the first-best outcome.

Proposition 1 shows that inefficiencies persist even though information reveals what the underlying state θ is. The government defaults when $0 < \theta < c$. This is because *strategic uncertainty* (that is, uncertainty about other investors' actions) is not resolved even when signals become very precise. Private noise destroys common knowledge, thereby preventing perfect coordination.

There is a critical threshold for the value of available cash below which the borrower is unable to roll over its debt and defaults. Conventional accounts obtain the default threshold for sovereign debt using some natural debt limit. This limit comes from assuming the risk-free status of government debt and finding the maximum debt that could be repaid under an optimal fiscal policy. In this sense, conventional accounts assume that short term creditors are able to coordinate their actions perfectly, thereby behaving as if there was one single creditor.

Yet, in the short run, default depends mainly on the ability of the sovereign to manage expectations and coordinate creditors into rolling over their claims. In the model proposed here, the default threshold depends on natural debt limits *and* on the willingness of investors to roll over their short term loans. As a result, the default threshold is more stringent than in conventional models of sovereign debt, because solvency and liquidity problems are not separable.

3.2 The sovereign

When the fundamental is good (that is, $y \geq c + e^*$) the sovereign sets the optimal level of adjustment effort e^*. For intermediate values of the fundamental ($c \leq y < c + e^*$), the sovereign is restricted by the behavior of investors as the country would default if the government set effort equal to the optimal level e^*. For intermediate values of the fundamental, the sovereign sets the level of effort equal to $e = y - c < e^*$, which is the maximum level of effort that

guarantees continuation. When $y < c$, the sovereign defaults.

A key feature of the model is that too much adjustment effort may lead to default. For example, Proposition 1 shows that adjustment effort triggers default when $y = c$.

4 Equilibrium with EU/IMF assistance programme

There is an international institution, which we call IMF, willing to help the country solve its liquidity problems. This is a simplification for financial assistance obtained through EU/IMF stabilization programmes. The IMF lends an amount of funds $m \geq 0$ to the debtor country.

The extensive form of the game is the following:

1. Nature draws the fundamental y; y is common knowledge.

2. The country chooses adjustment effort e; e is common knowledge.

3. The IMF chooses the amount of funding m; m is common knowledge.

4. Nature draws the available cash θ from a normal density with mean $y - e$ and variance $1/\alpha$. No one observes θ.

5. Each creditor i observes the realization of his signal $x_i = \theta + \frac{1}{\sqrt{\beta}} \varepsilon_i$ where ε_i is standard normal, independent and identically distributed across investors and independent of θ.

6. Based on the information y, e, m and his private signal x_i, each short term creditor individually decides whether or not to roll over his unit of debt.

The debtor country defaults on its debt if

$$\theta + m + A < 1.$$

We rewrite the payoff of short term creditors as

$$u(a_i, \theta, m, A) \equiv \begin{cases} 1 - c & \text{if} \quad a_i = 1 \text{ and } \theta + m + A \geq 1 \\ -c & \text{if} \quad a_i = 1 \text{ and } \theta + m + A < 1 \\ 0 & \text{if} \quad a_i = 0 \end{cases} \cdot$$

with $c \in (0, 1)$. The payoff function of the sovereign government is the same as in Section 2. Following Morris and Shin (2006), the payoff function of the international institution is given by

$$\widetilde{u}(\theta, m, A) \equiv \begin{cases} \Psi - bm & \text{if} \quad \theta + m + A \geq 1 \text{ and } \theta \geq 0 \\ -bm & \text{if} \quad \theta + m + A < 1 \text{ and } \theta \geq 0 \\ -bm & \text{if} \qquad\qquad \theta < 0 \end{cases}$$

with $b > 0$; the payoff from no intervention is null.[8] The intuition behind this function is that the IMF faces a cost b of funding and has a gain equal to Ψ if its intervention is successful. It implies that a small successful intervention yields bigger gains for the IMF, than a large successful intervention. According to its payoff function, the IMF wants to set the size of international assistance, m, as low as possible. There is an upper bound $\overline{m}$ for the IMF's intervention, because the IMF will not intervene if $\Psi - bm < 0$. Hence, $m \leq \frac{\Psi}{b} \equiv \overline{m}$.[9]

