

# 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 ESM programmes, 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. As long as macroeconomic imbalances are small, ESM programmes galvanize creditors into rolling over their loans, alleviate the liquidity crisis and help the country to implement structural reforms and correct imbalances. Hence, the sustainability of ESM stand alone assistance depends on the effectiveness of the preventive and corrective arms of the new European governance rules, as it would prevent too large macroeconomic and financial imbalances. Credible OMTs restore investors' confidence, and achieve the first best without the actual need for ECB financial support.

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\*The views expressed in this paper are our own and do not necessarily reflect the view of the European Central Bank.

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## Non-technical summary

Europe has created two new mechanisms to face the sovereign debt crisis - the European Stability Mechanism (ESM) and the programme for Outright Monetary Transactions (OMT). There is no theoretical framework to help us compare these policy responses, and this paper is the first attempt to fill this gap.

Our analysis builds up on the model of debt roll-over developed in Morris and Shin (2004, 2006). Creditors choose whether or not to refinance a sovereign with an uncertain capacity to repay. The sovereign fails if an insufficient mass of creditors rolls over their loans, thus causing a loss to creditors. Uncertainty about whether dispersed creditors will roll over their short term debt, induces creditors to refrain from investing, thereby creating solvent but illiquid sovereigns.

We extend their framework in two directions. First, in order to address the case of OMTs, we consider the possibility that the ECB intervenes ex post with probability lower than one. Being the central bank, the ECB has the ability to acquire financial assets via expansion of its balance sheet. Yet, the decision of 7 February of the German Constitutional Court has shown that Article 123 of the Treaty on the Functioning of the European Union creates uncertainty about ECB interventions to rescue member states of the euro area. Moreover, the ECB's statute of independence implies discretionary choices, further increasing the uncertainty about the use OMTs.

Second, we consider a J-curve effect of the adjustment policies, which creates tensions between the goals of fiscal consolidation and competitiveness. Adjustment policies are 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 reduce tax revenues and raise expenses with fiscal stabilizers, thereby reducing the amount of cash available to the government in the short run and raising questions about the ability of the sovereign to pay its short term creditors. Sovereigns thus face a dilemma between undertaking reforms which have beneficial long run effects, but raise questions about the ability to roll over their short term debt. The role of international institutions is to restore investors' confidence, thus solving the policy dilemma.

The official approach of the IMF to financial crises is based on the idea that the provision of a small amount of official financial assistance galvanizes the private sector creditors into rolling

over their short term loans. This approach is adequate when fundamentals are not too weak, but it is more difficult to manage expectations and coordinate investors when macroeconomic imbalances are large. In this case, the optimal intervention would imply financial assistance of a size that is not readily available for the IMF or the ESM, which may trigger a run on sovereign debt.

For the euro area, though, the ECB is able to provide enough funds so as to galvanize investors and thus prevent an illiquidity triggered default (when the ESM is unable to assist a country). The country may benefit from the confidence effect of the OMT programme without any material financial assistance, which explains why the conditional promise by the ECB proved so effective at stopping the run on sovereign debt that it never had to be carried out.

The ranking between ESM programmes and OMTs is ambiguous when the size of available ESM financial assistance is large and the probability of ECB ex post intervention with OMTs is low. In this case, multiple criteria - based on the probability of sovereign default, the effective need of funds, and the level of adjustment effort - is needed to rank the two types of official assistance.

ESM adjustment programmes induce high effort by the sovereign when the fundamentals are poor, but not hopelessly so. Hence, the sustainability of ESM stand-alone assistance depends on the effectiveness of the preventive and corrective arms of the new European governance rules. These are key features for the success of the ESM, as they would prevent too large macroeconomic and financial imbalances.

# 1 Introduction

In May 2010, Greece became the first euro area country to obtain financial assistance from the International Monetary Fund (IMF) and the other European countries. Assistance implied a commitment to implement an economic adjustment programme designed by the Troika of the European Commission, the IMF, and the European Central Bank (ECB). In the following years, Ireland, Portugal, and Cyprus followed a similar path, and Spain obtained European assistance to rescue its banking system. As the crisis of confidence unfolded, Europe created two new mechanisms to face the crisis - the European Stability Mechanism (ESM) and the programme for Outright Monetary Transactions (OMT). The objective of this paper is to compare the European responses to the crisis, and assess under which conditions each type of response is more efficient to deal with a financial crisis.

Compared with previous IMF adjustment programs, the Troika programmes were special for several reasons. For Greece, Ireland, and Portugal, the sizes of the macroeconomic imbalances at the start of the programmes were much greater than those in the beginning of previous IMF programmes. The debt-to-GDP ratios, the fiscal deficits, the external financial liabilities and current-account deficits were much larger than in the average IMF programme. These findings have been documented by Barkbu et al. (2012), who study the historical record of financial crises, and Pisani-Ferry et al. (2013), who assess the Troika programmes and compare them with previous IMF programmes.

The policy restrictions within the euro area are also extreme. First, it is impossible to devalue a currency inside a monetary union and, unlike previous IMF programmes, the rate of real depreciation has been limited. Second, transfers from a "federal" budget are forbidden as a logical consequence of Article 125 of the Treaty on the Functioning of the European Union (TFEU), the so called "no bail-out clause". Third, due to the so-called monetary financing prohibition enshrined in Article 123 of the TFEU, the ECB and the national central banks are prohibited from purchasing government debt securities in the primary market (albeit not in the secondary market).<sup>1</sup>

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<sup>1</sup>The Troika acknowledged such exceptional conditions, and its official assistance programmes differed from traditional IMF programmes. First, the euro area programmes were significantly larger and longer-lasting than previous IMF programmes. Second, unlike most IMF programmes, official assistance replaced markets in the financing of sovereigns. To contain the conventional "debtor moral hazard" effects, the European Union adopted a philosophy of explicit conditionality in the programmes and through a number of measures which have strengthened the Stability and Growth Pact.

Such exceptional conditions hindered the Troika programmes and, as the crisis of confidence unfolded, sovereigns seen by investors as more fragile faced increasing difficulties to refinancing their debt. In this setup, two types of official assistance were created for euro area countries. The first option is financial assistance from the European Stability Mechanism (ESM), akin to traditional assistance by the IMF.<sup>2</sup> ESM adjustment 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 in the country under intervention. A key feature of the ESM is its limited financial resources. The second option is a novel approach under which the ESM and the ECB may cooperate in insuring investors against the potential illiquidity of a solvent sovereign. This is ensured through the ECB's programme for Outright Monetary Transactions (OMTs), which involves unlimited purchases of government securities in the secondary debt market, conditional on the beneficiary country adopting an ESM precautionary programme.

