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## Fiscal spillovers in the euro area a model-based analysis

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EUROPEAN CENTRAL BANK  
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## Working Paper Series

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Igor Vetlov

### Fiscal spillovers in the euro area a model-based analysis

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## Abstract

The fiscal consolidation measures adopted in many euro area countries over 2010–13 reduced excessive domestic fiscal imbalances, but came at the cost of short-term output losses. This simultaneous tightening of fiscal policy raised concerns that such output losses might be exacerbated by negative spillovers from other countries. This paper presents some model-based simulations for the euro area with a view to gauge the cross-country impact of the fiscal measures adopted over 2010–13. The paper finds that the output effects of the fiscal consolidation were heterogeneous across countries, reflecting the different amounts and composition of fiscal measures adopted. We find that the trade channel is able to generate sizeable cross-border fiscal spillovers in the euro area. However, once the analysis takes into account the remaining channels (e.g. monetary policy reaction, exchange rate, and risk premium) total spillovers are estimated to be relatively small. In general, when compared to the growth fallout of domestic fiscal policies, negative fiscal spillovers do not seem to have added much to the economic growth woes of vulnerable countries.

**Keywords:** *Fiscal consolidation, policy spillovers, macroeconomic models, euro area*

**JEL classification:** E42, E32, F42, F45

## Non-technical summary

Since the onset of the global economic recession of 2008–09, and the sovereign debt crisis the role of fiscal policy in restoring fiscal sustainability and preserving financial market confidence has gained renewed attention. However, the possibility that national fiscal policies may spillover to other countries, has rekindled the academic and policy interest in the economic significance of fiscal spillovers and their implications for the international coordination of fiscal policies.

A fiscal expansion in one country affects foreign countries first of all via the trade channel. This captures the positive effect on demand for foreign products which materialises when a fiscal expansion stimulates domestic activity and part of the higher aggregate demand leaks towards foreign goods. Second, in response to a fiscal expansion the domestic interest rates increase thus determining an increase in the interest rate differential vis-à-vis the foreign country. Under the assumption of perfect capital mobility and flexible exchange rates, the ensuing flow of capital to the domestic country causes an appreciation of its currency relative to the foreign currency. Under sticky prices the country's exports become less competitive whereas imports are cheaper. This generates further positive spillovers to foreign countries as domestic demand switches towards cheaper imports. This positive effect on foreign output, however, can be mitigated if the foreign monetary authority tightens its policy stance in reaction to the inflationary pressures from higher demand.

In a monetary union, trade spillovers play an important role given the strong trade linkages among participating countries. If the country originating the fiscal shock is large enough, positive trade spillovers can be offset by rising area-wide short-term and long-term interest rates. The real effective exchange rate would appreciate, owing to higher domestic prices, resulting in a competitiveness loss to the benefits of other member countries thus reinforcing the positive spillovers. However, this effect has to be weighed against a possible appreciation of the common nominal and real effective exchange rate versus foreign currencies, which would undermine the competitiveness of the exports of other member countries as well.

Existing evidence points to a generally limited size of cross-country fiscal spillovers. Empirical studies focusing on the EU, find evidence of positive fiscal spillovers to foreign output via the trade channel. Structural models find in principle smaller or even negative spillover effects from a fiscal stimulus.

This paper studies the size of fiscal spillovers in euro area countries. It contributes to the literature in several ways. It provides a comprehensive review of the existing theoretical and empirical literature on fiscal spillovers with a focus on the main transmission channels and their economic significance. It then provides model-based simulations for the euro area countries with a view to gauge the macroeconomic impact of spillovers from domestic fiscal policies adopted over the period 2010–13 and gives a comprehensive account for contributions of various channels through which country-specific fiscal shocks transmit across the borders. Compared to existing estimates of fiscal spillovers, our findings confirm the relative importance of the trade channel. However, once the analysis takes into account the remaining channels total spillovers are relatively small. We find that when compared

to the growth fallout of domestic fiscal policies, negative fiscal spillovers do not seem to have added much to the economic growth woes of vulnerable countries.

# 1 Introduction

The global economic recession of 2008–09 and the sovereign debt crisis, that has raged the euro area since 2010, have revamped the debate on the effectiveness of fiscal policy in counteracting economic fluctuations and fostering growth. The possibility, that national fiscal policies may spillover to other countries, has rekindled the academic and policy interest in the economic significance of fiscal spillovers and their implications for the international coordination of fiscal policies.

The fiscal consolidation measures adopted in 2010–13 in many euro area countries succeeded in attenuating concerns about fiscal sustainability in several of them but came at the cost of short-term output losses. The simultaneous tightening of fiscal policy across the euro area raised concerns that such output losses might be exacerbated by negative spillovers from other countries. Against this background, this paper analyses the 2010–13 fiscal consolidations in the euro area with the focus on the channels and the strength of fiscal spillover effects implied by the simultaneous fiscal policy implementation.

Our contribution to the literature is manifold. First, it reviews the existing theoretical and empirical literature on fiscal spillovers, with a focus on the main transmission channels and their economic significance. Second, it presents model-based simulations for the euro area countries with a view to gauge the macroeconomic impact of spillovers from domestic fiscal policies adopted over the period 2010–13. To this end, the analysis utilises two large scale structural macroeconomic multi-country models featuring alternative modelling frameworks which facilitates a robust policy evaluation. Third, the paper provides a comprehensive account for contributions of various channels through which country-specific fiscal shocks transmit across the borders. Lastly, the discretionary fiscal policy measures adopted over 2010–13 are obtained using a bottom-up approach. Compared to more standard top-down measures (e.g. those relying on cyclical adjustment methodologies), the latter provides a proper way to approximate the actual composition of fiscal consolidation which has significant implications for the estimates of fiscal spillovers.

The rest of the paper is structured as follows. Section 2 reviews the literature on fiscal spillovers and the main channels that are at work. An important distinction is made between countries that retain monetary policy independence and those that are part of a currency union (i.e. share common nominal exchange rate and short-term interest rates). Some stylized facts about the magnitude and composition of fiscal consolidation measures implemented by individual euro area countries over 2010–13 are discussed in Section 3. Section 4 presents the New Multi-Country Model and describes the modelling framework of fiscal spillovers by means of some illustrative model-based simulations. Section 5 reports estimates of the fiscal spillovers in euro area countries during the fiscal consolidation episode of 2010–13. Overall, we find that when compared to the growth fallout of domestic fiscal policies, negative fiscal spillovers do not seem to have added much to the economic growth woes of vulnerable countries. Section 6 assesses robustness of the fiscal spillover estimates presented in the previous section. To this purpose it uses the Euro-Area and Global Economy model which follows an alternative modelling approach and facilitates flexible sensitivity analysis of the fiscal spillover

estimates with respect to alternative model parameterisation and scenario assumptions. Section 7 concludes.

## **2 A review of the literature on fiscal spillovers**

The size of fiscal spillovers is a largely debatable topic. The evidence derived from macroeconomic models suggests that the spillovers are small and that they depend on a number of transmission channels. In addition, those results are often shown to be sensitive to some key modelling assumptions. Empirical studies, in contrast, tend to be more robust and support the existence of significant spillover effects. This difference could, on the one hand, reflect insufficient modelling of global shocks in (G)VAR models, and on the other hand, it might also reveal poor modelling of the cross-border financial linkages and limited role of financial shocks in the existing macroeconomic models. For instance, Bayoumi and Vitek (2014) provide model-based evidence supporting the view that the spillovers via financial markets are potentially larger than trade channels, but they are also much less well understood and rarely captured in standard macroeconomic models.

As our paper provides a model-based assessment of the fiscal spillovers in the euro area, this section first reviews existing studies based on macroeconomic models. The aim is to uncover the channels that are at work in the transmission of fiscal shocks, and which are investigated in this paper, and the extent to which they offset each other. The second part provides a brief account of the empirical literature on fiscal spillovers which has also grown relatively large over the past few years.

### **2.1 Macro model-based studies of fiscal spillovers**

A large body of the literature that studies fiscal spillovers through the lenses of macroeconomic models usually considers three types of spillover channels: foreign trade, interest rate, and exchange rate. A stylised description of how these different channels work would be as follows: a fiscal expansion in one country benefits foreign aggregate demand via positive effects on the imports of foreign goods and services. By causing an increase in domestic output and inflation, the fiscal expansion may lead to an increase in interest rates from the part of the domestic monetary policy authority which implies a widening of the interest rate differential vis-à-vis the foreign countries. Under the assumption of perfect capital mobility, the ensuing flow of capital to the domestic country causes an appreciation of its currency relative to the foreign currency. This in turn, would benefit the foreign country by making its products more competitive. However, if the countries are part of a monetary union, the spillover effects described above work differently, depending on a (GDP-weighted) size of the country and the size of the fiscal shock. In principle, a fiscal expansion in a given country needs to be large enough to affect the area-wide inflation and the output gap. For example, if a large member state increases government spending, this is likely to exert upward pressure on the area-wide inflation, thus eliciting a tightening of the common monetary policy and results in negative spillovers on foreign output (including other countries in the union). However, a fiscal expansion in a smaller country would not, in theory, result in a similar effect as the inflationary pressures would be mainly domestic and the common interest rate would remain unchanged.