4.1 Short term investors

We apply the methods in Section 3 to obtain the solution to the subgame that begins with Nature's draw of the available cash θ. In this subgame, there is a threshold θ^*_{IMF} for the value of θ, and the country defaults if and only if $\theta < \theta^*_{IMF}$. The default threshold condition becomes $\theta^*_{IMF} + A + m = 1$, the indifference threshold condition remains the same, and

$$\theta^*_{IMF} = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\theta^*_{IMF} - (y - e) + \frac{\sqrt{\alpha + \beta}}{\alpha}\Phi^{-1}(c)\right)\right) - m. \tag{7}$$

We assume the limiting case, with $\alpha \to \infty$ and $\beta \to \infty$ such that $\frac{\alpha}{\sqrt{\beta}} \to 1 < \sqrt{2\pi}$, to obtain $\theta \to y - e$. Applying these results to expression (7), we obtain $\theta^*_{IMF} = c - m$, and the next result.

Proposition 2 *In the limiting case and when there is IMF, the sovereign defaults if and only if $y - e < c - m$.*

---

[8] We standardize the payoff from no intervention to zero, as Ψ parametrizes the difference in the payoff of the international institution obtained with continuation and default of the sovereign.

[9] Alternatively, we could have assumed that there was a limited amount of funds available for official assistance.

4.2 The IMF

The solution for the default threshold can now be used in evaluating the decisions of the IMF and the sovereign. Backward induction implies that we address first the IMF's decision.

The IMF can help short term creditors sorting out their coordination difficulties, thereby achieving an equilibrium which is closer to the first-best equilibrium. Yet, the IMF faces restrictions on the amount of funds $\overline{m}$ that can be used in a bailout programme.

In the limiting case, the IMF knows the fundamental y and the adjustment effort e, and chooses the amount of assistance m to maximize its expected payoff. It does not intervene when $y - e < 0$, because the country is not solvent. The IMF wants to set the value of m as low as possible, so that it will set $m = 0$ when there are no liquidity problems (that is, when $c \leq y - e$). When $0 \leq y - e < c$, the country is fundamentally sound but defaults without financial assistance. As long as $c - \overline{m} \leq y - e$, optimal IMF intervention sets $m = e - y + c$. If $y - e < c - \overline{m}$, the IMF is not willing to intervene since the required intervention is too big. Hence the optimal value of m satisfies

$$m^* = \begin{cases} e - y + c & if \quad \max\{0, c - \overline{m}\} \leq y - e < c \\ 0 & otherwise \end{cases} \tag{8}$$

The solution makes intuitive sense. The IMF intervenes when three conditions are fulfilled:

1. The country's finances are viable in the long run $(0 \leq y - e)$,

2. the coordination problem among short term creditors leads to default $(y - e < c)$, and

3. the size of the intervention is not too big $(m = e - y + c \leq \overline{m})$.

4.3 The sovereign

The sovereign anticipates the policy reaction of the IMF, and incorporates this information when taking its decision, thereby choosing adjustment effort e so as to maximize its own payoffs. If unrestricted, the sovereign will set $e = e^*$. If $c - m^* \leq y < c - m^* + e^*$, the sovereign sets the level of adjustment effort equal to $e = y + m^* - c$, which is lower than the optimal level of effort e^*.

4.4 Equilibrium

A key insight of the model is that the behavior of short term investors, the size of financial assistance m, and the level of adjustment effort of the government e are endogenous variables which depend on the framework used for financial assistance.

The default threshold can only be fully determined after defining the actions of investors, international institutions and sovereign. Given their equilibrium strategies, we are ready to present the equilibrium result. There are several possible cases:

- The case of good fundamentals. If $y \geq c + e^*$, the country faces no liquidity problems, and the IMF does not intervene. The country sets $e = e^*$.

- The case of (moderately) bad fundamentals, which warrant financial assistance. If $\max\{0, c - \overline{m}\} + e^* \leq y < c + e^*$, the sovereign sets the optimal level of effort e^*. The IMF sets $m^* = e^* - y + c$.

- The case of bad fundamentals, which warrant financial assistance. If $\max\{0, c - \overline{m}\} \leq y \leq \max\{0, c - \overline{m}\} + e^*$, the sovereign is restricted on the amount of adjustment effort that it can implement. The country sets a level of effort equal to $e = y - \max\{0, c - \overline{m}\}$, which is inferior to the optimal level e^*. The IMF sets $m^* = c - \max\{0, c - \overline{m}\} = \min\{c, \overline{m}\}$. This case exhibits two key features. First, there is a trade off between the adjustment effort and the size of the financial assistance. Second, given the limited amount of financial assistance, the country is unable to implement the optimal level of effort.