The European responses to the crisis had different impacts on the confidence of investors. While the implementation of Troika 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 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.<sup>3</sup>

Figure 1 shows that all yields were on an increasing trend before the Troika 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

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<sup>2</sup>The ESM is an intergovernmental organization, whose assistance programmes are designed by the European Commission in liaison with the ECB and, wherever possible, together with the IMF. For simplicity, we call "ESM programme" to a programme with financial assistance granted by the ESM and designed by the Troika. Appendix A.1 presents the assistance mechanisms available in the euro area, and how they have been used so far.

<sup>3</sup>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.

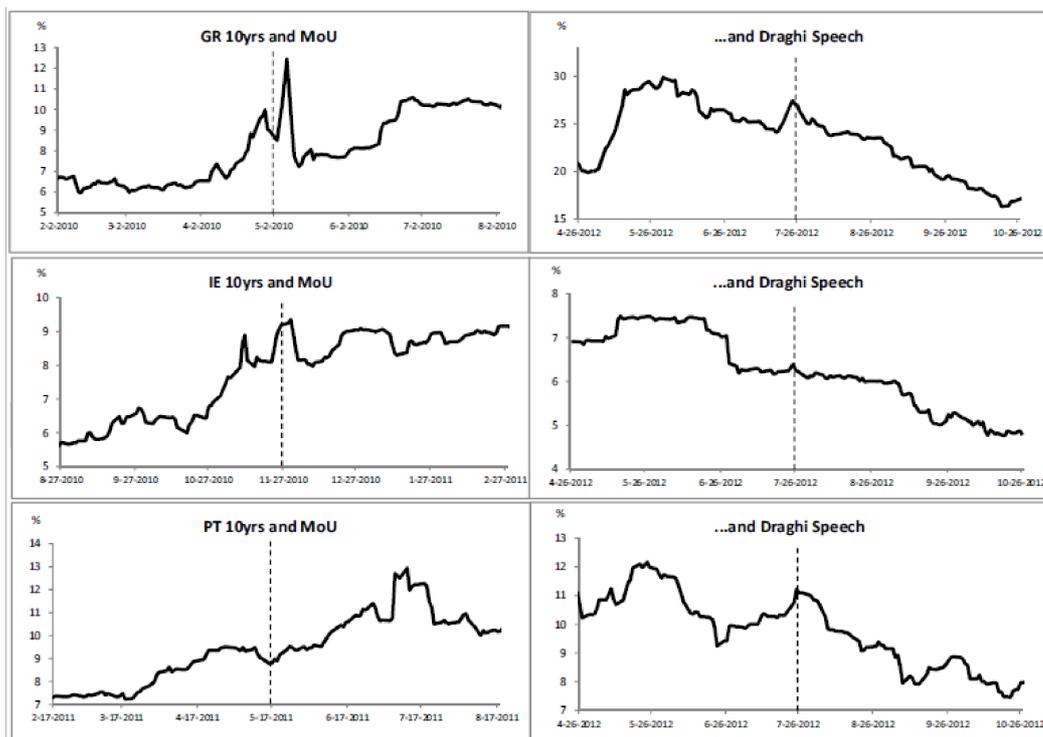


Figure 1: Daily evolution of ten year bond yields for Greece (GR), Ireland (IE), and Portugal (PT) in a six month window around the date of the signature of the Memorandum of Understanding (MoU) for each country, and the date of the speech of the President of the ECB vowing "to do whatever it takes to preserve the euro". Source: Reuters.

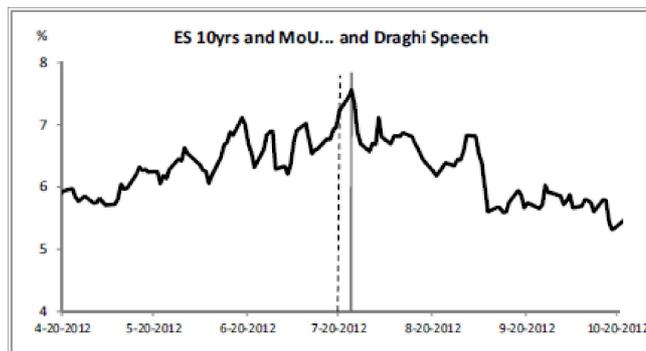


Figure 2: Daily evolution of ten year bond yields for Spain in a six month window around the dates of the signature of the Memorandum of Understanding (dashed line), and of the speech of the President of the ECB vowing “to do whatever it takes to preserve the euro” (solid line). Source: Reuters.

of OMTs, than to the Troika adjustment programmes. The difference in the response of investors 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.<sup>4</sup> 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 European policy responses, and this paper is the first attempt to fill this gap. Our analysis builds up on the model of debt roll-over developed in Morris and Shin (2004, 2006). Creditors (which we also call investors, lenders or international fund managers) choose whether or not to refinance a sovereign with an uncertain capacity to repay. The sovereign fails if an insufficient mass of lenders rolls over their loans, thus causing a loss to lenders. Uncertainty about whether dispersed creditors will roll over their short term debt, induces fund managers to refrain from investing, thereby creating solvent but illiquid sovereigns. Lenders thus face a coordination problem, since many refrain from investing even when they are (almost) sure that the sovereign is solvent. Such coordination problem

<sup>4</sup>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.

would not exist if there were one single creditor, and the role of international institutions is to manage expectations and sort out the coordination problem faced by dispersed creditors.

We extend their framework in two directions. First, in order to address the case of the OMT programme, we consider the possibility that the ECB intervenes ex post with probability lower than one. Being the central bank, the ECB has the ability to acquire financial assets via expansion of its balance sheet. However, according to Article 123 of the TFEU it is forbidden to purchase bonds in the primary market, or lending directly to governments (overdrafts are not allowed). The decision of 7 February of the German Constitutional Court has shown that this prohibition creates uncertainty about the ECB interventions to rescue member states of the euro area. Moreover, the ECB's statute of independence implies discretionary choices, further increasing the uncertainty about the use OMTs.

Second, we consider a J-curve effect of the adjustment policies, which creates tensions between the goals of fiscal consolidation and competitiveness. There are two dimensions in the adjustment programmes. 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 reduce tax revenues and raise expenses with fiscal stabilizers, thereby reducing the amount of cash available to the government in the short run and raising questions about the ability of the sovereign to pay its short term creditors. Sovereigns thus face a dilemma between undertaking reforms which have beneficial long run effects, but raise questions about the ability to roll over their short term debt. The role of international institutions is to restore investors' confidence, thus solving the policy dilemma.

