EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

Magdalena Lalik

Interactions between fiscal multipliers and sovereign risk premium during fiscal consolidation: model based assessment for the euro area

No 2016 / February 2017

Abstract

The paper presents a model-based assessment of fiscal multipliers operating in the euro area during the period 2011-2014. The assessment is conditional on two distinct reactions of the sovereign risk premium (either responding endogenously to fiscal shocks or being an exogenous process) and two types of monetary policy (accommodative and non-accommodative). Applying those multipliers to the amount of austerity measures implemented in years 2011-14, the paper evaluates their possible fallouts and shows that the output effects of the recent fiscal consolidations were largely determined by two key factors: financial markets' sentiments and the composition of adopted measures. Finally, the paper also highlights the importance of modelling of government's interest payments for predicting the evolution of debt-to-GDP ratios.

Keywords: *Fiscal multipliers, debt dynamics, sovereign risk premium, macroeconomic models, euro area*

JEL classification: E42, E32, F42, F45

Non-technical summary

The size of fiscal multipliers is a classic debate in macroeconomics. Likewise, the determinants of government bond yields have been studied for decades. Yet, an approach to combine both has attracted research interest only recently, reflecting the developments in some euro area countries where an unprecedented surge in the government bond yields has been accompanied by an introduction of substantial austerity measures. Against the background of such a turbulent economic environment, a natural question arises about an impact that the sovereign risk channel might have on the size of fiscal multipliers and thus on the outcome of fiscal consolidations.

Indeed, the recent literature provides increasing evidence that fiscal multipliers can vary through time and tend to be larger during recessions (see e.g. Auerbach and Gorodnichenko, 2012a; Batini et al., 2012; Baum et al., 2012; Corsetti et al., 2012; DeLong and Summers, 2012; Blanchard and Leigh, 2013). The monetary policy, which, at times, can be constrained by its zero lower bound (ZLB), has been shown to be one of the key determinants of these time-varying effects. As illustrated, for example, by Christiano et al. (2011) and Coenen et al. (2012), the binding ZLB constraint leads to higher fiscal multipliers. However, as emphasised by another recent strain of the literature, it is the sovereign risk premium channel which, along with the monetary policy channel, is crucial for influencing the outcomes of fiscal consolidation. A seminal work of Corsetti et al. (2013) shows that the sovereign risk premium is one of the key channels that can alter the propagation of fiscal shocks due to the pass-through mechanism between the sovereign and private financing conditions. Empirically, Harjes (2011) and Zoli (2013) estimate that for a 100 basis point increase in the sovereign spread about 50-60 is passed onto the private sector.

When studying the impact of fiscal measures on GDP growth (or, equivalently, the size of fiscal multipliers), it is therefore important to account for a reaction of the sovereign risk premium. A largely debatable question, however, is what determines this reaction. In brief, two views regarding the role of sovereign risk premium during the recent austerity period emerge across the literature. The standard accounts of the sovereign debt crisis point at deteriorating fundamentals (especially increasing debt-to-GDP ratios) as the main driver of rapidly increasing yields on bonds issued by the South-West euro area governments between 2010 and mid-2012. According to this view, financial markets by requesting high yields on the government bonds were just “messengers” of bad news, reflecting the unsound economic situation in those countries. Yet, an alternative interpretation of the events unfolding between 2010 and mid-2012 sees the surging yields as a result of markets’ “fear and panic” that was largely disconnected from the fundamentals (see e.g. De Grauwe and Ji, 2013a).

In order to illustrate the possible impact of the sovereign risk channel on the outcome of fiscal consolidation implemented in the euro area between 2011 and 2014, the paper uses the ECB’s New Multi Country Model (NMCM) and augments it with different specifications of the risk premium

mechanism. It then looks at the amount and the composition of those austerity measures, and studies their output effects through the lenses of the modified NMCM framework.

The model-based results presented in this paper point at three important messages. First, the composition of fiscal measures is a key for shaping their output effects, as it also affects the reaction of the sovereign risk premium. Second, a fiscal consolidation that is accompanied by decreasing sovereign risk premium is likely to result in limited short-term costs while its medium-term benefits materialise relatively quickly. A finding which is common across the recent literature (ECB, 2012; Nickel and Tudyka, 2013; Corsetti et al., 2013; Locarno et al., 2013). Third, in the event that during the period of fiscal tightening the sovereign risk premium becomes a subject to an exogenous shock (for example due to financial markets' "fear and panic"), the short-term outcome of fiscal consolidation can be more severe and the medium-term profits might be delayed. However, the size and the dynamics of such output losses depend largely on the composition of implemented measures. Finally, the paper illustrates that financial markets' sentiments can influence the evolution of debt-to-GDP ratios. As a ("fear and panic" driven) increase in the sovereign risk premium can lead to higher fiscal multipliers it can impair the effectiveness of fiscal consolidations via a direct mechanism whereby the higher the multiplier, the smaller debt-reducing power of fiscal consolidation (see e.g. Eyraud and Weber (2013)). In addition, such an increase might, at the same time, be associated with higher costs of government borrowing and higher interest payments. In particular, when a pass-through between the sovereign risk premium and the interest payments is high, it might further counterbalance the efforts spent on reducing the public debt.

1 Introduction

The size of fiscal multipliers is a classic debate in macroeconomics. Likewise, the determinants of government bond yields have been studied for decades. Yet, an approach to combine both has attracted research interest only recently, reflecting the developments in some euro area countries where an unprecedented surge in the government bond yields has been accompanied by an introduction of substantial austerity measures. Against the background of such a turbulent economic environment, a natural question arises about an impact that the sovereign risk channel might have on the size of fiscal multipliers and thus on the outcome of fiscal consolidations.