- There is default when $y < \max\{0, c - \overline{m}\}$. The IMF does not finance the country. If $c > \overline{m}$, there is an area for the fundamental in which the IMF has insufficient funds to save a solvent illiquid country.

5 Equilibrium with Outright Monetary Transactions

There is an international institution, which we call ECB and has an unlimited amount of funds available to finance the debtor country. This is a simplification for OMTs conducted by the ECB, when the country adopts an ESM precautionary programme. The extensive form of the game is:

1. Nature draws the fundamental y; y is common knowledge.

2. The country chooses adjustment effort e; e is common knowledge.

3. Nature draws the available cash θ from a normal density with mean $y - e$ and variance $1/\alpha$. No one observes θ.

4. Each creditor i observes the realization of his signal $x_i = \theta + \frac{1}{\sqrt{\beta}}\varepsilon_i$ where ε_i is standard normal, independent and identically distributed across investors and independent of θ.

5. Based on the information y, e and his private signal x_i, each short term creditor individually decides whether or not to roll over his unit of debt.

6. Based on the observation of the actions of short term creditors, the ECB decides whether or not to support the country. The ECB does not need to support the country when $\theta + A \geq 1$. If $\theta + A < 1$ and $\theta \geq 0$, the ECB supports the country with probability p and guarantees that $\theta + m + A = 1$; with probability $1 - p$, the ECB does not intervene and the country defaults. The probability p parametrizes the likelihood of intervention with OMTs. The mixed strategy of the ECB is common knowledge. The ECB does not help an insolvent country.[10]

The payoff of short term creditors is $1 - c$ when the country has enough liquidity. When the sovereign is solvent and has insufficient liquidity, the payoff of short term creditors depends on whether the ECB supports the country or not, and equals $p(1 - c) - (1 - p)c = p - c$. We rewrite the payoffs of short term creditors as

$$
u(a_i, \theta, m, A) \equiv \begin{cases} 1 - c & if & a_i = 1 \text{ and } \theta + A \geq 1 \\ p - c & if & a_i = 1 \text{ and } \theta + A < 1 \text{ and } \theta \geq 0 \\ -c & if & a_i = 1 \text{ and } \theta < 0 \\ 0 & if & a_i = 0 \end{cases}
$$

with $c \in (0, 1)$. The payoffs of the sovereign and international institutions are the same as before.

---

[10]Results would not change significantly, had we assumed that the ECB rescues an insolvent country with probability p, in which case the ECB suffers losses with positive probability.

In order to evaluate the role of the likelihood of intervention under the ESM/OMTs programme, consider the extreme case in which $p = 1$ (that is, the ECB intervenes whenever a solvent country is illiquid). In the limiting case $\alpha \to \infty$ and $\beta \to \infty$, investors roll over their loans if and only if the country is solvent and, as a result, the ECB never needs to intervene. Under the ESM/OMTs programme, the ECB acts as if it was a single creditor, thereby eliminating the coordination problems among short term creditors, and achieving the first-best.

We now consider the less extreme case, in which the ECB may not intervene ex post. The problem is well-behaved under the following assumption.

Assumption 1. $c + p < 1$ and $p < c$.

5.1 Short term creditors

The **default threshold condition** becomes an **ECB stress condition**, as the threshold θ^*_{ECB} separates those states in which ECB assistance might be needed, from those in which it is not needed. The threshold x^*_{ECB} separates those investors who roll over from those who do not. Hence,

$$\theta^*_{ECB} + A = 1 \Leftrightarrow x^*_{ECB} = \theta^*_{ECB} + \frac{\Phi^{-1}(\theta^*_{ECB})}{\sqrt{\beta}}.$$

The **indifference threshold condition** becomes

$$prob_i\left[\theta \geq \theta^*_{ECB}\right](1-c) + prob_i\left[0 \leq \theta < \theta^*_{ECB}\right](p-c) + prob_i\left[\theta < 0\right](-c) = 0$$

which can be rewritten as

$$\Phi\left(\sqrt{\alpha+\beta}\left(\theta^*_{ECB} - \frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right) =$$
$$1 - c + \left[\Phi\left(\sqrt{\alpha+\beta}\left(\theta^*_{ECB} - \frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right) - \Phi\left(\sqrt{\alpha+\beta}\left(-\frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right)\right]p.$$