Cwik and Wieland (2010) argue that the forward-looking nature of firms and agents assumed in most New-Keynesian model plays a central role in determining the size of the fiscal multipliers hence the trade spillovers. In presence of forward-looking agents, a debt-financed spending increase crowds out private consumption and investment as households and firms reduce spending in anticipation of future tax hikes and higher interest rates. This leads to a lower increase in domestic output than predicted by the traditional Keynesian models, thus weakening the scope for positive spillover effects via the trade channel<sup>5</sup>. Using the Taylor (1993) model of G7 economies, Cwik and Wieland (2010) quantify the effect of the stimulus measures adopted by the German government in 2009 and 2010 on the real GDP of Germany, France and Italy. The authors find that when the exchange rates are fixed and the monetary authority aims to stabilise the union-wide inflation and output gap, the size of spillover effects is rather small (i.e. the impact on the real GDP growth rate is below 0.1% and declining for both France and Italy). The main driver of this result appears to be the exchange rate channel. Indeed, for both France and Italy, the trade channel of higher export demand seems to react in a significant manner to the German stimulus. This positive direct effect, however, is largely offset by the indirect effect of a real appreciation of the euro as a fiscal expansion in Germany puts upward pressure on the euro relative to other countries outside the currency union. As a result, France and Italy loose competitiveness and their exports outside the euro area decline.

Using the EU-Quest model, in't Veld (2013) assesses the spillover effects from simultaneous fiscal consolidations in euro area countries during 2011–13 and finds that the fall in GDP (level) was up to between 1.6% and 2.6% larger when intra-euro area spillovers are taken into account. As regards the potential spillovers from a fiscal expansion in Germany to the rest of the euro area, in't Veld (2013) simulates the effect of a temporary two-year increase in government investment in Germany and other core euro area (excluding France) of 1% of GDP. He finds that import leakage leads to relatively high spillovers to other euro area countries, boosting GDP by some 0.2-0.3%. The simulations use changes in the structural primary balance as a measure of fiscal consolidation and assume crisis prevailing conditions (i.e. high share of liquidity-constrained households and monetary policy constrained by the zero lower bound). Trade linkages are distinguished into demand effects and competitiveness effects (via the change in relative prices). The model also accounts for a linear impact of (domestic) fiscal consolidation on (domestic) government bond yields, but the impact is found to be relatively small.

In a more recent paper, Blanchard et al. (2015) analyse the spillover effects of a fiscal expansion in core euro area countries on the peripheral countries using a New Keynesian model for a currency union and find that the size of the effects on the periphery GDP depends crucially on whether or not there is a liquidity trap. Outside a liquidity trap, the benefits of a stimulus are exclusively confined to core countries, while the GDP of the periphery slightly contracts. Higher output in core countries causes inflation to go above the periphery inflation for some time, thus implying a depreciation of the periphery's terms of trade which boosts the periphery's real exports. However, the increase in real interest rates in response to the stimulus in core countries would imply a drop in consumption of

<sup>5</sup> The crowding-out of consumption and investment, however, persists also when assuming that a given share of consumers is liquidity constrained. Coenen and Straub (2005) have shown that the empirically estimated share of liquidity-constrained households is not sufficient to overcome the negative wealth effects internalised by forward-looking consumers.



periphery thus offsetting the gains from higher exports. In a liquidity trap, instead, the spillovers are markedly different as the positive effects from the other channels (i.e. trade channel and terms of trade) dominate while the response of the real interest rates is weaker. The size of the spillover effects therefore depend on the expected duration of the liquidity trap, the import content of government spending and the responsiveness of inflation.

Elekdag and Muir (2014), using a multi-region DSGE model (GIMF), find that the beneficial spillovers associated with higher German public investment can be meaningful, while those associated with public consumption are limited. In particular, they find that a 2-year, 1 percent of GDP per year increase in public investment leads to an increase in GDP which peaks after two years at 0.13 p.p. (for stressed economies) and 0.22 p.p. (for other euro area countries). Finally, IMF (2013) shows that fiscal stimulus in Germany is likely to have a relatively small impact on the rest of the euro area and Germany's supply chain partners. Model simulations reveal that a two-year 1 percent of GDP fiscal stimulus in Germany has a maximum impact on the real GDP of the rest of the euro area amounts of 0.2 percentage points (in terms of deviation from the baseline).

Using a calibrated two-country business cycle model with Keynesian features (e.g. sticky prices/wages, liquidity-constrained households) and incomplete financial markets, Corsetti et al. (2010) assess the repercussions of a domestic spending shock on domestic and foreign activity, short and long-term interest rates and the real exchange rate. A novel feature in this approach is the assumption that temporary increases in government spending will be at least partly financed via future lower spending and not only higher taxes (spending reversals). This is a central assumption of the model, which delivers significant positive output spillovers from an increase in government spending. With spending reversals, the global interest rate does not increase in response to a fiscal expansion, as short-term interest rates are expected to fall in the future. As a consequence, the consumption multiplier is positive and the real exchange rate depreciates as a result of low long-term interest rates. The domestic multiplier of higher spending is larger, and the size of international spillovers (0.2% of foreign output) is also larger compared to a case with no spending reversals. The larger spillover effects work mainly via lower global interest rates which crowd-in consumption and investments from the part of asset holders. This effect is stronger than the competitiveness loss induced abroad by the depreciation of the home currency. The quantitative importance of spillover effects is affected by the policy framework and the structural features of the economy. In particular, a large degree of spending pro-cyclicality tends to reduce the size of fiscal spillovers. The transmission mechanism of fiscal policy also depends on the interaction between fiscal and monetary policy. The less accommodating is the monetary policy stance (i.e. the more hawkish) the stronger is the increase in short-term interest rates. This in turn makes long-term interest rates less responsive to anticipations of future spending reversals, thus reducing the size of fiscal multipliers as well as fiscal spillovers. Other factors affecting the size of fiscal multipliers and fiscal spillovers, are the trade price elasticities (e.g. the degree of substitutability between domestic and foreign goods), the degree of openness of a country and its size, the share of liquidity-constrained households.

## 2.2 Empirical studies of fiscal spillovers

Giuliodori and Beetsma (2004), in a VAR analysis of the fiscal spillovers between Germany, France and Italy, find that a 1 per cent higher public spending in France and Italy increases aggregate imports (i.e. exports from the rest of EU countries) by almost 2%, whereas a 1 percent lower net taxes in Germany increases aggregate imports by almost 1%. When looking at the impact on bilateral imports from all EU member countries, they find that for most countries bilateral imports react in a significant way to a fiscal loosening in the three largest countries.

Bénassy-Quéré and Cimadomo (2006) use a Factor Augmented VAR model (FAVAR) to study fiscal spillovers from Germany to France, Italy, the Netherlands, Belgium, Austria, Spain and the UK over the period 1971–2004. The authors find that, when significant, cross-border fiscal multipliers tend to have the same sign as the domestic ones. A net tax cut in Germany is found to have a positive short run effect on the GDP of France, Netherlands and Austria, whereas a positive spending shock has a positive impact on output only in Italy and in the short run. Using recursive estimation techniques, the authors find that cross-border net tax multipliers reached their maxima during the 1997–98 period, whereas they turn non-significant in the last period of analysis which includes the EMU period. When cross-border multipliers are significant they are found to be larger for neighbouring countries, whereas the more “remote” countries are less affected. This evidence, coupled with the finding that interest rates are not significantly raised for almost all subsamples, is interpreted by the authors as supporting the view that trade spillovers tend to dominate the interest rates spillovers.

Auerbach and Gorodnichenko (2013) study the significance of fiscal spillovers for a panel of OECD countries over the period 1984–2008. In particular, they assess whether spillover multipliers vary across the state of the business cycle and whether the exchange rate regime (flexible vs. floating) matters for the international transmission of fiscal policy shocks. They find that cross-border fiscal multipliers are large (above unity) in recession, whereas they are negative and not significant during expansions. Moreover, the size of the multipliers tends to be larger for countries sharing a floating exchange rate compared to countries sharing a fixed exchange rate. The authors find this evidence surprising, as they anticipate that under floating exchange rate, the positive trade spillovers in foreign countries are offset by an appreciation of the exchange rate owing to the increased demand for imports.

Hebous and Zimmermann (2013a) use a Global VAR for 12 EU countries over the period 1979–2009 to estimate the effect of a shock to the budget balance in one member country on the rest of the euro area. The authors identify total net spillovers (i.e. without distinguishing the various channels) and find that euro area-wide budget deficit shocks have a larger impact on output than a domestic shock of similar size. The authors document (unexplained) heterogeneity in the dynamics of output across member countries. Spillovers are found to be especially large and positive in the short run (around 1% effect on GDP) for countries such as Finland, Austria, the Netherlands and Ireland. Smaller but positive effects are found in France, Belgium and Spain; whereas they are close to zero in Italy, Germany, Greece and Luxembourg. In a follow up analysis of fiscal spillovers in advanced economies, Hebous and Zimmermann (2013b) find further evidence in support of cross-country heterogeneity in the transmission of fiscal policy shocks. Using data on the discretionary changes in

taxes and spending, as identified in Devries et al. (2011), the authors assess the impact of these shocks on foreign output. For the EU countries, the authors find large and significant negative effects of foreign fiscal consolidations on domestic output: 1% of GDP foreign consolidation reduces domestic GDP by 3%-7%. This effect seems to work mainly via the trade channel as the analysis does not provide evidence in support of a significant role of the interest rate and exchange rate channel. The US output, however, does not seem to react to foreign fiscal consolidation. Such heterogeneity is only partly explained by different trade intensities of different trade categories, as, in general, controlling for different categories of commodities in the analysis does not provide conclusive evidence.