The official approach of the IMF to financial crises is based on the idea of catalytic finance: that the provision of a small amount of official financial assistance galvanizes the private sector creditors into rolling over their short term loans (see, for example, Gosh et al. 2002, Cottarelli and Giannini 2002, and IMF 2014).

This approach is adequate when fundamentals are not too weak (see Morris and Shin 2006, and Corsetti et al. 2006), but it is more difficult to manage expectations and coordinate investors when macroeconomic imbalances are large. In this case, the optimal intervention would

imply financial assistance of a size that is not readily available for an International Lender of Last Resort with limited funds (like the Troika or the ESM).<sup>5</sup> This may dictate an adjustment path that is more front-loaded than would be desirable from a growth perspective. Strongly procyclical adjustment policies may also damage short term public accounts, and have a negative impact on medium term debt sustainability in two ways. First, strong recessions lead to permanent output losses, and lower potential output aggravates the debt burden. Second, harsh policy adjustment measures and the resulting reduction in growth and employment may weaken the political capacity to maintain the level of adjustment effort, which may lead to program failure and endanger debt sustainability. All in all, large macroeconomic imbalances coupled with insufficient official assistance will raise questions about debt roll-over and sustainability, which may trigger a run on sovereign debt.

For the euro area, though, the ECB is able to provide enough funds so as to galvanize investors and thus prevent an illiquidity triggered default (when the ESM is unable to assist a country). The country may benefit from the confidence effect of the OMT programme without any material financial assistance, which explains why the conditional promise by the ECB proved so effective at stopping the run on sovereign debt that it never had to be carried out.

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The remainder of the paper is organized as follows. The next section sets up the model

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<sup>5</sup>According to the official approach of the IMF, official lending strengthens the government's incentives to implement desirable but costly policies, thus justifying a philosophy of "parsimonious conditionality" in IMF programs (IMF, 2002). But when macroeconomic imbalances are too large, desirable policies become too costly, and the International Lender of Last Resort cannot rely exclusively on incentives to promote adjustment effort. In the case of Greece, Ireland, Portugal, Spain and Italy, Conesa and Kehoe (2014) suggest that debt levels are so high that it may be too late for official assistance to be successful in inducing them to reduce their debt.

of debt roll-over, and characterizes the equilibrium without international financial assistance. Section 3 incorporates ESM assistance programmes. Section 4 analyses the case of OMTs, and contrasts ESM programmes with OMTs. Section 5 links our results to the decision of the German Constitutional Court of 7 February 2014, and Section 6 concludes.

*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, and De Grauwe (2011) applied this principle to the ECB's programme for OMTs. We consider a framework with private information, which allows us to specify individual beliefs in equilibrium. As a result, expectations are correlated with the strength of the fundamentals of the debtor country and are neither necessarily irrational nor dependent on *ad hoc* sunspots.

Morris and Shin (2006) and Corsetti et al. (2006) 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. There are important differences with our paper. First, we highlight the immediate impact of adjustment effort on short term public accounts, whereas Morris and Shin (2006) and Corsetti et al. (2006) assume that adjustment effort reduces the payoff of the sovereign.<sup>6</sup> Second, and more importantly, the focus of these papers is on catalytic finance, while we think that the size of the imbalances in the euro area countries is too big for catalytic finance to work. Third, the timing of the game is different from Morris and Shin (2006), and we do not model the official creditor as a large player (as in Corsetti et al. 2006).

These differences reflect our concerns. The focus of our paper is not on moral hazard issues, but rather on the short term 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 Ji (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.

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<sup>6</sup>In our case, excessive adjustment effort will reduce the amount of cash available for the government and trigger a run on sovereign debt. Morris and Shin (2006) and Corsetti et al. (2006) are more concerned with moral hazard effects, in which case demanding too much effort will weaken the incentives of the debtor country to behave. In Morris and Shin (2006) and Corsetti et al (2006), moral hazard arises when the sovereign could sort out its problems without any financial assistance. Given the size of the macroeconomic imbalances, this is unlikely to be the case in the euro area.

## 2 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  $\theta$ , 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 (which we also call investors or creditors) of mass 1, each with one unit of funds, and willing to lend to the government only short term. The sequence of decisions can be summarized as follows.

1. Nature draws the strength of the economic fundamentals  $y$ ;  $y$  is common knowledge.
2. The government chooses adjustment effort  $e$ ;  $e$  is common knowledge.
3. Nature draws the available cash  $\theta$  from a normal density with mean  $y - e$  and variance  $1/\alpha$ . No one observes  $\theta$ .
4. Each investor  $i$  observes the realization of his signal  $x_i = \theta + \frac{1}{\sqrt{\beta}}\varepsilon_i$  where  $\varepsilon_i$  is standard normal, independent and identically distributed across investors and independent of  $\theta$ . Private information introduces heterogeneity in market expectations about the amount of cash available and may be understood 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.

Order the international fund managers, and let  $A = \int_0^1 a_i di$  denote the aggregate level of short term investment. The debtor country defaults on its debt if the amount of available cash  $\theta$  and the amount of short term investment  $A$  are insufficient to fulfill its short term promises, that is

$$\theta + A < 1.$$

Since  $A \leq 1$ , the country is not solvent when  $\theta < 0$ . For simplicity, we assume the borrower's finances are viable in the long run as long as  $\theta \geq 0$ . 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 will default if it is unable to convince them to buy short term sovereign debt.

The payoff of short term creditor  $i$  is given by

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

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

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

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

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

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  $\psi_1(\cdot)$  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.

## 2.1 Short term investors

The model is solved by backward induction and we start by short term creditors. In the next section we solve the sovereign's problem. Conditional on private information, the posterior distribution of cash  $\theta$  is normal with the following mean and variance:

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

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

We focus on *switching strategies*, in which creditor  $i$  rolls over if and only if his signal  $x_i$  is higher than some threshold level  $x^*$ . Later, we comment on why this is the only possible class of strategies in equilibrium. Two conditions characterize the problem: the default threshold condition and the indifference threshold condition.