The indifference threshold condition applies for $x_i = x^*_{ECB}$. Replacing the value of x^*_{ECB} obtained in the ECB stress condition into the indifference threshold condition, yields

$$\Phi\left(\frac{\alpha}{\sqrt{\alpha+\beta}}\left(\theta^*_{ECB} - (y-e) - \frac{\sqrt{\beta}}{\alpha}\Phi^{-1}(\theta^*_{ECB})\right)\right) = 1 - c + pA \qquad (9)$$

with $A = \Phi\left(\frac{\alpha}{\sqrt{\alpha+\beta}}\left(\theta^*_{ECB} - (y-e) - \frac{\sqrt{\beta}}{\alpha}\Phi^{-1}\left(\theta^*_{ECB}\right)\right)\right) - \Phi\left(-\frac{\alpha(y-e)+\beta\theta^*_{ECB}+\sqrt{\beta}\Phi^{-1}\left(\theta^*_{ECB}\right)}{\sqrt{\alpha+\beta}}\right)$.

From expression (9), one can write

$$
\theta^*_{ECB} = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\theta^*_{ECB} - (y-e)\right.\right. \tag{10}
$$
$$
\left.\left. -\frac{\sqrt{\alpha+\beta}}{\alpha}\Phi^{-1}\left(\frac{1-c}{1-p} - \frac{p}{1-p}\Phi\left(-\frac{\alpha(y-e)+\beta\theta^*_{ECB}+\sqrt{\beta}\Phi^{-1}\left(\theta^*_{ECB}\right)}{\sqrt{\alpha+\beta}}\right)\right)\right)\right)
$$

Assumption 1 guarantees that $\Phi^{-1}\left(\frac{1-c}{1-p} - \frac{p}{1-p}\Phi\left(-\frac{\alpha(y-e)+\beta\theta^*_{ECB}+\sqrt{\beta}\Phi^{-1}\left(\theta^*_{ECB}\right)}{\sqrt{\alpha+\beta}}\right)\right)$ is well de-
fined. The derivative of the right-hand side is lower than $\phi(.)\frac{\alpha}{\sqrt{\beta}}$, which means that the
condition $\frac{\alpha}{\sqrt{\beta}} \leq \sqrt{2\pi}$ is sufficient for the uniqueness of equilibrium. Expression (9) is also
equivalent to

$$
\theta^*_{ECB} = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\theta^*_{ECB} - (y-e) - \frac{\sqrt{\alpha+\beta}}{\alpha}\Phi^{-1}\left(1-c+pA\right)\right)\right). \tag{11}
$$

Since $\Phi\left(\sqrt{\alpha+\beta}\left(\theta^*_{ECB} - \frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right) > \Phi\left(\sqrt{\alpha+\beta}\left(-\frac{\alpha(y-e)+\beta x_i}{\alpha+\beta}\right)\right) \Leftrightarrow A > 0$, then $\frac{\partial\theta^*_{ECB}}{\partial p} < 0$ by the implicit function theorem.

It is possible to bound the value of the threshold θ^*_{ECB}. Using expression (10), one can
show that $\theta^*_{ECB} > \underline{\theta}^*$, where $\underline{\theta}^*$ satisfies

$$
\underline{\theta}^* = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\underline{\theta}^* - (y-e) - \frac{\sqrt{\alpha+\beta}}{\alpha}\Phi^{-1}\left(\frac{1-c}{1-p}\right)\right)\right),
$$

and, using expression (11), one can show that $\theta^*_{ECB} \leq \overline{\theta}^*$, where $\overline{\theta}^*$ satisfies

$$
\overline{\theta}^* = \Phi\left(\frac{\alpha}{\sqrt{\beta}}\left(\overline{\theta}^* - (y-e) - \frac{\sqrt{\alpha+\beta}}{\alpha}\Phi^{-1}\left(1-c\right)\right)\right).
$$

Hence, $\underline{\theta}^* < \theta^*_{ECB} \leq \overline{\theta}^*$.