Indeed, the recent literature provides increasing evidence that fiscal multipliers can vary through time and tend to be larger during recessions (see e.g. Auerbach and Gorodnichenko, 2012a; Batini et al., 2012; Baum et al., 2012; Corsetti et al., 2012; DeLong and Summers, 2012; Blanchard and Leigh, 2013). The monetary policy, which, at times, can be constrained by its zero lower bound (ZLB), has been shown to be one of the key determinants of these time-varying effects. As illustrated, for example, by Christiano et al. (2011) and Coenen et al. (2012), the binding ZLB constraint leads to higher fiscal multipliers. However, as emphasised by another recent strain of the literature, it is the sovereign risk premium channel which, along with the monetary policy channel, is crucial for influencing the outcomes of fiscal consolidation. A seminal work of Corsetti et al. (2013) shows that the sovereign risk premium is one of the key channels that can alter the propagation of fiscal shocks due to the pass-through mechanism between the sovereign and private financing conditions. The underlying mechanism assumes that a decline (increase) in the sovereign bond yields translates into lower (higher) bank lending rates. Roeger and in ‘t Veld (2013) illustrate this transmission channel by explicitly modelling the banking sector’s vulnerability to the variation in government bond prices. As banks hold the government bonds, their balance sheets are affected by changes in the government bond prices. Lower prices (higher yields) erode the current value of the bank’s capital. In the presence of capital requirements banks are likely to decrease their leverage by reducing the credit supply and/or by issuing more equities at competitive prices. In case of both of these actions, the non-financial sector is faced with higher costs of funding. Empirically, Harjes (2011) and Zoli (2013) estimate that for a 100 basis point increase in the sovereign spread about 50-60 is passed onto the private sector.

When studying the impact of fiscal measures on GDP growth (or, equivalently, the size of fiscal multipliers), it is therefore important to account for a reaction of the sovereign risk premium. A largely debatable question, however, is what determines this reaction. In brief, two views regarding the role of sovereign risk premium during the recent austerity period emerge across the literature. The standard accounts of the sovereign debt crisis point at deteriorating fundamentals (especially increasing debt-to-GDP ratios) as the main driver of rapidly increasing yields on bonds issued by the South-West euro area governments between 2010 and mid-2012. According to this view, financial

markets by requesting high yields on the government bonds were just "messengers" of bad news, reflecting the unsound economic situation in those countries. Yet, an alternative interpretation of the events unfolding between 2010 and mid-2012 sees the surging yields as a result of markets' "fear and panic" that was largely disconnected from the fundamentals (see e.g. De Grauwe and Ji, 2013a). Such an interpretation can also be viewed from an angle of self-fulfilling expectations whereby investors suddenly cast doubt in debt sustainability of some countries and start requesting higher interest rates on government bonds on the back of expected future defaults (see e.g. Lorenzoni and Werning, 2014).

In order to illustrate the possible impact of the sovereign risk channel on the outcome of fiscal consolidation implemented in the euro area between 2011 and 2014, the paper uses the ECB's New Multi Country Model (NMCM) and augments it with different specifications of the risk premium mechanism. It then looks at the amount and the composition of those austerity measures, and studies their output effects through the lenses of the modified NMCM framework. A particular strength of this analysis lies in the fact that the model has been estimated for 5 largest euro area economies (see Dieppe et al., 2012), hence it accounts for cross country differences such as degree of openness, the size of public sector, the extent of nominal and real rigidities, etc. In addition, thanks to its learning mechanism whereby agents adjust their expectations as the shokcs unfold, the NMCM replicates the key stylised facts associated with discretionary fiscal measures, such as time-varying aspect of fiscal multipliers and the role of credibility of policy announcements. Moreover, the NMCM features a rich fiscal block, which makes it well suited to study the effects of fiscal policies as it allows for taking into account the composition of fiscal measures. The latter plays a crucial role for determining the overall impact of a fiscal consolidation as the instrument-specific fiscal multipliers exhibit significantly different properties over time. Namely, the short-term effects of expenditure cuts are associated with larger output losses as compared to tax increases. The fallouts of the latter are, however, longer lived and increasing with time.

The model-based results presented in this paper point at three important messages. First, the composition of fiscal measures is a key for shaping their output effects, as it also affects the reaction of the sovereign risk premium. Second, a fiscal consolidation that is accompanied by decreasing sovereign risk premium is likely to result in limited short-term costs while its medium-term benefits materialise relatively quickly. A finding which is common across the recent literature (ECB, 2012; Nickel and Tudyka, 2013; Corsetti et al., 2013; Locarno et al., 2013). Third, in the event that during the period of fiscal tightening the sovereign risk premium becomes a subject to an exogenous shock (for example due to financial markets' "fear and panic"), the short-term outcome of fiscal consolidation can be more severe and the medium-term profits might be delayed. However, the size and the dynamics of such output losses depend largely on the composition of implemented measures. Finally, the paper also illustrates the case when fiscal multipliers are large and accompanied by an

increase in the government's interest payments that impairs the effectiveness of fiscal retrenchments (measured as a decline in debt-to-GDP ratio).