### **3 2010–13 fiscal consolidation in the euro area: some stylised facts**

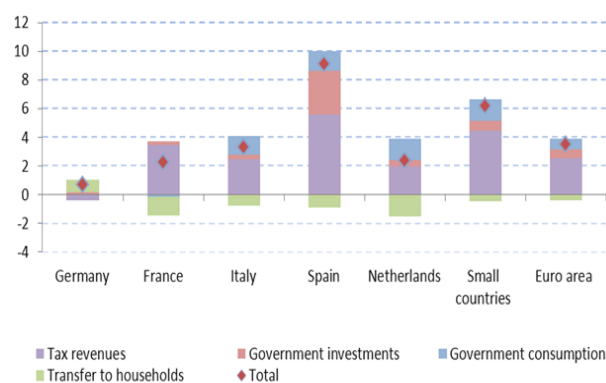
A key issue when using structural models to study the macroeconomic effects of fiscal consolidations is to identify by how much each of the main fiscal instruments embedded in the models (e.g. government consumption and investments, direct and indirect taxes and transfers) contributes to the overall impulse that discretionary government action provides to the economy. The composition of fiscal consolidation is indeed an important determinant of the macroeconomic effect of fiscal policy as the size of fiscal multipliers is instrument dependent. This task, however, is often complicated by the fact that discretionary fiscal policy is typically approximated by top-down measures (e.g. the change in the cyclically adjusted government budget balance) which fail to provide information on the composition of consolidation.

To attenuate this problem, in this paper we use a bottom-up approach to measure the amount of discretionary fiscal policy measures adopted by governments. On the revenue side, discretionary government action is approximated by summing up all individual measures adopted by governments based on information from a dataset developed by the ESCB on the basis of the disaggregated approach (Kremer et al., 2006). On the expenditure side, fiscal measures are computed as the difference between actual primary spending minus the expenditure “benchmark” defined as previous year’s primary spending uprated by the trend GDP growth rate. In order to exclude the effects related to the working of automatic stabilisers, the non-discretionary component of unemployment benefits is excluded.<sup>6</sup> Although this approach is not free from drawbacks (e.g. it entails an element of judgment in the quantification of the yield of a measure), we believe that it is the best way to approximate the actual composition of fiscal consolidation. The alternative of relying on top-down measures of fiscal consolidation and assume that its composition is equally balanced across the fiscal instruments (e.g. as in in’t Veld (2013)) introduces an element of distortion in the analysis of fiscal spillovers as the composition of consolidation matters for the overall growth effect of fiscal policy.

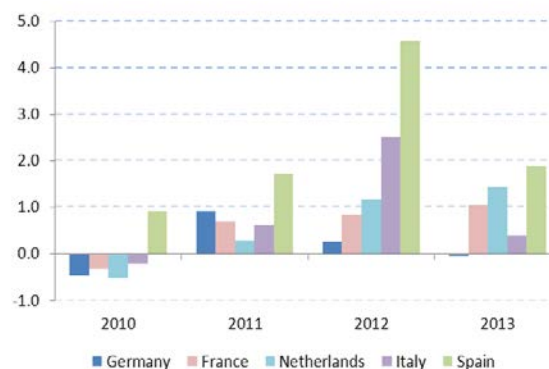
<sup>6</sup> The reason for using a different approach on the spending side, compared to the revenue side, is that a direct estimation of the yield of expenditure measures is generally not feasible since classification of a given measure as expansionary or contractionary depends on the definition of a benchmark and this is typically not possible in the case of most spending items, especially those which do not depend on entitlements written in legislation (e.g. intermediate consumption, investments). The approach we follow is very similar to the Discretionary Fiscal Effort (DFE) developed by the European Commission (2013).

Chart 1 shows the cumulative amount and composition of the discretionary fiscal policy measures, computed on the basis of the approach described above, in the five largest euro area countries plus the small countries aggregate. Over 2010–13 fiscal policy in the euro area was contractionary, although to different degrees across countries. In most countries, consolidation relied relatively more on higher taxes compared to spending cuts the latter being more concentrated on government consumption (except Spain). Germany implemented the lowest cumulative fiscal consolidation and, unlike the other countries, focused mostly on lower transfers to households<sup>7</sup>. The timing of consolidation also differed across countries, with Spain having started fiscal consolidation early on and having implemented the largest amount of consolidation.

**Chart 1: Cumulative size of fiscal consolidation measures over 2010–13 (% GDP)**



**Chart 2: Fiscal consolidation measures in five largest euro area countries over 2010–13 (annual, % GDP)**



Source: ECB staff calculations.

## 4 A model-based analysis of fiscal spillovers

The issue of how negative growth effects of fiscal consolidation in one country are compounded by restrictive fiscal measures in the rest of the euro area has been widely debated during the sovereign debt crisis. In order to assess the size of such cross-country spillovers, we conduct a number of simulations based on the New Multi-Country Model using as input various types of fiscal shocks. We first study standard spillover effects generated by the model, i.e. the spillovers induced by fiscal shocks of 1% of GDP, and then illustrate the transmission channels through which these spillovers propagate. We focus on the main channels identified in the literature, i.e. trade, interest rates, exchange rates and, differently from most of the existing literature, on the “confidence” channel that we introduce in order to capture the possible spillovers via the sovereign bond market. After having

<sup>7</sup> Compared to the change in the cyclically adjusted primary balance (CAPB), the bottom-up may yield a different quantification of the fiscal effort. Unlike the CAPB, the bottom-up approach excludes, on the revenue side, revenue windfalls/shortfalls and any decoupling of macroeconomic tax bases from GDP. On the expenditure side it excludes budgetary categories which do not have a direct effect on demand (e.g. financial support to the banking sector). In the case of Germany, the cumulative amount of consolidation over 2010–13 equals 1.9% of GDP according to the CAPB and 0.5% of GDP according to the bottom-up measure. This is largely explained by revenue windfalls and the inclusion of the decoupling of macroeconomic tax bases from GDP in the former approach.

pinned-down the model-specific responses, we proceed to estimating the spillover effects arising from the austerity measures adopted by the euro area countries over the period 2010–13. We investigate the robustness of those results by means of the Euro Area and Global Economy model that follows an alternative modelling approach and facilitates flexible sensitivity analysis of the fiscal spillover estimates with respect to alternative model parameterisation and scenario assumptions (see Section 6).

## 4.1 The New Multi-Country Model: An overview

The New Multi-Country Model (NMCM)<sup>8</sup> covers the 5 largest euro area countries (Germany, France, Italy, Spain, and the Netherlands) and the so-called “small countries bloc” covering the remaining euro area member states. It is an open economy model with one exportable domestic good and one imported good. All central behavioural relations are based on the optimisation behaviour of the private sector (households, labour unions, and firms) and the reaction functions of the government sector and the central bank. The model has been estimated and reflects cross-country differences such as degree of openness of the economy, the size of the public sector, frequency at which firms reset prices and wages, the degree of real rigidities in the economy and the degree of forward-looking behaviour of agents. The NMCM also features a relatively rich fiscal block which consists of five fiscal instruments, namely: government consumption, government investment, transfers to households, indirect taxes, and direct taxes applied to households and firms. This feature comes handy when analysing the effects of fiscal policies introduced in the euro area countries over the recent years.

To study the effects of fiscal spillovers, the NMCM is run in the “linked” version where cross-country interactions are captured via the trade channel, “confidence channel”, common monetary policy and exchange rates<sup>9</sup>. We describe these channels in more details below.

The version of the model utilised in this paper also features a sovereign risk premium channel that links debt-to-GDP ratios with public (and private) financing conditions. The functional specification of this channel follows the relationship estimated by Corsetti et al. (2013) where the sovereign risk premium is a (highly) non-linear function of the debt ratios.

More formally, building on Dieppe et al. (2015), the relationship depicted in Chart 3 is approximated by:

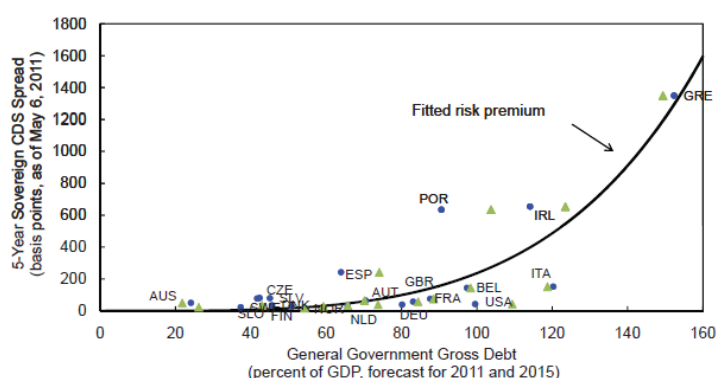
$$RP = 0.00087 * b^3 - 0.1014 * b^2 + 3.90941 * b - 24.492 \quad (1)$$

where  $RP$  is the actual risk premium and  $b$  is debt-to-GDP ratio.

<sup>8</sup> This model has been developed at the European Central Bank and is documented in Dieppe et al. (2012) and Dieppe et al. (2013).

<sup>9</sup> The NMCM can also be run in a single-country mode, i.e. each country acts in isolation, hence there is no role for cross-border effects of fiscal policy.

**Chart 3: Sovereign risk premium versus debt-to-GDP ratios**



Note: The figure shows 5-year sovereign CDS spreads against forecasts for end-2011 gross general government debt/GDP (blue circles) and end-2015 debt/GDP (green triangles).

Source: Corsetti et al., 2013.