5.2 The limiting case

In the limiting case, $\alpha \to \infty$ and $\beta \to \infty$ such that $\frac{\alpha}{\sqrt{\beta}} \to 1 < \sqrt{2\pi}$ and $\theta \to y-e$. We obtain
the following result.

Proposition 3 *In the limiting case, under Assumption 1 and the ESM/OMTs programme,
there is default when $y-e < 0$, there is default with probability $1-p$ when $0 \leq y-e < \widehat{c}$, and*

the country does not default when $y - e \geq \widehat{c}$, with $\frac{c-p}{1-p} < \widehat{c} < c$.

5.3 The sovereign

The sovereign anticipates the reaction of short term creditors and the ECB, and chooses adjustment effort e so as to maximize its own payoffs. If unrestricted, the sovereign will set $e = e^*$. If $y - e^* < \widehat{c}$ and $y \geq \widehat{c}$, the sovereign will consider the possibility of strategically entering the ESM/OMTs programme. It weighs the gain of avoiding the ESM/OMTs programme and setting a level of effort e below the optimum level e^*, against the gain of setting $e = e^*$ and entering the ESM/OMTs programme (and defaulting with probability $1 - p$). We assume that the ECB is able to prevent this type of strategic behavior, as it could threaten not to rescue the country (although this strategy is dynamically inconsistent, and thus vulnerable to moral hazard).

5.4 Equilibrium

There are several possible cases:

- Good fundamentals. When $y \geq \widehat{c} + e^*$, the sovereign anticipates that it will not default and sets $e = e^*$.

- The case of (moderately) bad fundamentals, in which the ECB does not intervene. When $\widehat{c} \leq y < \widehat{c} + e^*$, the sovereign sets $e = y - \widehat{c} < e^*$ and avoids financial support. A key feature of the model is that the country benefits from the possibility of OMTs, but does not receive any financial assistance when $\widehat{c} \leq y$.

- The case of (moderately) bad fundamentals, with ECB intervention. When $0 \leq y < \widehat{c}$, the sovereign sets the optimal level of effort e^*, and the ECB intervenes with probability p.
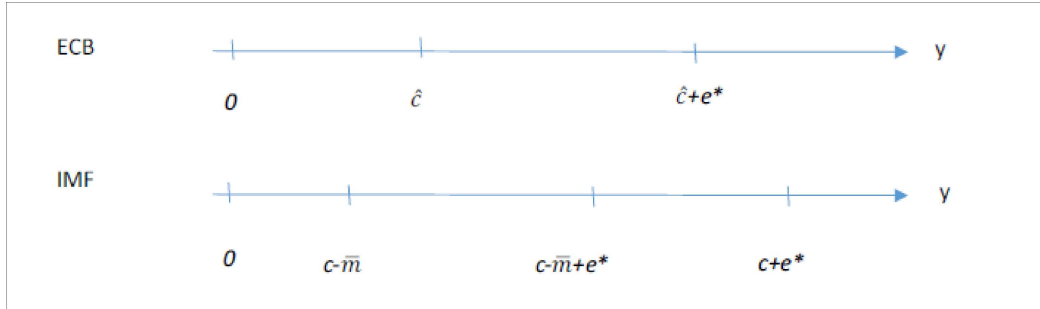
- The country defaults when $y < 0$.

Figure 3: The $0 < c - \overline{m} < \widehat{c}$ case.

5.5 Contrasting the EU/IMF programme with the ESM/OMTs programme

When $y < 0$ or $y \geq c + e^*$, both types of programme are equivalent. When $\widehat{c} + e^* \leq y < c + e^*$, the ESM/OMTs programme is unambiguously better in terms of welfare as it requires no financial assistance and the country is able to set the best level of adjustment effort.

Welfare results are ambiguous for $0 \leq y < c + e^*$. Still, there are policy implications regarding feasibility. When $\overline{m}$ is large and p is low, such that $\max\{0, c - \overline{m}\} < \widehat{c}$, then the EU/IMF programme is safer for $y \in [\max\{0, c - \overline{m}\}, \widehat{c})$ as this type of programme undoubtedly rescues the country. The EU/IMF programme is better suited to implement large levels of adjustment effort when $c - \overline{m} < \widehat{c}$ and $y \in [c - \overline{m}, \widehat{c} + e^*)$. Figure 3 illustrates the relation between parameters for this case.