**Default threshold condition.** Denote by  $\theta^*$  the critical state  $\theta$  which separates those states in which default occurs from those states in which the sovereign continues servicing its debt, that is  $\theta^* + A = 1$ . Since each investor holds one unit of funds,  $A$  also represents the mass of investors. With a continuum of individuals, the mass of investors  $A$  is equal to the probability that an individual investor receives a signal higher than  $x^*$ . When  $\theta = \theta^*$ , the distribution of  $x_i$  is normal with mean  $\theta^*$  and precision  $\beta$ . In this case  $A = 1 - \Phi(\sqrt{\beta}(x^* - \theta^*))$ , where  $\Phi(\cdot)$  is the cumulative distribution function of the standard normal. Since  $\theta^* = 1 - A$ , we obtain

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

**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  $prob_i[\theta \geq \theta^*](1 - c) - prob_i[\theta < \theta^*]c \geq 0$ . The value of  $prob_i[\theta < \theta^*]$  is the probability that investor  $i$  attaches to  $\theta$  being lower than  $\theta^*$ . Investor  $i$  believes that  $\theta$  has a normal distribution with mean  $\frac{\alpha(y - e) + \beta x_i}{\alpha + \beta}$  and precision  $\alpha + \beta$  - see expressions (1) and (2). Hence, the probability that investor  $i$  attributes to default is equal to  $prob_i[\theta < \theta^*] = \Phi\left(\sqrt{\alpha + \beta}\left(\theta^* - \frac{\alpha(y - e) + \beta x_i}{\alpha + \beta}\right)\right)$ . For the marginal investor who is indifferent between investing or not,

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

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  $\Phi^{-1}(1 - c) = -\Phi^{-1}(c)$ ,

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

**Critical value of  $\theta$ .** Equilibrium in the short term debt market is identified with a joint solution to conditions (3) and (4). Substituting (3) into (4) yields

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

When  $0 \leq \theta < \theta^*$ , the country defaults even though it is fundamentally sound; when  $\theta \geq \theta^*$  there is no default. The critical state  $\theta^*$  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  $\phi(\cdot)$  is the density of the standard normal distribution. Since  $\phi(\cdot) \leq \frac{1}{\sqrt{2\pi}}$ , a sufficient condition for a unique solution for  $\theta^*$  is given by

$$\frac{\alpha}{\sqrt{\beta}} \leq \sqrt{2\pi}. \quad (6)$$

This bound guarantees that the precision of *private information* (measured by  $\beta$ ) is large enough

when compared with the precision of *public information* (measured by  $\alpha$ ). Precise private information rules out multiple equilibria. Were the precision of public information too big, and investors would coordinate their decisions and beliefs in a way which invites multiplicity of equilibria, as the bank run game by Diamond and Dybvig (1983) or the model of sovereign debt crises by De Grauwe (2011).

It turns out that inequality (6) is also sufficient for uniqueness of equilibrium in any class of strategies - not simply the switching strategies (see Morris and Shin, 2004).

### 2.1.1 Limiting case

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

$$\theta^* = \Phi(\theta^* - (y - e) + \Phi^{-1}(c)) \quad (7)$$

In the limiting case,

$$\theta \rightarrow y - e,$$

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

**Lemma 1** *There is a unique equilibrium, and the sovereign defaults if and only if  $y - e < \theta^*$ .*

The threshold  $\theta^*$  defines the critical value for  $y - e$ , above which there is no default. Replacing  $y - e$  by  $\theta^*$  in equation (7), we obtain  $\theta^* = c$  and the next result.

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

When  $y - e$  is larger than  $c$ , then the default threshold  $\theta^*$  is lower than  $c$  and the country does not default. If  $y - e < c$ , then  $\theta^* > c$  and the country defaults.

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  $\theta > 0$ .<sup>7</sup> We consider this the first-best outcome.

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<sup>7</sup>In November 2013, Slovenia was able to overcome its liquidity shortage with the help of one big private investor - Pacific Investment Management Company (PIMCO).

Proposition 1 shows that the government defaults when  $0 < \theta < c$ , so that inefficiencies persist even though information reveals what the underlying state  $\theta$  is. This feature makes the limiting case appealing. Despite being an extreme case, it preserves the coordination problem among disperse creditors.

## 2.2 The sovereign

When the fundamentals are strong (that is,  $y \geq c + e^*$ ) the sovereign sets the optimal level of adjustment effort  $e^*$ . For intermediate values of the fundamentals ( $c \leq y < c + e^*$ ), the sovereign is restricted by the behavior of investors as it would default if the government set effort equal to the optimal level  $e^*$ . For intermediate values of the fundamentals, 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. Proposition 1 shows that adjustment effort triggers default when  $y = c$ . In this case, international official assistance would induce the country to implement adjustment effort and would prevent default.

## 3 Equilibrium with international assistance programmes

In this section, we consider the case in which an international institution provides limited official assistance to a country with weak fundamentals. Official assistance will galvanize private creditors into rolling over short term loans when the economy is weak, but not hopelessly so.

Formally, there is an international institution, which we call ESM, willing to help the country solve its liquidity problems. This is a simplification for financial assistance obtained through stabilization programmes with limited funds, like the IMF or the ESM programmes. The ESM 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 strength of the economic fundamentals  $y$ ;  $y$  is common knowledge.
2. The country chooses adjustment effort  $e$ ;  $e$  is common knowledge.
3. The ESM chooses the amount of funding  $m$ ;  $m$  is common knowledge.

4. Nature draws the available cash  $\theta$  from a normal density with mean  $y - e$  and variance  $1/\alpha$ . No one observes  $\theta$ .
5. Each creditor  $i$  observes the realization of his signal  $x_i = \theta + \frac{1}{\sqrt{\beta}}\varepsilon_i$  where  $\varepsilon_i$  is standard normal, independent and identically distributed across investors and independent of  $\theta$ .
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 creditor  $i$  as

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

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

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

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

<sup>8</sup>We standardize the payoff from no intervention to zero, as  $\Psi$  parametrizes the difference in the payoff of the international institution obtained with continuation and default of the sovereign.

<sup>9</sup>Alternatively, we could have assumed that there was a limited amount of funds available for official assistance.

### 3.1 Short term investors

In this section we solve the investors' problem, and in the next sections we solve the problems of the ESM and of the sovereign. We apply the methods in Section 2 to obtain the solution to the subgame that begins with Nature's draw of the available cash  $\theta$ . In this subgame, there is a threshold  $\theta_{ESM}^*$  for the value of  $\theta$ , and the country defaults if and only if  $\theta < \theta_{ESM}^*$ . The default threshold condition becomes  $\theta_{ESM}^* + A + m = 1$ , the indifference threshold condition remains the same, and

$$\theta_{ESM}^* = \Phi \left( \frac{\alpha}{\sqrt{\beta}} \left( \theta_{ESM}^* - (y - e) + \frac{\sqrt{\alpha + \beta}}{\alpha} \Phi^{-1}(c) \right) \right) - m. \quad (8)$$

We assume the limiting case, with  $\alpha \rightarrow \infty$  and  $\beta \rightarrow \infty$  such that  $\frac{\alpha}{\sqrt{\beta}} \rightarrow 1 < \sqrt{2\pi}$ , to obtain  $\theta \rightarrow y - e$ . Replacing  $y - e$  by  $\theta_{ESM}^*$  in expression (8), we obtain  $\theta_{ESM}^* = c - m$ , and the next result.