In the NMCM the sovereign risk premium directly affects the interest rates paid by the government on its debt and it also spills over to the private sector’s lending rates. The latter, in turn, influence consumption and investment decisions of households and firms. The pass-through between public and private financing conditions is modelled by assuming that the short-term lending rates are a function of the euro area-wide policy rate and a spread, while the long-term lending rates are a function of country-specific long-term interest rates (10-year government bonds) and a spread. The initial level of spreads is exogenously given. The changes in spreads are then calculated as a fraction of changes in the sovereign risk premium. The corresponding equations can be summarised as:

$$\begin{aligned}
 s_{short}^{hh} &= s\_base_{short}^{hh} + \sigma * RP \\
 s_{short}^{nfc} &= s\_base_{short}^{nfc} + \sigma * RP \\
 s_{long}^{hh} &= s\_base_{long}^{hh} + \sigma * RP \\
 s_{long}^{nfc} &= s\_base_{long}^{nfc} + \sigma * RP
 \end{aligned}
 \tag{2}$$

where  $s_{short}^{hh}$  denotes the spread of the short-term lending rates applied to households over the short-term policy rates,  $s\_base_{short}^{hh}$  is the baseline level of the spread,  $\sigma$  is the level of pass-through and  $RP$  is the sovereign risk premium. Analogously, superscript  $nfc$  refers to non-financial corporations while subscript  $long$  denotes the spread between the long-term interest rates and the rates applied by banks on the long-term contracts. The level of pass through from the sovereign to the private sector’s borrowing conditions ( $\sigma$ ) is assumed to be around 60%, following the estimates reported in the recent empirical literature (Harjes, 2011; Zoli, 2013).

Finally, for the purpose of this paper the NMCM is augmented with the so-called “confidence channel” that approximates the possible consequences of fiscal policy in one country for the other euro area member states via the sovereign bond market. In particular, it is assumed that the sovereign



risk premium in a given country is also affected by a confidence factor<sup>10</sup> which, for each country, is approximated by a debt-to-GDP weighted average of the changes in sovereign risk premium in the rest of the euro area. We refer to this additional spillover channel as a “*confidence channel*” (CON). Under this setting, equations (2) become:

$$\begin{aligned}
 s_{short}^{hh} &= s\_base_{short}^{hh} + \sigma * (RP + CON) \\
 s_{short}^{nfc} &= s\_base_{short}^{nfc} + \sigma * (RP + CON) \\
 s_{long}^{hh} &= s\_base_{long}^{hh} + \sigma * (RP + CON) \\
 s_{long}^{nfc} &= s\_base_{long}^{nfc} + \sigma * (RP + CON)
 \end{aligned} \tag{3}$$

Finally, the NMCM can be run by employing two types of agents’ expectation: either rational (forward-looking) or based on model-consistent learning rules (bounded rationality). Throughout this paper we use the latter as we believe that they reflect better the uncertainty perceived by agents during the European sovereign debt crisis, i.e. during a large part of our simulations’ horizon. Firstly, over this period the private sector might have not perceived the announced fiscal measures as fully credible. Secondly, we believe that at the onset of the crisis the agents did not fully anticipate the zero-lower bound constraint that became effective around the mid of our horizon. Thirdly, several recent papers have argued that when employing rational expectations to analyse the reaction of current output and inflation when the interest rates constraint is binding can generate too strong (even unrealistic) results (see e.g. Carlstrom et al. (2012) and Del Negro et al. (2013)). McKay et al. (2015) have shown that this powerful effect of the forward guidance in structural models is highly sensitive to the assumption about complete markets. In a model where agents face uninsurable risk and borrowing constraints (e.g. models featuring overlapping generation assumption, such as the NMCM) the agents’ responses to promises about the future interest rates are more muted. However, Fahri and Werning (2016) illustrate that the uninsurable idiosyncratic risk alone may have weak mitigation effects but combined with an assumption of bounded rationality can substantially reduce the so-called “forward guidance puzzle”. Although the framework of bounded rationality applied by Fahri and Werning (2016) differs from the concept used in the NMCM (the former is forward-looking while the latter bears a large degree of backward-lookingness), we believe that this finding strengthens the case for applying learning-based expectations. This choice has, however, important implications for the outcome of our simulations, namely, the fiscal multipliers and spillovers obtained under learning scenarios are significantly smaller as compared to those generated by rational expectations, especially in the short run.

To gauge the implications of different assumptions about the expectations formation process, we consider a scenario of 1% of GDP increase in government consumption in Germany sustained over a medium run (7-year) horizon with a gradual return to baseline thereafter. We assume that the stimulus is undertaken at times when the euro area short-term interest rate reached its zero-lower bound (ZLB) and that the central bank commits not to change its policy rate for 2 years. This commitment is then fully anticipated in case of forward-looking agents. In case of learning-type of expectations, the

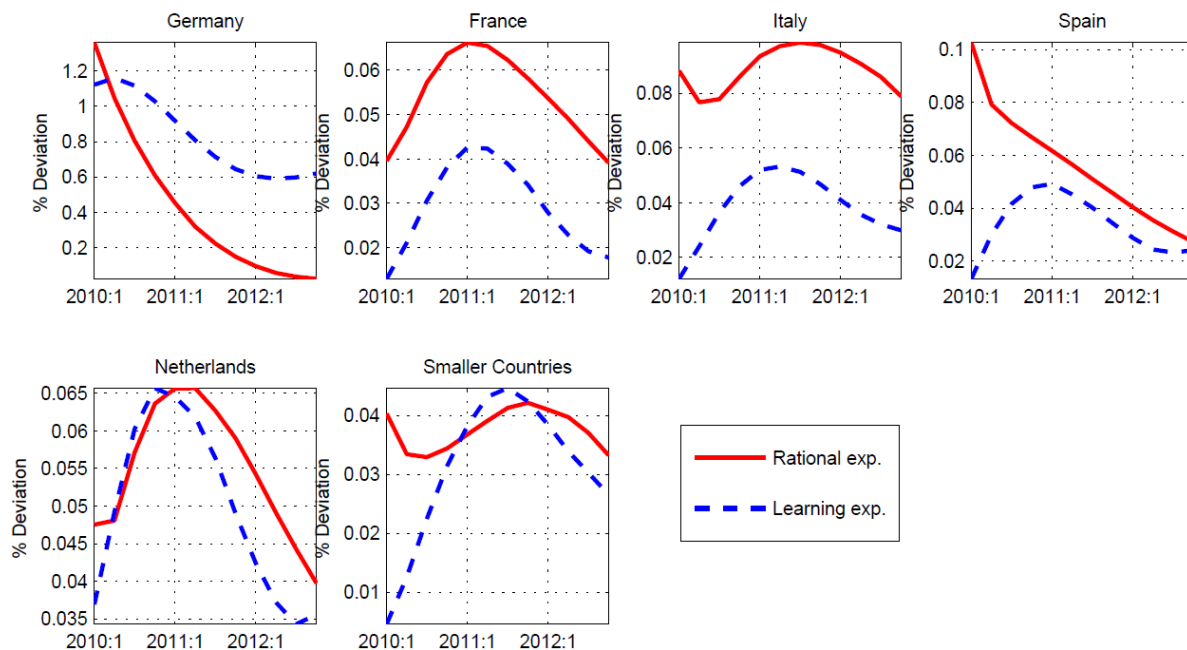
<sup>10</sup> For empirical evidence of the confidence effects see e.g. De Santis (2012).



agents initially do not know the duration of the interest rate constraint but learn about it with time (“acquired credibility”). Moreover, in both cases, the fiscal rule is operational ensuring long-run debt stability. In case of debt-based expenditure increases, the debt will return to the baseline levels via higher taxes in the future. This is fully anticipated by forward-looking agents while in case of learning the tax increases planned for a more distant future do not play a role.

Figure 1, illustrates the GDP effects for 5 largest euro area countries and the “Smaller Countries” bloc that encompasses the rest of the euro area. In case of forward-looking agents we observe a strongly front-loaded reaction of GDP and prices in Germany (in line with the “forward guidance puzzle”). As the interest rates are fixed, the spillovers generated by this scenario operate via two main channels: via an increase in the global price level, which reduces area-wide real interest rates and boosts investment and consumption in the recipient countries, and via an increased demand for foreign goods in Germany. In case of a learning scenario, the dynamics are quite different. The agents initially do not anticipate the length of the fixed interest rates, so the reaction of prices and wages in Germany is more moderate (in particular, the reaction of prices is much smaller as compared to the fully anticipated scenario). Consequently, the spillovers are of a lower magnitude. As the initial reaction of inflation in Germany is smaller, the price of goods in the rest of the euro area is hardly affected. There is no change in the real interest rates in the rest of the euro area. Consequently, the main spillover channel is trade whereby fiscal expansion in Germany results in higher exports of other countries. However, as the domestic impact of fiscal expansion in Germany is smaller, also its imports increase by less and generate smaller trade spillovers.

**Figure 1: GDP effects of 1% of GDP increase in government consumption in Germany under 2-year ZLB – the role of expectations formation (percentage deviation from baseline levels)**



Source: NCM simulations.

## 4.2 Fiscal spillover channels in the NMCM

This section presents the size of fiscal spillovers generated by the NMCM in response to some standardised negative fiscal shocks. It describes and evaluates the contribution of different spillover channels such as trade, confidence, monetary policy and exchange rates channels. We show that fiscal consolidations generate negative trade spillovers but the remaining channels contribute positively to the overall GDP effects. As a convention, whenever a reduction in fiscal deficit will lead to a decline in output, we will present the fiscal multipliers with a negative sign, although formally they should be positive. Similarly, the sign of fiscal spillovers will indicate whether they have a positive or negative impact on GDP growth in the recipient countries.

### 4.2.1 Fiscal spillovers via the trade channel

Table 1 illustrates the magnitude of the spillovers generated in the NMCM when each country undertakes a fiscal consolidation of the same size (1% of GDP) and the same composition (i.e. distributed evenly between expenditure and revenue measures). Monetary policy and exchange rates are kept exogenous, and the sovereign risk premium reacts in response to improving domestic fundamentals (debt-to-GDP ratio). The shocks are assumed to be persistent – i.e. to stay in place for 7 years and then gradually return to baseline.