When $\overline{m}$ is low and p is high, such that $\widehat{c} < c - \overline{m}$, then the country is better off with an ESM/OMTs programme for $y \in [\widehat{c}, c - \overline{m})$ as there are insufficient funds to implement an EU/IMF programme. The ESM/OMTs programme is better suited to implement adjustment effort when $\widehat{c} < c - \overline{m}$ and $y \in [\widehat{c}, c - \overline{m} + e^*)$. In this case, the level of adjustment effort under the EU/IMF programme is $e = y - c + \overline{m}$ while the level of effort under the ESM/OMTs programme is $e = y - \widehat{c}$, which is bigger. Figure 4 illustrates the relation between parameters.

5.6 Discussion of the results

Summing up, heterogeneous expectations create coordination problems among disperse creditors, thus creating solvent but illiquid sovereigns. Unlike Morris and Shin (2006) and Corsetti,
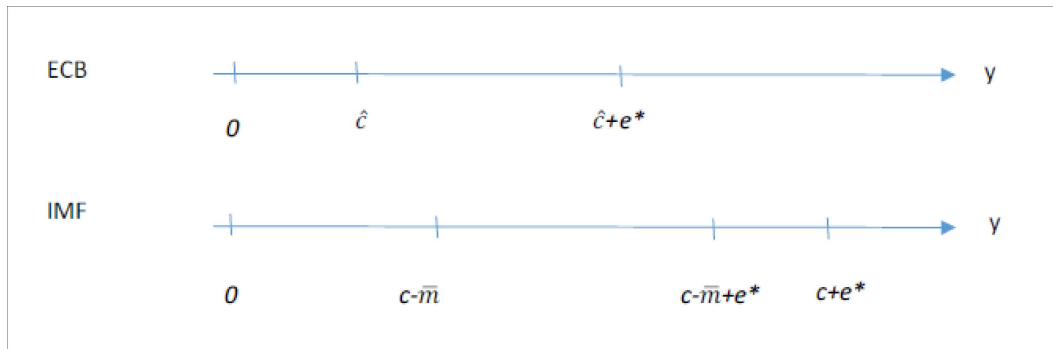
Figure 4: The $\widehat{c} < c - \overline{m}$ case.

Guimarães and Roubini (2006), we assume that the ajustment effort needed to address macro-economic imbalances and implement structural reforms reduces the likelihood of additional cash available in the short run.

Sovereigns thus face a dilemma between undertaking reforms which have beneficial long run effects, but raise questions about the ability of the sovereign to roll over its short term debt. The role of international institutions is to alleviate coordination problems, thus solving the policy dilemma.

Costly official assistance, make international institutions want to solve liquidity problems with minimum official assistance. As in Morris and Shin (2006) and Corsetti, Guimarães and Roubini (2006), sometimes a small amount of official assistance can restore investors' confidence and stop destructive runs. Technically, international assistance has a "catalytic" effect.

Still, when the amount needed for intervention is large, international institutions like the IMF or the EU (until 2012) lack the means to deal with a liquidity crisis. A programme with the possibility of unlimited assistance is the adequate solution, but the advantages of this option depend crucially on the probability of ex post intervention. With low probability of intervention, the ESM/OMTs programme will not be able to manage effectively the expectations of short term investors. When the ECB guarantees intervention if there is insufficient roll-over, the mere possibility of OMTs is sufficient to restore investors' confidence, and the ECB does not need to intervene ex post.

It is important to distinguish between the ex ante promise to intervene with unlimited amounts, and the actual ex post intervention which is always limited. With perfect commitment

by the ECB, the ex post intervention is null; with imperfect commitment the amount of official assistance is lower or equal to one. The maximum amount of official assistance occurs when international institutions roll over the whole amount of short term debt. The same will happen with the actual implementation of the OMTs, as the total outstanding debt stock in the relevant maturities puts a natural limit to the potential purchases by the ECB.

6   The decision of 7 February 2014 of the German Constitutional Court

On 7 February 2014 the German Constitutional Court stated that it considers the 6 September 2012 OMTs Decision by the ECB an act which goes beyond the powers assigned to the ECB by the TFEU, unless a more limited interpretation is given which, in its opinion, would require: (i) that the bonds acquired under the OMTs are exempted from any debt reduction agreed by the bondholders; (ii) that there is a limit in the acquisitions; (iii) observance of certain time lags between the emission of a government bond and its purchase; (iv) that there is no interference with the fixing of the market price; and (v) that the bonds are not held to maturity.