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

### 3.2 The ESM

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

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

In the limiting case, the ESM knows the fundamentals  $y$  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 ESM 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  $c - \bar{m} \leq y - e$ , optimal ESM intervention sets  $m = e - y + c$ . If  $y - e < c - \bar{m}$ , the ESM is not willing to intervene since the required intervention is too big.

Hence the optimal value of  $m$  satisfies

$$m^* = \begin{cases} e - y + c & \text{if } \max\{0, c - \bar{m}\} \leq y - e < c \\ 0 & \text{otherwise} \end{cases} \quad (9)$$

The solution makes intuitive sense. The ESM 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 ( $m = e - y + c \leq \bar{m}$ ).

### 3.3 The sovereign

The sovereign anticipates the policy reaction of the ESM, 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  $e^*$ .

### 3.4 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. Given the equilibrium strategies of investors, international institutions and the sovereign, we are ready to present the equilibrium result. There are several possible cases:

- The case of strong fundamentals. If  $y \geq c + e^*$ , the country faces no liquidity problems, and the ESM does not intervene. The country sets  $e = e^*$ .
- The case of (moderately) weak fundamentals, which warrant financial assistance. If  $\max\{0, c - \bar{m}\} + e^* \leq y < c + e^*$ , the sovereign sets the optimal level of effort  $e^*$  with the help of the ESM. The ESM sets  $m^* = e^* - y + c$ .
- The case of weak fundamentals, which warrant financial assistance. If  $\max\{0, c - \bar{m}\} \leq y \leq \max\{0, c - \bar{m}\} + e^*$ , the sovereign is restricted on the amount of adjustment effort that

it can implement. The country sets a level of effort equal to  $e = y - \max\{0, c - \bar{m}\}$ , which is inferior to the optimal level  $e^*$ . The ESM sets  $m^* = c - \max\{0, c - \bar{m}\} = \min\{c, \bar{m}\}$ . 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  $y < \max\{0, c - \bar{m}\}$ . The ESM does not finance the country. If  $c > \bar{m}$ , there is an interval for the fundamentals in which the ESM has insufficient funds to save a solvent illiquid country.

### 3.5 Contrasting ESM programmes with no official assistance

Comparing the results in Section 2.2 to the results in Section 3.4 allows us to compare the extent of adjustment effort with and without ESM intervention. Official assistance has a catalytic effect when the economic fundamentals  $y$  belongs to the interval  $[\max\{0, c - \bar{m}\}, c + e^*]$ . Official assistance strengthens the government's incentives to implement desirable but costly policies in this interval, and rescues the country in the interval  $[\max\{0, c - \bar{m}\}, c]$ .

Limited official assistance is ineffective if  $0 < c - \bar{m}$  and fundamentals  $y$  belong to the interval  $[0, c - \bar{m}]$ , as too weak fundamentals reduces the willingness of creditors to roll over their debts. With limited financial assistance, the international institution does not galvanize private creditors and, therefore, is unable to strengthen the government's incentives to implement desirable but costly policies.

When there are large macroeconomic imbalances and policy constraints are tight, there is no catalytic effect in limited official financial assistance. When the size of the problems is too large, new policy tools are needed to help debtor countries.

## 4 Equilibrium with Outright Monetary Transactions

In this section, we consider an international institution, which we call ECB, that has the ability to intervene ex post with unlimited funds but with probability lower than one. This is a simplification for OMTs conducted by the ECB, when the country adopts an ESM precautionary programme. The institutional design of European institutions creates uncertainty about the

ECB interventions to rescue members of the Euro area.

The extensive form of the game is:

1. Nature draws the strength of the economic fundamentals  $y$ ;  $y$  is common knowledge.
2. The country chooses adjustment effort  $e$ ;  $e$  is common knowledge.
3. Nature draws the available cash  $\theta$  from a normal density with mean  $y - e$  and variance  $1/\alpha$ . No one observes  $\theta$ .
4. Each creditor  $i$  observes the realization of his signal  $x_i = \theta + \frac{1}{\sqrt{\beta}}\varepsilon_i$  where  $\varepsilon_i$  is standard normal, independent and identically distributed across investors and independent of  $\theta$ .
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 acts in the following way. The ECB does not intervene when  $\theta + A \geq 1$ . If  $\theta + A < 1$  and  $\theta \geq 0$ , the ECB supports the country with probability  $p$  so 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 of the ECB. This mixed strategy is common knowledge. The ECB does not help an insolvent country.<sup>10</sup>

The timing of the game is different from the game with the ESM in Section 3. In the current game the international institution plays after the short term creditors, whereas in Section 3 the ESM plays before the short term creditors. Moreover, in the current game, the ECB may set  $m = 1$  and buy all the bonds issued by the sovereign, whereas the ESM has limited financial resources. These differences impact on the payoffs of short term creditors as follows.

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

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<sup>10</sup>Results would not change significantly, had we assumed that the ECB rescues an insolvent country with probability  $p$ , in which case the ECB would suffer losses with positive probability.

rewrite the payoffs of short term creditor  $i$  as

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

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

The problem is trivial if the ECB buys bonds in the primary market with probability  $p = 1$ . In this case, the ECB intervenes whenever a solvent country is illiquid. In the limiting case  $\alpha \rightarrow \infty$  and  $\beta \rightarrow \infty$ , 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 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.<sup>11</sup>

Still, institutional restrictions eliminate this solution. We now consider the less extreme case in which the ECB may not intervene ex post.

#### 4.1 Short term creditors

We rename the **default threshold condition** as **ECB stress condition**, since the threshold  $\theta_{ECB}^*$  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

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

<sup>11</sup>The problem of the ECB is different from the problem of other central banks, like the Fed. The TFEU establishes restrictions for ECB intervention, thus making  $p < 1$ . Moreover, the statute of ECB independence rules out  $p = 1$ .