The remaining of this paper is structured as follows: Section 2 relates the paper's analysis to the recent findings in the literature on determinants of sovereign risk premium and fiscal multipliers. Section 3 presents the NMCM model and shows the impact of the sovereign risk premium (and the monetary policy channel) on the size of model-implied fiscal multipliers generated by five fiscal instruments: government consumption, government investment, transfers to households, direct and indirect taxation. Section 4 provides an overview of austerity measures implemented in the euro area in years 2011-14 and investigates their impact on GDP growth. It is followed by a robustness analysis that takes into account alternative forms of the sovereign risk premium channel as well as various levels of the pass-through parameter that governs the spillovers between sovereign and private financing conditions. Finally, the conclusions are summarized in Section 5.

2 Related literature

This paper draws on two strains of the literature: addressing the determinants of the sovereign risk premium as well as studying the size of fiscal multipliers.

The recent literature that explores drivers of government bond yields seem to provide increasing evidence that the relationship between the sovereign risk premium and the country-specific economic fundamentals has changed in the past few years, especially in the euro area stressed countries: Greece, Ireland, Italy, Portugal, and Spain. In view of the unprecedented surge in government bond yields observed in these countries during the period 2010-12, the empirical studies tend to suggest that such a stark increase cannot be fully explained by changes in macroeconomic fundamentals. For instance, Di Cesare et al. (2012) use several econometric models and illustrate that during the sovereign debt crisis the government bond spreads in Italy and Spain significantly exceeded their fair value. As one of possible reasons of these divergences, the authors suggest the perceived risk of a break-up of the euro area. The fear factor has been also emphasised in a study of De Grauwe and Ji (2013a), which argues that the sovereign risk premium during the period 2010-12 was driven mainly by financial markets' "fear and panic" rather than by economic fundamentals. The authors back their assessment by analysing the correlation between the initial level of sovereign spreads (in 2012Q2) and changes thereof that followed the ECB's announcement of Outright Monetary Transactions in August 2012. They find that the variation in spreads between mid-2012 and the beginning of 2013 can be largely explained by one factor only – the initial level of spreads. Moreover, they observe that whilst the spreads went down as of mid-2012, the debt-to-GDP ratios continued to grow. A development which they consider at odds with the theory that postulates debt ratios to be the key determinants of the sovereign bond yields. The authors therefore conclude that the decline in the sovereign bonds spreads observed in the second half of 2012, was mainly due to the ECB's action, which took away the fear

factor. In addition to those empirical studies, the "fear and panic" factor has also its theoretical underpinnings. As illustrated by Lorenzoni and Werning (2014), the observed turbulence in sovereign debt markets can be explained by an existence of a bad equilibrium whereby self-fulfilling expectations lead to an increase in interest rates solely due to fears of sovereigns' future default.

The above-mentioned views stand, however, in a rather stark contrast to the evidence provided by earlier studies where the macroeconomic fundamentals were found to be valid predictors of the sovereign bond yields. Admittedly, the majority of previous analysis was based on the pre-crisis data (i.e. up to 2009) thus cannot provide a complete explanation for the surge and the subsequent decline of spreads observed in the recent years. Nevertheless, most of the previous studies consistently documented that economic fundamentals together with fiscal outlook, particularly debt-to-GDP ratios, are statistically significant and economically meaningful determinants of the sovereign risk premium. For instance Ardagana et al. (2007) studied the implications of changes in fiscal variables on long-term interest rates and found that in the sample of 16 OECD countries over the period 1960-2002 such a relationship was indeed relevant. Moreover, they found the relationship between debt-to-GDP ratios and the sovereign risk premium to be highly non-linear, with only the levels of debt-ratios that exceeded a given threshold influencing the yields. Attinasi et al. (2009) perform similar analysis focusing on 10 euro area countries from July 2007 to March 2009, i.e. covering the initial period of the crisis when the government bond spreads relative to Germany started to widen. Their findings also confirm the important role of fiscal variables for determining the sovereign bond yields during that period. Aizeman et al. (2013) use panel regression for 60 OECD countries over the years 2005-10 and find that one of the key drivers of government bond yields during the initial period of the crisis was the sensitivity of the sovereign risk premium to changes in fiscal space. Similarly, Borgy et al. (2011) show that a particularly important driver of the sovereign bonds spreads prior to the crisis was a common (international) factor, however an influence of this factor has weakened during the crisis and, consequently, a bulk of the increase in the sovereign yield spreads in 2009-11 can be attributed to the expected country-specific fiscal factors.

Against the backdrop of different possible responses of the sovereign risk premium to changes in fiscal policy, it is interesting (and important) to explore to which extent such reactions may influence the size of fiscal multipliers. Several recent papers document that the presence of the sovereign risk premium channel can alter considerably the output effects of fiscal shocks, especially in the medium run. These results are, however, dependent on a number of factors, which are discussed below.

Firstly, it should be noted that the estimates of fiscal multipliers vary substantially across the literature. In particular, there seem to be new evidence across the recent literature supporting the notion of time-varying and state-dependent fiscal multipliers as opposed to the previous perception of fiscal multipliers that used to be considered rather small and time-independent. The recent studies

emphasise that fiscal multipliers can vary through time and are larger during recessions than they are during normal times (see e.g. Auerbach and Gorodnichenko, 2012a; Batini et al., 2012; Baum et al., 2012; Corsetti et al., 2012; DeLong and Summers, 2012; Blanchard and Leigh, 2013). The recent literature identifies a number of factors that are potential determinants of these time-varying characteristics of fiscal multipliers. These are: monetary policy, which might reach its zero lower bound; amount of liquidity-constrained households, which might increase during a crisis period; health of financial system, which might deteriorate rapidly during a financial turmoil; condition of public finances, which vary with the business cycle; credibility of government announcements; and reaction of the sovereign risk premium (see e.g. Cogan et al., 2010; Christiano et al., 2011; ECB, 2012; Coenen et al., 2012, Corsetti et al., 2013a).