**Table 1: GDP spillover effects arising via trade channel from a 1% of GDP balanced fiscal consolidation** (*% deviation from baseline levels after 3 years; diagonal values represent domestic fiscal multipliers*)

	Country originating the fiscal shock	Recipient country					Small countries	Euro area aggregate	
		DE	FR	IT	ES	NL		excl. country of origin	incl. country of origin
<i>% deviation from baseline domestic GDP</i>									
1	<b>DE</b>	<b>-0.51</b>	-0.03	-0.04	-0.05	-0.06	-0.05	-0.04	-0.17
2	<b>FR</b>	-0.02	<b>-0.46</b>	-0.03	-0.04	-0.03	-0.03	-0.03	-0.12
3	<b>IT</b>	-0.01	-0.01	<b>-0.18</b>	-0.01	-0.01	-0.01	-0.01	-0.04
4	<b>ES</b>	-0.01	-0.01	-0.02	<b>-0.59</b>	-0.01	-0.02	-0.01	-0.08
5	<b>NL</b>	-0.01	-0.01	-0.01	-0.01	<b>-0.44</b>	-0.01	-0.01	-0.04
6	<b>Small countries</b>	-0.02	-0.01	-0.02	-0.02	-0.03	<b>-0.46</b>	-0.02	-0.09
<i>Impact of 1% GDP consolidation</i>									
7	if country acts alone	-0.51	-0.46	-0.18	-0.59	-0.44	-0.46		
8	if simultaneous consolidation	-0.58	-0.53	-0.30	-0.73	-0.58	-0.59		
9	<i>% of total GDP losses due to spillover effects [(8)-(7) as a share of (8)]</i>	11.4	13.1	38.5	18.5	24.2	20.9		
	<i>memo: share to euro area</i>	0.27	0.21	0.17	0.12	0.06	0.17		

Source: NMCM simulations.

Comparing the size of domestic fiscal multipliers (diagonal values of Table 1) with the off-diagonal values, we see that the trade spillover effects on other euro area member states stemming from the fiscal consolidation adopted only in one country are relatively small compared to its domestic effects. However, when all countries adopt the same consolidation measures simultaneously, the trade spillover effects in a recipient country can account for up to 1/3 of the total decline in GDP growth 3

years after the consolidation begins (see line 9). The largest portion of total output losses due to the trade effects is observed in Italy, the Netherlands, and the smaller countries bloc while the spillover impact on Germany and France is limited. In the case of Italy, the stronger spillover effects can be explained by the fact that the negative impact of domestic fiscal cuts dissipates quicker than in other countries owing to a strong decline of the sovereign risk premium<sup>11</sup> that helps to boost investment. As the domestic factors improve, the negative contribution of the trade channel becomes, in relative terms, more prominent. In case of other countries, the results shown in Table 1 mainly reflect the structure of intra-euro area trade and the countries' sensitivity to a foreign demand shock. For instance, Germany's share of exports to the euro area is the smallest hence Germany is the least affected by declining demand for foreign goods observed in other euro area countries. On the contrary, the Netherlands having a large share of goods exported to the euro area suffers sizable losses arising from the euro area slow down. France's share of intra-euro area exports is also relatively large, however, compared to the Netherlands, France appears to be considerably more insulated from the fluctuations in foreign demand, according to the NMCM estimates<sup>12</sup>. Finally, Spain with the largest domestic fiscal multiplier, as estimated by the NMCM, and with a large share of exports to the euro area, observes significant losses due to both domestic factors and the spillover effects operating via the trade channel.

#### **4.2.2 Fiscal spillovers via trade channel, by fiscal instruments**

The results presented in Table 1, although illustrative, do not allow for examining the key aspects of discretionary fiscal policy, namely that fiscal multipliers, hence fiscal spillovers, are instrument-specific. To illustrate this feature, Table 2 presents the size of domestic fiscal multipliers and the associated trade spillovers effects, which arise from a persistent fiscal consolidation of 1% of GDP achieved by using one fiscal instrument only. It is assumed that a country acts alone, that is, the recipient countries do not undergo any simultaneous consolidation. Table 2 illustrates that the largest trade spillover effects are generated by the expenditure measures. The largest spillover effects are associated with a cut in government investment as its import content is the highest among all fiscal instruments. In the NMCM framework, also government consumption is assumed to have positive import content (albeit smaller than investment). Government consumption has the largest domestic multiplier as it impacts directly the domestic demand and in the short-term leads to a decline in imports. Over the medium-run, the shock exerts strong downward pressures on domestic prices thus improving the country's competitiveness. The decline in export prices, observed in the consolidating country, amplifies the negative trade spillover effects as time elapses.

Finally, according to the NMCM, also a persistent increase in indirect taxation can generate significant trade spillovers. In this analysis,<sup>13</sup> the increase in indirect taxes leads to upward domestic price pressures and results in a steady decline in domestic real disposable income. Domestic private

<sup>11</sup> As the relationship between the risk premium and debt level is nonlinear and given the high level of public debt in Italy, any consolidation efforts in this country result in a strong reduction in the risk premium and spill over to the private sector' financing conditions, boosting investment.

<sup>12</sup> See Dieppe et al. (2012) for the cross-country comparison of the responses to a permanent foreign demand shock.

<sup>13</sup> Recall that interest rates and exchange rates effects are excluded from this analysis.

consumption gradually declines. Successively, as economic activity slows down, the wage pressures weaken and lead to a decline in unit labour costs which, over a medium run, results in domestic competitiveness gains. As a result, 3 years after the consolidation begins the spillovers are of a magnitude similar to those induced by the government spending cuts.

**Table 2: Domestic fiscal multipliers and the corresponding trade spillover effects from a 1% of GDP instrument-specific fiscal consolidation (% deviation from baseline levels after 3 years)**

	DE		FR		IT		ES		NL		Smaller countries	
	Domestic GDP	REA GDP*	Domestic GDP	REA GDP*	Domestic GDP	REA GDP*	Domestic GDP	REA GDP*	Domestic GDP	REA GDP*	Domestic GDP	REA GDP*
Government consumption	-0.70	-0.05	-0.71	-0.04	-0.63	-0.02	-0.82	-0.02	-0.77	-0.01	-0.68	-0.02
Government investment	-0.48	-0.06	-0.57	-0.04	-0.40	-0.03	-0.65	-0.02	-0.45	-0.01	-0.42	-0.03
Transfers to households	-0.43	-0.03	-0.33	-0.02	0.00	0.00	-0.48	-0.01	-0.31	-0.01	-0.23	-0.01
Indirect taxes	-0.68	-0.05	-0.54	-0.04	-0.15	-0.01	-0.76	-0.02	-0.44	-0.01	-0.59	-0.03
Direct taxes	-0.30	-0.02	-0.20	-0.01	0.14	0.00	-0.27	-0.01	-0.25	-0.01	-0.03	0.00

Note: REA GDP denotes the impact of the shock on the euro area aggregate excluding the country of origin.

Source: NMCM simulations.

### 4.2.3 Contribution of the transmission channels to the total spillover effects

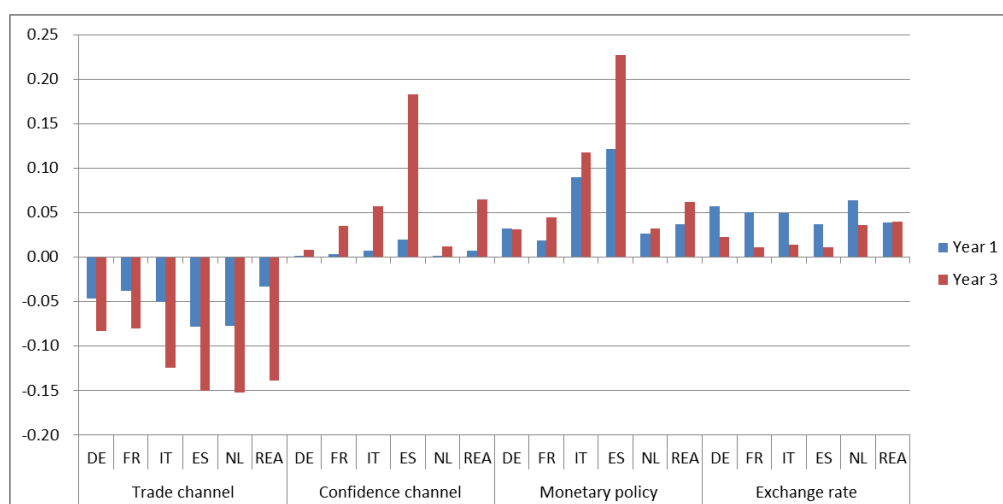
In addition to the trade effects, the NMCM can account for several other spillover channels documented in the literature. For instance, as the version of the NMCM utilised in this paper features a cross-border confidence channel, we can approximate the possible consequences of fiscal policy in one country for the other euro area member states that arises via the sovereign bond market. We also estimate the effects stemming from the standard monetary policy and exchange rates reactions. This is done by allowing these two channels to be temporarily exogenous – i.e. not reacting to fiscal shocks – and comparing the results of such simulations with scenarios where the same variables are allowed to respond endogenously, i.e. when the Taylor rule and uncovered interest rate parity are active. The scenario in which monetary policy is assumed not to react to the fiscal shocks is of particular interest as it mimics the situation when the zero lower bound constraint is binding and the monetary authority cannot decrease the interest rates in response to a negative demand shock. The contribution of all these channels to the total spillover effects is illustrated in Chart 4.

In this exposition it is assumed that all countries undergo a simultaneous consolidation, hence Chart 4 illustrates the amount of additional output losses/gains that a given country observes due to consolidation measures implemented in the rest of the euro area, split into channels through which they arise. The fiscal efforts in each country are assumed to be 1% of GDP, implemented already in the first year and persistent (i.e. staying in place for 7 years and then gradually returning to baseline). The consolidation measures are distributed evenly between the expenditure and the revenue side.