This condition is different from the indifference threshold condition in the ESM case in Section 3, because the additional term  $prob_i [0 \leq \theta < \theta_{ECB}^*] (p - c)$  represents the expected gain of the fund managers when  $0 \leq \theta < \theta_{ECB}^*$  and the ECB intervenes with probability  $p$ . The indifference threshold condition 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

$$\Phi \left( \frac{\alpha}{\sqrt{\alpha + \beta}} \left( \theta_{ECB}^* - (y - e) - \frac{\sqrt{\beta}}{\alpha} \Phi^{-1}(\theta_{ECB}^*) \right) \right) = 1 - c + p\Omega \quad (10)$$

with  $\Omega = \Phi \left( \frac{\alpha}{\sqrt{\alpha + \beta}} \left( \theta_{ECB}^* - (y - e) - \frac{\sqrt{\beta}}{\alpha} \Phi^{-1}(\theta_{ECB}^*) \right) \right) - \Phi \left( -\frac{\alpha(y - e) + \beta\theta_{ECB}^* + \sqrt{\beta}\Phi^{-1}(\theta_{ECB}^*)}{\sqrt{\alpha + \beta}} \right)$ . As long as  $c + p < 1$  and  $p < c$ , expression  $\Phi^{-1} \left( \frac{1 - c}{1 - p} - \frac{p}{1 - p} \Phi \left( -\frac{\alpha(y - e) + \beta\theta_{ECB}^* + \sqrt{\beta}\Phi^{-1}(\theta_{ECB}^*)}{\sqrt{\alpha + \beta}} \right) \right)$  is well-defined and, from expression (10), one can write

$$\theta_{ECB}^* = \Phi \left( \frac{\alpha}{\sqrt{\beta}} \left( \theta_{ECB}^* - (y - e) - \frac{\sqrt{\alpha + \beta}}{\alpha} \Phi^{-1} \left( \frac{1 - c}{1 - p} - \frac{p}{1 - p} \Phi \left( -\frac{\alpha(y - e) + \beta\theta_{ECB}^* + \sqrt{\beta}\Phi^{-1}(\theta_{ECB}^*)}{\sqrt{\alpha + \beta}} \right) \right) \right) \right) \quad (11)$$

The derivative of the right-hand side is lower than  $\phi(\cdot) \frac{\alpha}{\sqrt{\beta}}$ , which means that the condition  $\frac{\alpha}{\sqrt{\beta}} \leq \sqrt{2\pi}$  is sufficient for the uniqueness of equilibrium. Expression (10) is also equivalent to

$$\theta_{ECB}^* = \Phi \left( \frac{\alpha}{\sqrt{\beta}} \left( \theta_{ECB}^* - (y - e) - \frac{\sqrt{\alpha + \beta}}{\alpha} \Phi^{-1}(1 - c + p\Omega) \right) \right). \quad (12)$$

Using expression (12), one can show that  $\theta_{ECB}^* \leq \theta^*$ , where  $\theta^*$  satisfies

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

Hence  $\theta_{ECB}^* \leq \theta^*$ , with  $\theta_{ECB}^* = \theta^*$  if and only if  $p = 0$ . The default threshold  $\theta_{ECB}^*$  is lower than the default threshold  $\theta^*$  obtained without official assistance, showing that the mixed

strategy of the ECB helps to coordinate dispersed creditors and may alleviate the funding crisis faced by the debtor country.

#### 4.1.1 The limiting case

In the limiting case,  $\alpha \rightarrow \infty$  and  $\beta \rightarrow \infty$  such that  $\frac{\alpha}{\sqrt{\beta}} \rightarrow 1 < \sqrt{2\pi}$  and  $\theta \rightarrow y - e$ . Replacing  $y - e$  by  $\theta_{ECB}^*$  in equation (11), we obtain  $\theta_{ECB}^* = \frac{c-p}{1-p}$  and the following result.

**Proposition 3** *In the limiting case with  $c + p < 1$  and  $p < c$ , and when there is OMT programme, there is default when  $y - e < 0$ , there is default with probability  $1 - p$  when  $0 \leq y - e < \frac{c-p}{1-p}$ , and the country does not default when  $y - e \geq \frac{c-p}{1-p}$ .*

With OMTs, the country is undoubtedly saved when  $y - e$  is above the threshold  $\frac{c-p}{1-p}$ . This threshold is lower or equal than the default threshold  $c$  obtained without official assistance.

## 4.2 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  $y - e^* < \frac{c-p}{1-p}$  and  $y \geq \frac{c-p}{1-p}$ , the sovereign will consider the possibility of strategically entering the OMT programme. It weighs the gain of avoiding the OMT programme and setting a level of effort  $e$  below the optimum level  $e^*$ , against the gain of setting  $e = e^*$  and entering the OMT 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).

## 4.3 Equilibrium

There are several possible cases:

- Strong fundamentals. When  $y \geq \frac{c-p}{1-p} + e^*$ , the sovereign anticipates that it will not default and sets  $e = e^*$ .
- The case of (moderately) weak fundamentals, in which the ECB does not intervene. When  $\frac{c-p}{1-p} \leq y < \frac{c-p}{1-p} + e^*$ , the sovereign sets  $e = y - \frac{c-p}{1-p} < e^*$  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  $\frac{c-p}{1-p} \leq y < c + e^*$ .

- The case of weak fundamentals, with possible ECB intervention. When  $0 \leq y < \frac{c-p}{1-p}$ , the sovereign sets the optimal level of effort  $e^*$  as long as  $y - e^* \geq 0$  and sets  $e = y$  otherwise; the ECB intervenes with probability  $p$ .
- The country defaults when  $y < 0$ .

#### 4.4 Contrasting ESM programmes with OMTs

The results in Section 3.4 and in Section 4.3 allow us to compare the extent of adjustment effort and the probability of default under the two types of official assistance available to euro area members. The analysis shows that countries fall into several categories according to their fundamentals. At one extreme are countries with strong fundamentals (that is,  $y \geq c + e^*$ ). These countries are able to implement the optimal level of adjustment effort and do not need official assistance. At the other extreme are insolvent countries with  $y < 0$ , and thereby not eligible for official assistance. In between, there are several possibilities. When  $\frac{c-p}{1-p} + e^* \leq y < c + e^*$ , the OMTs are unambiguously better than ESM programmes as the country is able to set the best level of adjustment effort without the actual need of ECB financial support. For  $0 \leq y < \frac{c-p}{1-p} + e^*$ , one must consider two possible cases.

**Case 1.** When  $\bar{m}$  is low and  $p$  is high, such that  $\frac{c-p}{1-p} < c - \bar{m}$ . Figure 3 plots the level of adjustment effort implemented in a ESM programme (solid line) and the level of effort implemented with OMTs (dashed line) against the different levels of the fundamentals.