The importance of monetary policy for determining the size of fiscal multipliers is illustrated, for example, in Coenen et al. (2012). The paper reports the results of a discretionary fiscal stimulus shock as generated by seven structural policy models and two prominent academic peers. The size of many multipliers is found to be large, however, these sizes vary depending on the persistence of shocks and on the reaction of the interest rates. The longer monetary policy remains accommodative, the larger the multipliers. A somewhat complementary analysis that has been run with the New Area Wide Model[2], reported in ECB (2012), shows that regardless the monetary policy stance, the short-term multipliers can be actually much smaller in case the government plans are fully credible (i.e. when markets believe that the consolidation efforts will be fully implemented and lasting). Likewise, smaller fiscal multipliers can be also observed when a decline in the debt-to-GDP ratio is associated with a reduction in the sovereign risk premium. In the short run, the beneficial effects stemming from a lower sovereign risk premium are moderate but the long-run effects clearly outweigh the results of benchmark simulation where the risk premium is kept constant.

Both of the above mentioned channels – the credibility and the sovereign risk premium have been found to be key determinants of fiscal multipliers also in a study of in ‘t Veld (2013) that analyses the role of fiscal spillovers that could have arisen from the austerity measures implemented in 2011-13. After adding a higher risk premium to their simulation scenarios, this channel is found to play a non-trivial role in transmitting the fiscal shocks. In particular, the estimated impact of 2011-13 austerity measures on GDP growth increases by 2-3 percentage points after increasing the sovereign risk premium in Ireland, Italy and Spain by 300bp and in Greece and Portugal by 600bp.

Corsetti et al. (2012) confirm empirically (using VARs) that fiscal multipliers are larger during times of financial crisis. However, they add a caveat that this finding holds true when public finances are strong. Corsetti et al. (2013) show that when public finances are fragile and monetary policy is

[2] New Area Wide Model is one of the key DSGE models developed and used at the ECB. The model was one of the seven policy-relevant models investigated in (Coenen, et al., 2012).

constrained for an extended period, then it is the sovereign risk channel that becomes the key determinant for the size, and even the sign, of fiscal multipliers. The result holds true as the sovereign risk premium is assumed to respond to the improved fiscal outlook and to spill over to the private sector's borrowing conditions, lowering the costs of credit. The relationship between the risk premium and the expected fiscal outlook is estimated to be highly non-linear, thus countries with the high level of public debt are expected to benefit most from the consolidation efforts in the short term. However, they also find that the same risk premium channel may give rise to indeterminacy, or belief-driven equilibria. Such an unfavourable outcome is likely to be observed when the constrained monetary policy is accompanied by a pessimistic shift in expectations which cause the sovereign risk premium to rise unrelatedly to fundamentals. By the same pass-through mechanism as described above, this higher risk premium can lead to an increase in costs of credit, hence weight negatively on growth. This, in turn, might result in a deterioration of fiscal positions and further increases in the sovereign risk premium, worsening investment conditions. This "vicious circle" of self-fulfilling expectations is especially likely to kick in when the sovereign risk premium is very high.

Despite the large number of academic studies addressing the topic, there is still a lot of uncertainty around the estimates of fiscal multipliers. The estimates depend on a country, time periods considered, models used, assumptions about credibility of fiscal policies etc. A suggestive example of the uncertainty surrounding the model-based assessments of fiscal policies is a study of Jorda and Taylor (2013), which shows that depending on the model used and the assumptions about the (non-)randomness of policy interventions, two divergent responses to fiscal consolidation can be replicated: expansion and contraction[3].

3 A large multi-country model and fiscal multipliers

This section presents model-based estimates of fiscal multipliers for the 5 largest euro area countries and the remaining euro area Member States[4] treated as a bloc. The fiscal multipliers are estimated for five main fiscal instruments: government consumption, government investment, transfers to households, direct taxes, and indirect taxes. For each of these variables, the multiplier is defined as a percentage deviation of real GDP from its baseline level, following a fiscal shock totalling (ex-ante) 1% of GDP. The shocks are assumed to be permanent. The ECB's New Multi Country Model (NMCM) is used to assess the effects thereof.

In what follows, five modelling scenarios are investigated which aim at illustrating the role of the sovereign risk premium and, for completeness reasons, the monetary policy for determining the size of fiscal multipliers. The first of these modelling scenarios investigates the size of fiscal multipliers

[3] However, after introducing a model that corrects the allocation bias, they also show that there is a stronger evidence of contractionary austerity in the weak economy.

[4] In this paper, the euro area composition does not include Latvia and Lithuania.

when monetary policy is accommodative - i.e. the monetary authority does not react to fiscal shocks that would require lowering the interest rates in order to stabilise the euro area inflation and output gap - and the sovereign risk premium channel is absent. The remaining four scenarios combine two types of sovereign risk premium reactions with two types of monetary policy responses. In these scenarios, the sovereign risk premium is assumed to either endogenously respond to changes in fiscal variables (debt ratios) or to be subject to an exogenous shock. The monetary policy, in turn, is assumed to be either accommodative or non-accommodative, where in the latter case the interest rates are determined via a standard Taylor rule.