As argued in section 4.2.1, the trade spillovers triggered by fiscal consolidations are negative. However, it is interesting to notice that these spillovers accumulate over the 3-year horizon owing to the composition of fiscal measures in place. As we assume that the consolidation packages are equally divided between expenditure and revenue measures, the path of fiscal spillovers is determined by different time dynamics of those measures. Namely, the expenditure-side spillovers are larger on impact but at the same time are less persistent while the revenue-driven measures are associated with a smaller short-term impact which gains strength over time. These different time dynamics are due to

the fact that expenditure measures affect directly the aggregate demand while revenue measures operate via changes in households' real disposable income. In presence of habits formation and precautionary savings, the response of private consumption is more gradual. As a consequence, the combination of expenditure and revenue measures results in an overall decline in trade over the 3-year horizon causing the negative spillovers associated with this channel to rise.<sup>14</sup>

**Chart 4: Total fiscal spillover effects, by transmission channels (% deviation from domestic GDP baseline levels)**



Note: Compared to Table 1, the red bars represent the difference between the impact on GDP when country undertakes consolidation efforts alone (line 7) and when all countries adopt consolidation measures at the same time (line 8). Source: NMCM simulations.

Last but not least, on the back of decreasing interest rates, the euro depreciates contributing positively to the total spillover effects. This result is, however, sensitive to the assumption about the future fiscal stance. If the shocks were to be less persistent, the appreciation could occur already before the end of the 3-year horizon due to the agents' anticipation of future interest rates increases.

## 5 Fiscal spillovers in euro area countries during 2010–13

We now turn to evaluating the size of spillover effects triggered by the fiscal measures implemented across the euro area over the period 2010-13.

To study the role of different spillover channels during that period, we use the data as presented in Section 3 and undertake a sequence of simulations by adding one channel at a time. We first estimate the domestic impact of fiscal measures adopted in the euro area countries in 2010-13. In this scenario we assume that monetary policy and the exchange rates do not react. Results of this simulation pertain to a hypothetical situation where a country undertakes consolidation alone and demand for the country's exports from the rest of the euro area remains unchanged.<sup>16</sup> We then proceed to the next

<sup>14</sup> Note that, for example, in Figure 1 the increase in trade spillovers is not present as fiscal shock is applied to government consumption only.

<sup>16</sup> This scenario takes into account that the competitiveness of the consolidating country increases due to lower export prices. The assumption of the unchanged foreign demand refers to the fact that the demand for the country's export is not distorted by any consolidation measures in the rest of the euro area.

simulation and activate the sovereign risk premium channel. This allows us to assess the output effects stemming from the response of the sovereign risk premium to the amount of fiscal measures implemented in a given country. To gauge the costs that the country has to bear due to the consolidation measures adopted in the rest of the euro area, we run the next simulation where all countries are assumed to undergo the consolidation efforts simultaneously. The difference between these two simulations approximates the additional drag on domestic GDP growth that arises via the trade channel. To assess the impact of the remaining channels, i.e. monetary policy and the exchange rates, we proceed with the simulations by successively endogenising these channels. First, we allow the interest rates to react to the declining activity and then we let the exchange rates to adjust. Finally, to take into account possible cross-country spillovers in the financial markets confidence, we assume that the financial conditions in a given country are affected by the reduction in the sovereign risk premium observed in other countries (confidence channel).

The results are in line with most of the existing literature. Our findings suggest that the impact on GDP growth arising from fiscal spillovers was overall limited as compared to the effect of domestic fiscal measures. Trade spillovers, which account for the impact of fiscal consolidation on demand for foreign products, are the main channel in the transmission of fiscal policy shocks, especially when monetary policy is constrained by the zero lower bound. For the euro area aggregate the cumulative contraction in the GDP level due to trade effects is about 0.3% (line 3). For countries with large adjustment needs, and under intense financial market pressure, the favourable impact of fiscal consolidation on domestic sovereign bond spreads is transmitted to the private sector borrowing conditions. The improved financing conditions partly offset the short-term negative effects of fiscal consolidation on domestic growth. This effect is amplified when the confidence channel is accounted for, as the fall of the risk premium in a given country is even larger thanks to the consolidation efforts undertaken by other countries in the euro area. Finally, when monetary policy is allowed to react, it largely offsets the negative trade spillovers that follow the area-wide consolidation. This holds in particular for Italy and Spain, where the negative trade spillovers are more than compensated. This owes to the responsiveness of investment to changes in financing conditions which is higher in Spain and Italy than in the other countries, according to the NMCM estimates. The impact of the exchange rate channel is positive but rather limited. However, sensitivity analysis around this channel shows that when the fiscal measures are assumed to be less persistent and agents expect the future interest rates to increase earlier, then the exchange rate appreciates and contributes negatively to growth, especially in 2013.

**Table 3: Impact on real GDP from fiscal measures 2010-13 – NMCM estimates** (*% deviation from domestic GDP baseline levels*)

		Germany				France				Italy				Spain			
		2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013
Domestic effects:	1. Fiscal measures	0.15	0.16	-0.06	-0.03	-0.13	-0.02	-0.15	-0.20	-0.08	-0.68	-1.74	-2.54	-0.62	-2.20	-5.40	-6.49
	2. Public debt risk premium	-0.00	-0.00	-0.00	-0.00	-0.00	0.00	0.01	0.01	0.01	0.03	0.14	0.46	0.00	0.01	0.07	0.24
Fiscal spillovers:	3. Trade spillovers	-0.03	-0.09	-0.19	-0.27	-0.02	-0.07	-0.17	-0.26	-0.02	-0.07	-0.16	-0.27	-0.03	-0.08	-0.17	-0.29
	4. Confidence spillovers	0.00	-0.00	0.00	0.01	-0.00	0.00	0.02	0.07	0.00	0.01	0.04	0.11	0.01	0.03	0.11	0.28
	Total fiscal spillovers (3+4)	-0.03	-0.10	-0.18	-0.26	-0.02	-0.07	-0.15	-0.20	-0.02	-0.06	-0.13	-0.17	-0.02	-0.04	-0.06	-0.00
	Additional effects with																
	5. Endogenous monetary policy	0.01	0.04	0.10	0.14	0.01	0.03	0.08	0.13	0.03	0.13	0.34	0.50	0.05	0.22	0.59	0.87
	6. Endogenous exchange rate	0.11	0.19	0.16	0.06	0.10	0.13	0.11	0.04	0.10	0.12	0.10	0.06	0.07	0.07	0.07	0.05
	Total spillover effects (3+4+5+6)	0.09	0.13	0.07	-0.06	0.09	0.09	0.04	-0.02	0.11	0.19	0.32	0.39	0.10	0.25	0.59	0.92

		Netherlands				Small countries				Euro Area			
		2010	2011	2012	2013	2010	2011	2012	2013	2010	2011	2012	2013
Domestic effects:	1. Fiscal measures	0.14	-0.22	-0.08	-0.79	-0.77	-1.53	-1.96	-2.17	-0.19	-0.61	-1.31	-1.66
	2. Public debt risk premium	-0.00	-0.00	0.00	0.00	0.00	0.01	0.02	0.04	0.00	0.01	0.04	0.11
Fiscal spillovers:	3. Trade spillovers	-0.04	-0.11	-0.24	-0.36	-0.01	-0.04	-0.12	-0.25	-0.02	-0.07	-0.17	-0.27
	4. Confidence spillovers	0.00	0.00	0.01	0.01	0.00	0.01	0.04	0.12	0.00	0.01	0.03	0.09
	Total fiscal spillovers (3+4)	-0.04	-0.11	-0.23	-0.35	-0.01	-0.03	-0.08	-0.13	-0.02	-0.07	-0.14	-0.18
	Additional effects with												
	5. Endogenous monetary policy	0.01	0.04	0.09	0.13	0.02	0.06	0.14	0.21	0.02	0.08	0.20	0.30
	6. Endogenous exchange rate	0.13	0.16	0.17	0.11	0.07	0.16	0.17	0.11	0.10	0.14	0.13	0.07
	Total spillover effects (3+4+5+6)	0.10	0.09	0.02	-0.11	0.08	0.19	0.23	0.19	0.09	0.15	0.19	0.18

Source: NCMC simulations.

## 6 Robustness analysis using the EAGLE model

To assess the robustness of the fiscal spillover estimates presented in section 5 we now turn to an alternative modelling framework. To this end, we employ the Euro Area and Global Economy (EAGLE) model – a large-scale micro-founded global model jointly developed by modelling experts of the European System of Central Banks.<sup>17</sup> The EAGLE model facilitates flexible sensitivity analysis of the fiscal spillover estimates with respect to alternative model parameterisation and scenario assumptions. The benchmark version of the model features four regions: two for the euro area, of which one singles out a specific country (e.g. Spain) and the other represents the rest of the euro area, the United States, and the rest of the world. The model builds on the open-economy version of the New Keynesian paradigm – the “New Open Economy Macroeconomics” framework and enables sound analysis of monetary, exchange rate, fiscal and structural policy measures. The basic version of the model is documented in Gomes et al. (2010).