- When fundamentals are too weak (that is, for  $0 \leq y < c - \bar{m}$ ), the ESM has insufficient funds to rescue the country, so that the only available option for the country is to adopt an OMT programme. If  $0 \leq y < \frac{c-p}{1-p}$ , the ECB intervenes with probability  $1 - p$  and the country chooses maximum effort  $e^*$ ; if  $\frac{c-p}{1-p} \leq y < c - \bar{m}$ , the ECB does not need to intervene to rescue the country, but the country is unable to set the optimal level of adjustment effort.
- For fundamentals in the range  $c - \bar{m} \leq y < \frac{c-p}{1-p} + e^*$ , OMTs are unambiguously better.

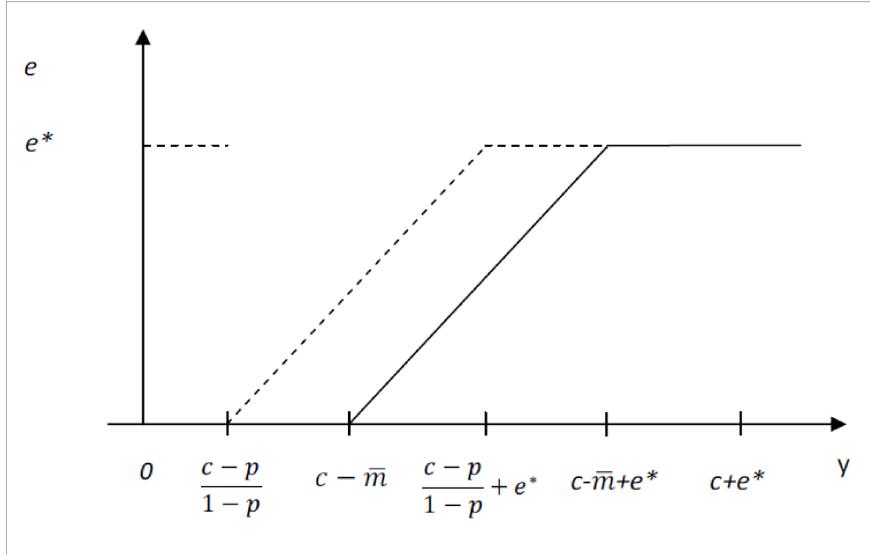


Figure 3: The  $\frac{c-p}{1-p} < c - \bar{m}$  case. The dashed line represents the OMT programme, and the solid line represents the ESM programme.

They allow the country to implement higher level of effort than ESM programmes, and the ECB does not use funds to rescue the country.

Hence, OMTs are unambiguously better in this case.

**Case 2.** When  $\bar{m}$  is large and  $p$  is low, such that  $0 < c - \bar{m} < \frac{c-p}{1-p}$ .<sup>12</sup> Figure 4 plots the levels of adjustment effort in both types of programme against the different levels of the fundamentals.

- When  $0 \leq y < c - \bar{m}$ , fundamentals are too weak and ESM programmes have insufficient funds to rescue the country. Only OMTs can rescue the country, which implements the optimal level of effort  $e^*$  but may default with probability  $1 - p$ .
- When  $c - \bar{m} \leq y < \frac{c-p}{1-p}$ , fundamentals are weak. ESM funds are sufficient as long as the country does not implement maximum effort. OMTs allow the country to implement maximum effort which, however, may imply sovereign default with probability  $1 - p$  (the ECB intervenes with probability  $p$ ). The ranking between ESM programmes and OMTs is ambiguous for this range of fundamentals.

<sup>12</sup>The general case would be  $\max\{0, c - \bar{m}\} < \frac{c-p}{1-p}$ , but the interesting case is the one with  $0 < c - \bar{m} < \frac{c-p}{1-p}$ . With very large  $\bar{m}$  (such that  $c - \bar{m} \leq 0$ ), catalytic finance would always work.

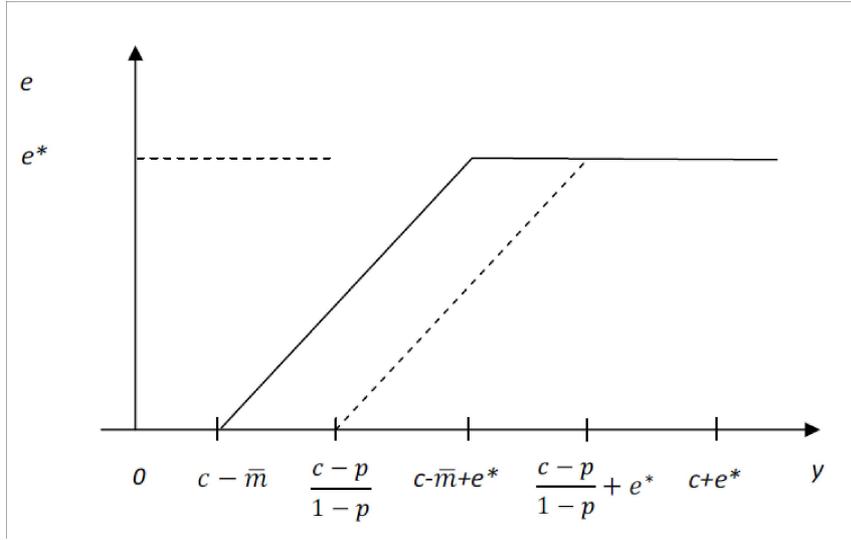


Figure 4: The  $0 < c - \bar{m} < \frac{c-p}{1-p}$  case. The dashed line represents the OMT programme, and the solid line represents the ESM programme.

- When  $\frac{c-p}{1-p} \leq y < \frac{c-p}{1-p} + e^*$ , ESM programmes have enough funds to rescue the country, and deliver the highest level of effort. Still, OMTs insure solvency without the need for ex post intervention. The ranking between ESM programmes and OMTs is ambiguous, to the extent that the actual commitment of funds is a relevant criterion.

In Case 2, the ranking between ESM programmes and OMTs depends on the criteria being used. Table 1 indicates the best programme for each range of fundamentals according to three criteria: the level of adjustment effort implemented by the country, the likelihood of solvency of the sovereign, and the effective commitment of funds by international institutions. The table shows that it is not possible to rank the programmes unambiguously for fundamentals in the range  $\left[ c - \bar{m}, \frac{c-p}{1-p} + e^* \right)$ .