With a view to analysing the output effects of austerity measures implemented in the euro area in the course of 2011-14, the above-described scenarios allow for conducting a robust examination that accounts for various specifications of the key channels that were likely to influence the propagation of fiscal shocks during that period. On the one hand, assuming that the surge in the government bond yields observed between 2010 and mid-2012 was triggered by financial markets' "fear and panic", the scenarios that employ the exogenously driven risk premium can provide an approximation of the size of fiscal multipliers operating in such a turbulent environment. On the other hand, the scenarios that illustrate endogenous responses of the risk premium to changes in the debt-to-GDP ratios offer the estimates of possible benefits stemming from the consolidation efforts that are accompanied by improvements in financial market's confidence. Furthermore, recalling that during the recent years the euro area policy makers have been faced with a zero-lower bound (ZLB) constraint on the key policy interest rates, the scenarios with accommodative policy stance allow for encompassing this factor to a large extent. Finally, to complete the picture, the scenarios with an active Taylor rule can be considered as a proxy for a possible impact of non-standard policy actions implemented in the euro area as of mid-2012. Bearing in mind that the non-standard monetary policy measures can be interpreted as further cuts in the interest rates, the shadow interest rate obtained from the Taylor-rule type approximation, can provide meaningful estimates of the accommodation provided.

Prior to discussing the simulation outcomes, Section 3.1 describes the main features of the model used to conduct the analysis- i.e. the ECB's New Multi Country Model (NMCM).

3.1 The New Multi Country Model: An Overview

The NMCM was developed at the European Central Bank and is documented in Dieppe et al. (2012) and Dieppe et al. (2013). It covers the 5 biggest euro area countries (Germany, France, Italy, Spain and The Netherlands) and the so-called "smaller countries bloc" covering the remaining euro area Member States.[5] For the purpose of this paper the model is used in the linked version where the cross-country interactions are captured via the trade channel, common monetary policy and exchange rates.

[5] The version of NMCM used in this paper does not include Latvia and Lithuania.

It is an estimated model, hence it accounts for the differences across countries in terms of degree of openness, the size of public sector, the extent of nominal and real rigidities, the habit formation as well as forward-lookingness of agents.

The model features a rich fiscal block in which the governments' income is generated through direct taxes (applied to households and firms), indirect taxes, and other public income. On the expenditure side, the main fiscal variables are government consumption, government investment, and transfers to households. The latter are modelled as a fraction of nominal GDP and a deviation of employment from its baseline levels. The primary government deficit/surplus each period is the difference between government's revenues and expenditures. For the purpose of simulations undertaken in this paper it is assumed that all the fiscal instruments are exogenous in real terms,[6] which allows for defining specific paths of fiscal variables in question, so that they match various consolidation scenarios. The fiscal policy rule, which in the full version of the NMCM is based on a reaction of personal income taxes to the deviation of the government's debt-to-GDP ratio from its predetermined target, is therefore temporarily deactivated.[7] The fiscal multipliers obtained in this way obviously vary from the standard results where the fiscal rule aiming at stabilising the government debt-to-GDP ratio typically results in adjustment of taxes in response to spending shocks.

The NMCM's monetary transmission mechanism consists of an area-wide short-term policy interest rate, modelled via the Taylor rule, and the country-specific long-term interest rates that derive from the expectation theory. Both, the short- and the long-term interest rates have an impact on the lending rates applied to households and firms. A direct transmission of a monetary policy shock to real economy occurs via the households' consumption (affected by consumption lending rates) and firms' investment decision (affected by the user cost of capital). In addition, a change in short-term interest rates directly translates into a change in the exchange rates, via a standard UIP condition. This, in turn, affects trade balances. A change in aggregate demand leads to a relatively quick adjustment of employment and impacts the marginal costs of production. The main transmission from a demand shock to prices occurs via marginal costs directly affecting the hybrid New Keynesian price and wage Phillips Curve. It then leads to second round effects whereby lower/higher prices boost/depress the demand.

In order to study the role of the sovereign risk premium for determining the output effects of fiscal consolidation, this paper introduces an important innovation to the NMCM model which consists of an enhanced modelling of short- and long-term lending rates applied to the private sector (households and firms). Compared to the original version of the NMCM model, the equations have been modified

[6] For taxes, the exogenous variable is the ratio between tax income and nominal GDP. For transfers, the share of nominal GDP is kept constant.

[7] The fiscal rule is activated in the long-run in order to ensure stock-flow stability.

to feature both, the spread over the short- and the long-term interest rates as well as the pass-through channel linking the private sector's cost of credit with the government's financing conditions. The spreads are modelled as:

$$s^{hh}_{short} = s\_base^{hh}_{short} + \sigma * RP$$
$$s^{nfc}_{short} = s\_base^{nfc}_{short} + \sigma * RP$$
$$s^{hh}_{long} = s\_base^{hh}_{long} + \sigma * RP$$
$$s^{nfc}_{long} = s\_base^{nfc}_{long} + \sigma * RP$$

where s^{hh}_{short} denotes the spread of the short-term lending rates applied to households over the short-term policy rates, $s\_base^{hh}_{short}$ is its baseline level, σ 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 (10-year government bonds) and the rates applied by banks on the long-term contracts. The lending rates are then expressed as:

$$l^{hh}_{short} = i + s^{hh}_{short}$$
$$l^{nfc}_{short} = i + s^{nfc}_{short}$$
$$l^{hh}_{long} = l + s^{hh}_{long}$$
$$l^{nfc}_{long} = l + s^{nfc}_{long}$$

where l^{hh}_{short} is the short-term lending rate applied by banks to households and i is the nominal short-term policy rate. Analogously, superscript nfc refers to non-financial corporations while subscript $long$ denotes the long-term lending rate and l is the average interest rate paid on the 10-year government bonds in a given country.