The model simulation results reported below are based on a version of EAGLE with an enhanced fiscal block where government consumption and investment play a nontrivial role in affecting the optimal decision-making of the private sector (following Leeper et al., 2010). More specifically, it is assumed that households derive utility from consumption of a composite good consisting of private and public consumption goods. As a result of the assumed complementarity<sup>18</sup> between private and public consumption goods, changes to public consumption have persistent effects on the private consumption. Moreover, government capital stock is assumed to be an important factor of production. Consequently, variation in public investment has strong and persistent supply-side effects. Lastly, the government pays a risk premium on its debt in case the actual debt-to-GDP ratio deviates from the debt target. The public debt risk premium in the euro area countries is assumed to consist of a transitory and a permanent component. The transitory component is country-specific and captures impact of growth in actual domestic government debt-to-GDP ratio (approximates the government budget position). The permanent component is common to all the members of the monetary union and

<sup>17</sup> The model has been calibrated for a number of EU countries (Cyprus, Germany, France, Ireland, Italy, Spain, Luxembourg, Portugal, Malta, Slovakia, Slovenia, and Poland) and applied to study topical policy issues: e.g., fiscal expansion and consolidation measures, competitiveness and external sector rebalancing, impact of structural reforms.

<sup>18</sup> The implied degree of complementarity is time-varying with stronger effects realized in the short run.



captures the impact of a level change of the area-wide government debt-to-GDP ratio (the weighted average of national debt-to-GDP ratios) with respect to the initial level.<sup>19</sup> Changes in the sovereign risk premia are assumed to affect financing costs of both government and private sector.

**Table 4: Impact on real GDP level from 2010–2013 fiscal measures based on EAGLE-Spain simulations (% deviation from baseline levels)**

	<i>Spain</i>				<i>Euro Area excl. Spain</i>			
	2010	2011	2012	2013	2010	2011	2012	2013
Domestic effects:								
1. Fiscal measures	-0.74	-2.66	-6.27	-6.63	-0.36	-1.22	-1.93	-2.15
2. Public debt risk premium	0.00	0.01	0.04	0.07	-0.01	0.04	0.13	0.22
Spillover effects:								
3. Trade spillovers	-0.03	-0.16	-0.24	-0.21	-0.04	-0.15	-0.40	-0.52
4. Public debt risk premium	-0.01	0.07	0.19	0.24	0.01	0.02	0.06	0.09
<i>Total fiscal spillovers (3+4)</i>	<i>-0.04</i>	<i>-0.09</i>	<i>-0.05</i>	<i>0.03</i>	<i>-0.04</i>	<i>-0.13</i>	<i>-0.34</i>	<i>-0.42</i>
<i>Additional effects with</i>								
5. Endogenous monetary policy	0.05	0.22	0.47	0.74	0.06	0.26	0.59	0.94
6. Endogenous exchange rate	-0.01	0.06	0.11	0.07	-0.01	0.14	0.26	0.21
<i>Total spillover effects (3+4+5+6)</i>	<i>0.01</i>	<i>0.19</i>	<i>0.53</i>	<i>0.84</i>	<i>0.01</i>	<i>0.26</i>	<i>0.52</i>	<i>0.73</i>
<b>Total effects (1+2+3+4+5+6):</b>	<b>-0.73</b>	<b>-2.45</b>	<b>-5.69</b>	<b>-5.72</b>	<b>-0.36</b>	<b>-0.92</b>	<b>-1.28</b>	<b>-1.21</b>

Source: EAGLE-Spain model simulations.

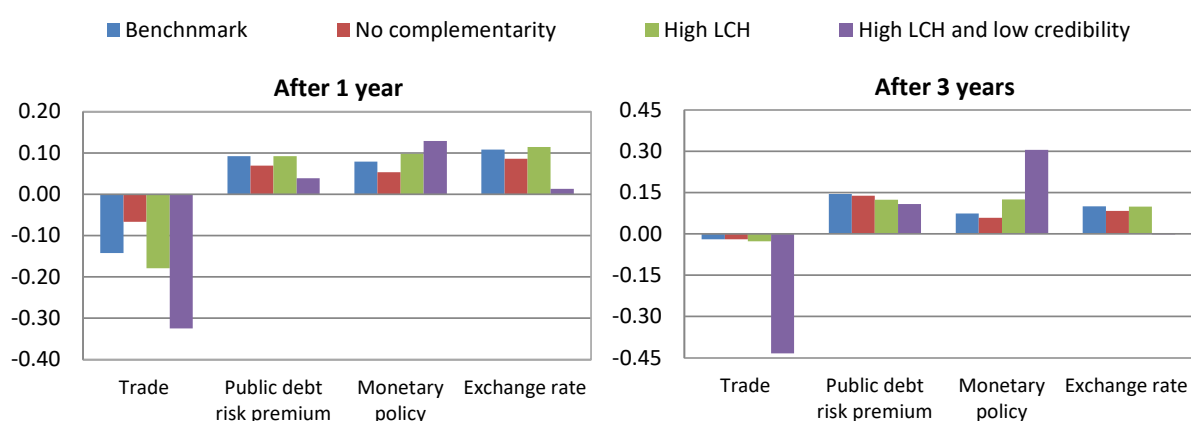
As a first step, we apply the EAGLE model to evaluate the spillover effects from the 2010–13 fiscal consolidation. To this end, we focus on Spain where the implemented fiscal measures are the largest (in terms of GDP) among the euro area countries. To facilitate comparison with the respective NMCM simulations above, the multi-year fiscal measures are assumed to be announced and implemented in a gradual manner. The agents initially do not anticipate the shock, but when it materialises, they adjust their behaviour and expect the shock to be persistent. This pattern is repeated for each simulation period and is similar to the learning mechanism employed in the NMCM. As in the case of NMCM simulations, the observed fiscal measures are expected to stay until 2017 and later on are withdrawn gradually over the long run. The model scenario assumes an active role of monetary policy, endogenous reaction in the euro nominal exchange rate and government debt risk premium. The EAGLE-based simulation results for Spain and the rest of the euro area in terms of impact on GDP are reported in Table 4.

Overall, the EAGLE-based estimates are largely in line with the corresponding estimates obtained on the basis of the NMCM. The exception is due to the implied effects of the risk premium paid on public debt, which in the NMCM is assumed to be a highly non-linear function of public debt whilst the EAGLE specification assumes a linear relationship. In the EAGLE model-based simulations the public debt-to-GDP ratio falls only gradually reflecting the negative impact of the consolidation policy on domestic demand. As a result, both domestic effects of public debt risk premium and its spillover effects on the rest of the euro area estimated to be small.

<sup>19</sup> The sensitivity of the risk premium to variation in the debt is calibrated in line with Laubach (2009): a deceleration in the actual debt-to-GDP ratio by 1 percentage point implies 25 basis points lower interest rate whereas a permanent reduction in the long-run debt target leads to interest rate lower by 4 basis points.

Robustness of the fiscal spillover effects with respect to several modelling assumptions is further assessed on the basis of the EAGLE model-based simulations of a fiscal consolidation package, standardized to 1 per cent of GDP, which is equally distributed between expenditure and revenue instruments. Chart 5 summaries the implied contributions of various fiscal spillover channels estimated under alternative modelling assumptions about degree of complementarity between public and public consumption goods, share of liquidity-constrained households and policy credibility. More detailed simulation results are reported in the annex (Table A1–Table A4).

**Chart 5: Contribution of various transmission channels to fiscal spillover on Spain under alternative modelling assumptions (% deviation from baseline levels)**



Note: The table shows the impact of a one per cent of GDP (ex post) fiscal consolidation in the euro area balanced across expenditure and revenue fiscal instruments.

Source: EAGLE-Spain model simulations.

In comparison to the benchmark simulation results, the short-run fiscal spillover effects are estimated to be weaker in case private and public consumption goods are not complementary. The complementarity assumption employed in the benchmark simulations strengthens co-movement between public and private consumption following the public consumption shock. As a result, the implied fiscal multipliers and cross-border spillover effects are considerably higher as compared to a more standard modelling approach whereby government consumption does not explicitly affect private sector's optimal choices.

The benchmark simulations assume that only 25 percent of households are liquidity-constrained, i.e. have limited access to the financial market and, hence, ability to smoothen consumption over time. Arguably, during an economic crisis, a share of such households may increase considerably implying stronger dependence of private consumption on contemporaneous income. Indeed, assuming a larger share of liquidity-constrained households (50 per cent) in economy leads to higher estimates of domestic fiscal multipliers as well as spillover effects in the short run. In particular, the negative contribution of the foreign trade channel to the fiscal spillovers increases. The latter is partly mitigated by a lower policy interest rate which implies larger positive contribution stemming from the monetary policy channel.

Lastly, the assumption of full credibility of the announced consolidation measures implemented in the environment of the ongoing major economic crisis, in particular the policy sustainability aspects, may be challenged as well. In case the policy lacks credibility, the perceived longer-term benefits of the

consolidation policy, such as lower future taxes and lower borrowing costs, are lower and the implied crowding-in effects in private sector are limited. Furthermore, private sector adjustment, in particular price and wage adjustment, depends crucially on the perceived duration of the shock. When the consolidation policy is not credible the burden of economic adjustment will be placed on the real sector implying greater output costs. In this regard, Chart 5 reveals that lack of policy credibility may lead to a significant increase in the negative trade spillover effects supported by a larger fall in foreign demand for domestic goods. Stronger contractionary domestic effects in both euro area regions result in a more delayed reduction in the level of public sector indebtedness, hence, limiting positive contribution from a reduced risk premium. At the same time, more accommodative monetary policy would be required to restore the economic equilibrium.

Overall, among the four considered channels only the trade channel features negative spillover effects of fiscal consolidation. However, when the fiscal measures are perceived to be persistent the trade contribution shrinks over time as external prices adjust restoring the competitiveness of the (Spanish) domestic goods. Hence, under full policy credibility the medium-term spillover effects tend to be positive. When the consolidation measures are perceived to be temporary (low credibility), the overall spillover effects are likely to be negative and substantially large, especially if monetary policy faces the zero lower bound constraint.