The concerns of the German Constitutional Court are that the OMTs Decision exceeds the ECB's monetary policy mandate and that it is incompatible with the prohibition of monetary financing (Art 123. of TFEU).

For the first time since the signature of the Treaty of Rome in 1958, the German Constitutional Court has requested the Court of Justice of the European Union (ECJ) for a preliminary ruling about the non-conformity with EU law of a decision taken by an European institution. According to the TFEU, when a question on the validity and interpretation of acts of the EU institutions, or on the interpretation of the treaties, is raised before a national supreme court, the court is obliged to bring the matter before the ECJ. Recall that it was the Bundesbank (the German central bank) that raised the question of the validity of the OMTs Decision.[11]

Although the ECJ is not bound by the interpretation of the relevant EU law given by the German Constitutional Court if it assesses the OMTs Decision as being in full compliance with EU law, a direct conflict with the German Constitutional Court would be opened which the

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[11] The Bundesbank President, and ECB Governing Council Member, J. Weidemann has been very vocal in opposing the OMTs Decision.

ECJ may wish to avoid. Therefore, it is possible that the ECJ, in trying to reach a compromise, takes a decision that undermines the effectiveness of the OMTs.

After the ECJ provides the assessment, the German Constitutional Court will reopen the proceedings and will re-enter into an assessment. While it will not challenge the interpretation given by the ECJ it will still have to assess whether the interpretation given by the ECJ is compatible with the German Constitution. Thus, the whole process will be lengthy and its final outcome highly uncertain.

In the light of our model the most damaging requirement that could undermine the effectiveness and the credibility of the OMTs would be an eventual requirement by the ECJ that there should be an ex ante limit to the acquisitions under OMTs. In fact, that would tend to make assistance with ESM/OMTs closer to an EU/IMF programme, making it superfluous. In any case, in the light of the model, the decisions of the courts (and the lengthy procedures) likely have affected (i.e. lowered) the probability that the ECB would accept a request for OMTs, even if all conditions were met. Both the quantitative limit to the OMTs intervention and the lowering of its probability would reduce the credibility of the OMTs and therefore risk re-creating financial instability in the euro area by undermining the liquidity insurance for solvent sovereigns provided by the OMTs.

The other requirements referred above cannot be assessed using our model but intuitively they would probably not damage the impact of the OMTs, perhaps with the exception of the rejection of the preferred creditor status of the ECB (in line with the IMF's).[12]

7 Conclusion

The new approach by the ECB and the EU is a bold attempt to separate solvency from liquidity problems in the European sovereign debt crisis. Quite surprisingly, assistance with OMTs is not unambiguously better than the EU/IMF assistance programme. The success of international financial assistance depends on the ability to shift the incentives of the private sector creditors to roll over their claims. For the OMTs to work, the likelihood of ECB intervention must be large enough, thus reducing the probability of default and providing the right incentives to the

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[12]Those conditions are technically incoherent. For example, OMTs are supposed to interfere with market prices; in a sense, it is the potential mispricing in euro area bond markets that triggers the need for OMTs in the first place.

private sector.

For an EU/IMF programme to work, two conditions must be met. There must be enough funds to prevent default, and the fundamentals cannot be too weak. Default is inevitable if private sector creditors think the amount of financial assistance is insufficient to solve the aggravated short term problems of the country (and thus the need for a mechanism with "unlimited firepower").

When there are enough funds available for official assistance, then the EU/IMF programme might be safer than the ESM/OMTs programme. A country that has lost access to international capital markets and, therefore, is most likely under an EU/IMF adjustment programme, may not be considered for assistance with OMTs as it would risk default with positive probability. This may justify why the ECB states that OMTs do not apply to countries under an EU/IMF adjustment programme or that have lost market access.

The relative advantage of each type of programme also depends on the ability of the country to correct macroeconomic imbalances and implement structural reforms. We provided some intuition about the relationship between financial assistance and adjustment effort, but much still remains to be done. We have considered a model without moral hazard, and we have focused on a limiting case chosen for analytical tractability. Relaxing the assumptions of our model in these two dimensions may provide additional insights that have not been captured in the paper.

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