Consistently with the recent findings in empirical literature (Harjes, 2011; Zoli, 2013), the degree of pass-through (σ) has been assumed to be 60%.[8] Likewise, the equation governing the interest payments (inn) on the government debt has been adjusted to capture the effects of the sovereign risk premium.

$$r = i + RP$$
$$inn = r * gdn(-1)$$

where r denotes the gross interest rate applied to government interest payments, i is the short-term nominal interest rate (policy rate), RP is the risk premium, and $gdn(-1)$ denotes the outstanding

[8] Given that this is a calibrated parameter, a sensitivity analysis with respect to its value is conducted in the later part of the paper.

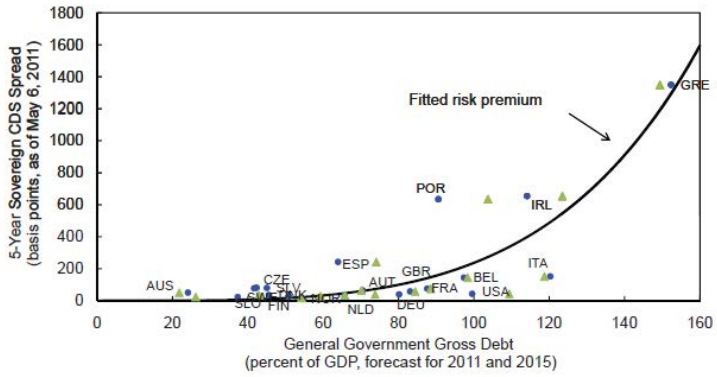
amounts of public debt in the previous period. This relation implies, in particular, that when the monetary policy is constrained then a change in the government's financing conditions derives solely from changes in the risk premium.

Finally, building on a work of Dieppe et al. (2015), the simulations that assume endogenous response of the risk premium to changes in the underlying fundamentals are based on the relationship estimated in Corsetti et al. (2013), depicted in Chart 1 and approximated by:

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

where RP is the actual risk premium and b is debt-to-GDP ratio. In turn, the shock to the risk premium is assumed to be an AR(1) process with a decay parameter of 0.9.

Chart 1: Sovereign Risk Premium versus debt-to-GDP ratios



Source: Corsetti et al., (2013).
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).

Thanks to its rich structure, the NMCM captures a number of key features documented in the recent literature on fiscal policies such as the importance of expectations and the credibility of policy announcements as well as the time-varying nature of fiscal multipliers. As shown in Dieppe et al. (2013), in the NMCM, the key driver of these time-varying effects is the learning mechanism. The learning approach embedded in the model assumes that the optimising agents have only limited-information (model-consistent) and form their expectations by updating their estimates about the future in response to the new information arriving. It is an attractive way for approximating the agents' reactions, especially in times of increased uncertainty (e.g. times of financial and economic crises). The NMCM could, in fact, be solved also by assuming a perfect foresight of the optimising agents but, given that the aim of this paper is to study the effects of fiscal measures during turbulent times, the learning approach appears to be more suitable and is used consistently throughout the paper.

Apart from the fiscal interactions, the NMCM captures a number of cross-country differences reflecting different sensitivity of the euro area countries to various shocks. For example, Table 1 shows the impact of a 1-year decline in short-term term interest rates (policy rate), lending rates – both short- and long-term, and long-term interest rates (10-year government bond). As the NMCM is an estimated model, the responses reveal the structural differences among the euro area economies. In particular, looking at Table 1, Italy and Spain emerge as the two countries in which the shock to interest rates has the largest effects. A feature that can be empirically explained by a large amount of floating rates agreements prevailing in these countries, as documented in ECB (2014b).

Table 1: Impact of a 1-year-50-basis-points decline in interest rates *(percentage deviation from baseline, cumulative after 2 years)*

	Impact on GDP			Impact on HICP		
	Short-term rates (policy rate)	**Lending-rates (short- and long-term)**	**Long-term rates (10-year government bond)**	**Short-term rates (policy rate)**	**Lending-rates (both short- and long-term)**	**Long-term rates (10-year government bond)**
Euro area	0.20	0.25	0.18	0.11	0.14	0.10
Germany	0.17	0.21	0.18	0.13	0.15	0.13
France	0.13	0.13	0.11	0.09	0.09	0.07
Italy	0.29	0.38	0.24	0.17	0.23	0.14
Spain	0.33	0.44	0.26	0.17	0.23	0.13
Netherlands	0.14	0.16	0.13	0.08	0.09	0.07
Smaller countries	0.18	0.22	0.17	0.04	0.05	0.04

3.2 NMCM-based fiscal multipliers

In this section the linked version of the NMCM is used to examine the impact of five fiscal instruments on GDP growth in 5 largest euro area countries and the smaller countries bloc. The fiscal instruments in question are: government consumption, government investment, transfers to households, direct and indirect taxes. Each of them is subject to an exogenous shock that corresponds to a contractionary fiscal stance. The shocks are assumed to be permanent, amounting to a size of 1% of GDP, and implemented already in the first year. To evaluate the effects of such fiscal policies, five scenarios are investigated that take into account different behaviour of the sovereign risk premium and different reaction of the monetary policy. The first scenario assumes accommodative monetary policy, i.e. that the central bank keeps their rates unchanged in response to a fiscal shock, and that the sovereign risk premium is not affected by changes in countries' economic fundamentals. The second scenario alters the assumption about the sovereign risk premium behaviour and assumes that it follows an endogenous process that depends on the level of public debt. In the third scenario the endogenous behaviour of the sovereign risk premium is replaced by an exogenous increase in the sovereign risk premium in Italy, Spain and the "smaller countries" by 100 bp for 1 year with a gradual

return to the baseline levels thereafter. The "safe haven" phenomenon is, however, not considered here, hence the government bond yields of the "core" euro area countries remain unaffected. The fourth and the fifth scenarios are then variants of the scenario two and three where the monetary policy is allowed to react via a standard Taylor rule and, accordingly, to respond to fluctuations in the area-wide inflation and the output gap. In this set up, the first three scenarios correspond to a situation where the zero lower bound (ZLB) constraint is binding, while in the fourth and the fifth case, the central bank has some room for manoeuvre (or, equivalently, introduces non-standard monetary policy measures).