## 7 Conclusions

The fiscal consolidation measures adopted in many euro area countries since 2010 succeeded in attenuating concerns about fiscal sustainability in several of them, but came at the cost of short-term output losses. The simultaneous tightening of fiscal policy, which occurred across the euro area during 2010–13, raised concerns that such output losses might be exacerbated by negative spillovers from other countries.

In this paper we have conducted a model-based analysis of fiscal spillovers with a specific focus on euro area countries and on the consolidation episodes of 2010–13. Our main aim was to analyse the economic significance of cross-country spillovers and the relevance of individual transmission channels.

As shown in the literature review, and partly in our analysis, estimates of the size of fiscal spillovers are subject to considerable uncertainty depending on: 1) the method of estimation used; 2) the size of domestic fiscal multipliers; 3) trade price elasticities; 4) the degree of openness of a country; 4) the share of liquidity-constrained households and the 5) monetary policy stance.

Model-based evidence for the euro area over the period 2010–13 shows that the output effects of fiscal policy were heterogeneous across countries, reflecting the different amounts and composition of fiscal measures adopted. Negative trade spillovers across euro area countries resulting from fiscal consolidation built up gradually, with an aggregate impact on euro area GDP of about 0.30%. Accounting for an endogenous monetary policy response, falling interest rates offset the negative trade spillovers. In general, when compared to the growth fallout of domestic fiscal policies, negative fiscal spillovers do not seem to have added much to the economic growth woes of vulnerable

countries. Moreover, this result appears to be sensitive to a number of model assumptions, including the credibility of government plans.

The estimates of fiscal spillovers presented in this paper are subject to uncertainty as a number of caveats apply to the model simulations. On the one hand there may be, in addition to the trade channel, negative business and household confidence effects in the short-term which may exacerbate the negative spillovers. In presence of financial frictions (e.g. myopic or inefficient financial markets), short-term spillovers can also be larger. On the other hand, it should be considered that the negative growth effects, both domestic and the spillovers to other countries, could have been even larger in the absence of consolidation during 2010–13, given the fiscal sustainability concerns in some member countries and the increasing fragmentation risks. This means in turn, that the spillover effects estimated in this analysis can be considered on the low side.

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## Annex

**Table A1: GDP impact of fiscal consolidation in a benchmark scenario** (*deviation from baseline levels in %, cumulative*)

	Spain				Euro Area excl. Spain			
	1Y	2Y	3Y	4Y	1Y	2Y	3Y	4Y
Domestic effects:								
1. Fiscal measures	-0.58	-0.34	-0.28	-0.33	-0.96	-0.69	-0.53	-0.55
2. Public debt risk premium	0.00	0.01	0.02	0.02	0.04	0.09	0.14	0.19
S pillover effects:								
3. Trade spillovers	-0.14	-0.09	-0.02	0.01	-0.04	-0.06	-0.05	-0.05
4. Public debt risk premium	0.09	0.13	0.14	0.18	0.01	0.01	0.01	0.02
<i>Total fiscal spillovers (3+4)</i>	-0.05	0.04	0.12	0.19	-0.04	-0.05	-0.04	-0.03
<i>Additional effects with</i>								
5. Endogenous monetary policy	0.08	0.11	0.07	0.07	0.09	0.13	0.09	0.08
6. Endogenous exchange rate	0.11	0.13	0.10	0.09	0.22	0.28	0.26	0.25
<i>Total spillover effects (3+4+5+6)</i>	0.14	0.27	0.30	0.34	0.27	0.36	0.31	0.30
<b>Total effects (1+2+3+4+5+6):</b>	<b>-0.44</b>	<b>-0.06</b>	<b>0.03</b>	<b>0.04</b>	<b>-0.65</b>	<b>-0.24</b>	<b>-0.08</b>	<b>-0.07</b>

*Note: The table shows the impact of a one per cent of GDP (ex post) fiscal consolidation balanced across expenditure and revenue fiscal instruments. The benchmark scenario assumes 25 per cent of households are liquidity constrained, private and public consumption goods are complementarities, the policy is fully credible, i.e. the measures are expected to last as announced by the government.*

*Source: EAGLE-Spain model simulations.*

**Table A2: GDP impact of fiscal consolidation assuming no complementarity between private and public consumption goods** (*deviation from baseline levels in %, cumulative*)

	Spain				Euro Area excl. Spain			
	1Y	2Y	3Y	4Y	1Y	2Y	3Y	4Y
Domestic effects:								
1. Fiscal measures	-0.47	-0.31	-0.27	-0.32	-0.68	-0.61	-0.53	-0.55
2. Public debt risk premium	-0.00	0.01	0.02	0.02	-0.01	0.06	0.13	0.19
S pillover effects:								
3. Trade spillovers	-0.07	-0.07	-0.02	-0.00	-0.03	-0.04	-0.04	-0.04
4. Public debt risk premium	0.07	0.12	0.14	0.18	0.00	0.01	0.01	0.02
<i>Total fiscal spillovers (3+4)</i>	0.00	0.05	0.12	0.18	-0.03	-0.04	-0.03	-0.02
<i>Additional effects with</i>								
5. Endogenous monetary policy	0.05	0.08	0.06	0.06	0.06	0.09	0.07	0.06
6. Endogenous exchange rate	0.09	0.11	0.08	0.07	0.20	0.27	0.25	0.24
<i>Total spillover effects (3+4+5+6)</i>	0.14	0.24	0.26	0.31	0.23	0.32	0.29	0.28
<b>Total effects (1+2+3+4+5+6):</b>	<b>-0.33</b>	<b>-0.07</b>	<b>0.00</b>	<b>0.02</b>	<b>-0.46</b>	<b>-0.23</b>	<b>-0.11</b>	<b>-0.08</b>

*Note: The table shows the impact of a one per cent of GDP (ex post) fiscal consolidation balanced across expenditure and revenue fiscal instruments. This scenario deviates from the benchmark case by assuming no complementarity between private and public consumption goods.*

*Source: EAGLE-Spain model simulations.*

**Table A3: GDP impact of fiscal consolidation assuming a higher share of liquidity-constrained households** (deviation from baseline levels in %, cumulative)

		Spain				Euro Area excl. Spain			
		1Y	2Y	3Y	4Y	1Y	2Y	3Y	4Y
Domestic effects:	1. Fiscal measures	-0.67	-0.38	-0.28	-0.32	-1.11	-0.75	-0.51	-0.5
	2. Public debt risk premium	0.00	0.01	0.02	0.02	0.05	0.09	0.12	0.16
Spillover effects:	3. Trade spillovers	-0.18	-0.13	-0.03	0.01	-0.05	-0.07	-0.06	-0.05
	4. Public debt risk premium	0.09	0.12	0.12	0.16	0.01	0.01	0.01	0.02
	<i>Total fiscal spillovers (3+4)</i>	-0.09	-0.01	0.10	0.17	-0.05	-0.06	-0.04	-0.03
	<i>Additional effects with</i>								
	5. Endogenous monetary policy	0.10	0.16	0.13	0.12	0.11	0.18	0.15	0.14
	6. Endogenous exchange rate	0.11	0.14	0.10	0.08	0.23	0.28	0.25	0.23
	<i>Total spillover effects (3+4+5+6)</i>	0.13	0.29	0.32	0.37	0.29	0.41	0.36	0.33
<b>Total effects (1+2+3+4+5+6):</b>		<b>-0.55</b>	<b>-0.08</b>	<b>0.06</b>	<b>0.07</b>	<b>-0.77</b>	<b>-0.26</b>	<b>-0.02</b>	<b>-0.00</b>

Note: The table shows the impact of a one per cent of GDP (ex post) fiscal consolidation balanced across expenditure and revenue fiscal instruments. This scenario deviates from the benchmark case by assuming that 50 per cent of households are liquidity constrained.

Source: EAGLE-Spain model simulations.

**Table A4: GDP impact of fiscal consolidation assuming higher share of liquidity-constrained households and low policy credibility** (deviation from baseline levels in %, cumulative)

		Spain				Euro Area excl. Spain			
		1Y	2Y	3Y	4Y	1Y	2Y	3Y	4Y
Domestic effects:	1. Fiscal measures	-0.77	-0.77	-0.79	-0.86	-1.3	-1.42	-1.4	-1.42
	2. Public debt risk premium	-0.00	0.00	0.01	0.01	0.03	0.07	0.10	0.13
Spillover effects:	3. Trade spillovers	-0.32	-0.44	-0.43	-0.42	-0.05	-0.09	-0.09	-0.09
	4. Public debt risk premium	0.04	0.08	0.11	0.13	0.00	0.01	0.01	0.01
	<i>Total fiscal spillovers (3+4)</i>	-0.29	-0.36	-0.33	-0.29	-0.05	-0.08	-0.08	-0.08
	<i>Additional effects with</i>								
	5. Endogenous monetary policy	0.13	0.27	0.31	0.31	0.15	0.31	0.36	0.37
	6. Endogenous exchange rate	0.01	0.01	-0.00	-0.01	0.03	0.03	0.01	-0.01
	<i>Total spillover effects (3+4+5+6)</i>	-0.14	-0.09	-0.02	0.01	0.13	0.26	0.29	0.28
<b>Total effects (1+2+3+4+5+6):</b>		<b>-0.92</b>	<b>-0.86</b>	<b>-0.81</b>	<b>-0.84</b>	<b>-1.15</b>	<b>-1.09</b>	<b>-1.00</b>	<b>-1.01</b>

Note: The table shows the impact of a one per cent of GDP (ex post) fiscal consolidation balanced across expenditure and revenue fiscal instruments. This scenario deviates from the benchmark case by assuming that 50 per cent of households are liquidity constrained and the fiscal measures are expected to last only for 1 year.

Source: EAGLE-Spain model simulations.

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