Summing up, as the upper bound for official assistance  $\bar{m}$  increases and the probability  $p$  decreases, the ranking between ESM programmes and OMTs becomes ambiguous. In this case, multiple criteria - based on the probability of sovereign default, the effective commitment of funds, and the level of adjustment effort - is needed to rank the two types of official assistance.

Fundamentals	Adjustment effort	Likelihood of solvency	No effective need of funds
$0 \leq y < c - \bar{m}$	OMT	OMT	
$c - \bar{m} \leq y < \frac{c-p}{1-p}$	OMT	ESM	OMT
$\frac{c-p}{1-p} \leq y < \frac{c-p}{1-p} + e^*$	ESM	Equivalent	OMT
$\frac{c-p}{1-p} + e^* \leq y < c + e^*$	Equivalent	Equivalent	OMT
$c + e^* \leq y$	Equivalent	Equivalent	Equivalent

Table 1: The  $0 < c - \bar{m} < \frac{c-p}{1-p}$  case. The table indicates the best programme according to the criteria on the top. "Equivalent" means that both programmes are equivalent. In the blank cell it is not possible to rank the programmes.

## 5 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 (Article 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 European Union (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 European Union 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.<sup>13</sup>

<sup>13</sup>The Bundesbank President, and ECB Governing Council Member, J. Weidemann has been very vocal in opposing the OMTs Decision.

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.<sup>14</sup>

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 OMTs closer to an ESM 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. 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).<sup>15</sup>

Finally, one should assess the impact of the decision of the German Constitutional Court in a broader context. First, the new governance rules of the EU have strengthened its preventive and corrective arms, making large imbalances more unlikely and, second, the Troika programmes are finishing so that the negative short term effects of adjustment are over. In these circumstances, the ESM becomes effective at restoring investors' confidence and stopping the run on sovereign debt.

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<sup>14</sup>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 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.

<sup>15</sup>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.

## 6 Conclusion

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 private sector. For the ESM assistance programme to work, there must be enough official funds available for official assistance, since default becomes inevitable if private sector creditors think the amount of financial assistance is insufficient to solve the aggravated short term problems of the country. Both types of official assistance will be successful whenever fundamentals are not too weak, which highlights the role of the preventive and corrective arms of the new European governance rules.

Regarding the OMTs, 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 limited. 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.

We have provided some intuition about the relationship between financial assistance and adjustment effort, but much still remains to be done. Moral hazard problems may be contained with a philosophy of more explicit conditionality, and we have focused on a limiting case chosen for analytical tractability. Extending the model in these two dimensions may provide additional insights that have not been captured in the paper.

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## A Appendix

### A.1 Euro area assistance mechanisms

Since the start of the crisis, European countries and institutions have designed a plethora of assistance mechanisms. This appendix reviews the set of available mechanisms and how they have been used so far.

The European Financial Stability Mechanism (EFSM) was created on 10 May 2010. It consists of EU loans, in which the European Commission borrows money using the EU budget as collateral, and lends the proceeds to member states. Euro area member states also created two intergovernmental support mechanisms: the European Financial Stability Facility (EFSF) and the ESM.

The creation of the EFSF was decided on 9 May 2010, and started in August 2010. It was created as a temporary rescue mechanism and, as of 1 July 2013, the EFSF may no longer engage in new financing programmes or enter into new loan facility agreements. It is a “société anonyme” set up under Luxembourgish law on 7 June 2010. It obtains financing by issuing debt instruments on the financial markets, backed by guarantees of the shareholder member states. These guarantees total EUR 780 billion. As a result of the assistance programmes, Greece, Ireland and Portugal requested an opt-out of the guarantee structure, so that the EFSF has effective guarantees equal to EUR 726 billion that provide a lending capacity of EUR 440 billion.

The creation of the ESM was decided in October 2010, and entered into force on 8 October 2012. It is a permanent mechanism replacing the EFSF. It is an intergovernmental organization set up as an international financial institution, which raises funds backed by EUR 80 billion of paid-in capital and EUR 620 billion of callable capital. It cooperates closely with the IMF (a country requesting financial assistance from the ESM is expected to address a similar request to the IMF). It has a maximum lending capacity of EUR 500 billion, with the remaining EUR 200 billion of the fund being earmarked as reserves in order to guarantee that the issuance of

ESM bonds will always get the AAA credit rating. Assistance provided by the ESM will not be redirected to the public finance statistics of the member states, thereby preventing the rating migration of member states.

When a ESM member requests stability support, Article 13 of the Treaty Establishing the ESM states that the ESM will ask the European Commission, in liaison with the ECB, to assess the risk to the financial stability of the euro area, the sustainability of public debt (wherever appropriate and possible, such an assessment is expected to be conducted together with the IMF) and the financing needs of the ESM member. If it decides to grant financial stability support, the ESM entrusts the European Commission in liaison with the ECB and, wherever possible, together with the IMF with the task of negotiating a Memorandum of Understanding detailing the conditionality attached to the financial assistance facility.

Finally, countries also engage in bilateral lending. This type of lending was especially important for the first greek programme, when the Eurogroup agreed to provide bilateral loans pooled by the European Commission (the so called "Greek Loan Facility").

Table 2 provides an overview of the financial composition of the bailout programmes for Greece, Ireland, Portugal, Spain and Cyprus.

Programme	Time Span	EFSM (billion EUR)	EFSF (billion EUR)	ESM (billion EUR)	Bilateral contributions (billion EUR)	IMF (billion EUR)	Total (billion EUR)
Greece First Programme	2 May 2010 14 March 2012				52.9 out of 80 (77.3 after Ireland, Portugal, and Slovakia opted out)	20.1 out of 30 (plus 8.2)	73 out of 110
Greece Second Programme	14 March 2012 March 2016		144.7			19.8 out of 28	172.7
Ireland	28 November 2010 8 December 2013	22.5	17.7 (plus 0.7)		3.8 (UK) 0.6 (Sweden) 0.4 (Denmark)	22.5	68.2
Portugal	17 May 2011 18 May 2014	26	26			26 (plus 1.4)	79.4
Spain	20 July 2012 31 December 2013		0 out of 30	41.3 out of 100			41.3 out of 100
Cyprus	24 April 2013 March 2016			9		1	10

Table 2: Composition of the bailout programmes. Whenever the effective disbursement was inferior to the total financing package made available, the table reports "X out of Y". Whenever additional funds were pledged after the start of the programme, the table reports "(plus X)".

## A.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).<sup>16</sup>

In this appendix 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 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

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<sup>16</sup>For full account of the various initiatives the reader is invited to visit [http://ec.europa.eu/index\\_en.htm](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).

(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.

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 conditional 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.