In all five scenarios the countries are assumed to undertake the consolidation efforts via a single fiscal instrument only and to act alone. The scenarios of simultaneous consolidation are omitted at this stage in order to separate domestic from spillover effects. As documented in Attinasi et al. (forthcoming), when all countries adopt the same fiscal measures at the same time, the cross-border spillover effects might account up to 30% of total domestic losses in some countries. These effects are instrument specific, as different fiscal instruments are not only associated with different multipliers but also with different impact on countries' trade balances. For instance, as the government spending is less import intensive than the government investment, the two instruments are likely to generate different spillover effects.

It is also worth highlighting, that under the above-specified assumptions, the scenarios of non-accommodative monetary policy allow for approximating the impact of a fiscal consolidation in a given country on the area-wide interest rate. The reaction of the euro area-wide interest rate would be obviously stronger if all countries adopted the same consolidation measures simultaneously. Likewise, the role of ZLB constraint would be more prominent in case of co-ordinated area-wide consolidation efforts.

The NMCM-based estimates of short- and medium-term (domestic) fiscal multipliers generated by the five different fiscal instruments are reported in Figure 1. The charts depict the output effects of a 1% of GDP decrease in real government consumption (GCR), real government investment (GIR), and transfers to households (TRX), as well as 1% of GDP increase in indirect taxes (TIX) and direct taxes (PDX). Detailed results are also available in Tables A1-A6 in Annex 1.

Looking at the simulation results presented in Figure 1, a broad cross-country picture appears to be similar: a reduction in government spending has the largest short-term impact on growth while the effects of changes in revenue measures progress over time. The sovereign risk premium that responds endogenously to the changing debt-ratios cushions the negative impact of fiscal cuts while the exogenous shock to the risk premium amplifies the output losses, especially in the countries where the shock materializes. As it is assumed that the shock to the risk premium hits Italy, Spain and the smaller countries, the fiscal multipliers in Germany, France and the Netherlands are only slightly

affected by this scenario. When monetary policy is allowed to react, it somewhat compensates the negative impact of the exogenous increase in the sovereign risk premium, especially on the side of expenditure measures. The stressed countries – i.e. Italy, Spain and the smaller countries bloc – observe the largest beneficial effects stemming from the lower area-wide interest rates. The fiscal multipliers in the "core" euro area countries also decrease in case of non-accommodative monetary policy, albeit to a lesser extent.

Figure 1: Instrument-specific fiscal multipliers *(percentage deviation from baseline GDP levels)*

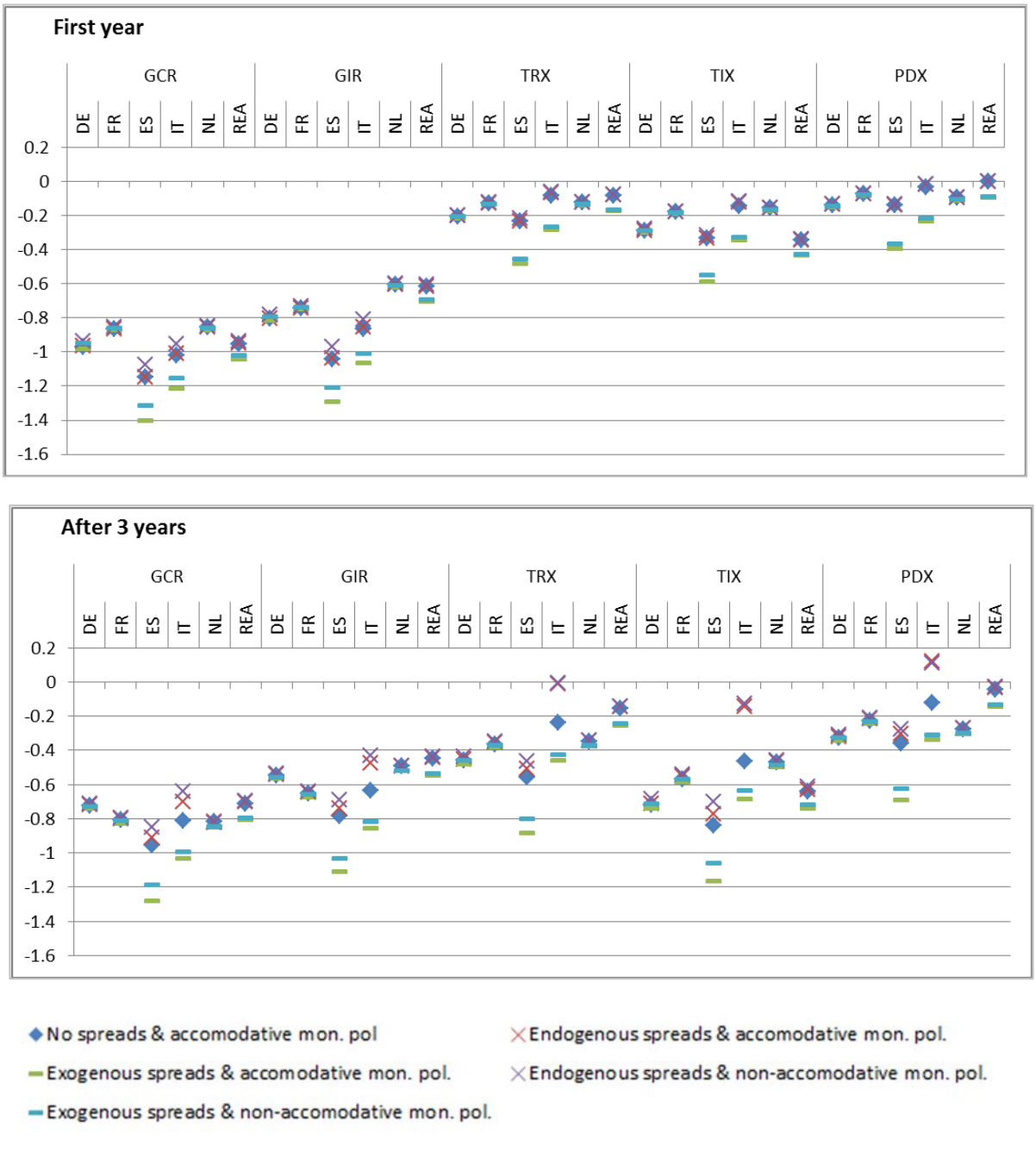


Figure 1 reveals also that the role of the risk premium channel in determining the size (and even the sign) of fiscal multipliers is particularly important in case of Italy and Spain. These are the two

countries which, as mentioned in Section 3.1, are the most sensitive to changes in the interest rates in the NMCM framework. Therefore, when the sovereign risk premium reacts endogenously to changes in public debt, the fiscal multipliers in Italy and Spain become much smaller (even positive in the medium run) thanks to the positive spillover effects from public to private financing conditions. Correspondingly, the fiscal multipliers become larger if the sovereign risk premium increases (exogenously) during the fiscal consolidation.

Furthermore, it emerges from Figure 1 that the composition of fiscal measures that constitute consolidation packages matters greatly for designing an optimal fiscal policy that seeks to minimise output losses in the short term and to boost growth in the longer run. The expenditure-side consolidation has a larger impact in the short run while the revenue measures exhibit more protracted effects, which in the longer run depend largely on the behaviour of the sovereign risk premium. A key driver of the result that the short-term effects of fiscal austerity are more contractionary when expenditures are cut rather than when taxes are increased owes to the fact that cuts in government spending directly affect the aggregate demand while the tax increases affect output via a reduction in personal disposable income, which in the presence of habit formation decreases private consumption only gradually.

Finally, the impact of the endogenous sovereign risk premium reaction is visible already after 3 years when the revenue-driven multipliers become much smaller (and even positive) as compared to the scenarios where the sovereign risk premium is absent or it is subject to an exogenous shock. Such a strong impact of the sovereign risk premium channel can be explained by the fact that the measures associated with smaller multipliers have larger debt-reducing power (see e.g. Eyraud and Weber; 2013). As the risk premium is expected to respond to changes in debt-ratios, the most favourable type of measures that triggers the largest risk premium reaction are naturally those with the smallest short-term multipliers. A faster debt reduction and therefore faster decrease in the risk premium leads to a further reduction in the sovereign risk premium, which in turn, provides an additional boost to investment. It then cushions the impact of fiscal retrenchments, lowers down the size of fiscal multipliers, and as a result can give rise to a “vitreous circle” in which fiscal consolidation leads to positive effects on GDP growth.

3.2.1 Comparison with other estimates available in the literature

The sizes of fiscal multipliers reported in Figure 1 (and Tables A1-A6) are broadly in line with the estimates available in the literature. Nonetheless, it is important to stress that these estimate vary significantly across studies as they depend on models used (VAR vs structural models), country of interest, time period considered etc. Among the available studies investigating the size of fiscal multipliers, the closest to the current paper in terms of modelling approach is a study of Kilponen, Pisani, Schmidt et al. (2015), hereafter KPS, which investigates the fiscal multipliers generated by

fifteen dynamic macroeconomic models maintained within the European System of Central Banks (ESCB). The NMCM and the ESCBs models share a number of common features and have been often estimated using similar datasets therefore a cross-checking of the results seems in place. A summary of the comparison between KPS and the NMCM-based estimates for the 4 largest euro area economies is presented below.

However, it should be noted that the approach introduced in KPS differs in many aspect from the methodology adopted in the current paper. As KPS work predominantly with DSGE models, their assumptions about the future fiscal policy plays an important role. They also distinguish between temporary and permanent shocks, as well as between types of fiscal instruments that can be used to ensure fiscal sustainability in the future. The latter, for instance, is found to have a significant implication for the size of long-run multipliers. In the NMCM, all these factors are not accounted for. Due to the NMCM's learning mechanism, the agents initially do not distinguish between a temporary and a permanent change in fiscal policy, thus the short-run effects of both types of shocks are similar. The differences unveil only over the medium run as agents' expectations become influenced with time. But even then, the agents do not distinguish between the types of taxes that can be used in the future to balance the fiscal space.

Notwithstanding, an overall assessment suggests that the NMCM estimates are broadly in line with the results published in KPS. Specifically, both studies find that short-run government consumption multipliers are larger than short-run tax multipliers. In addition, both studies agree that the latter increase with time (although in KPS the result holds only under an assumption that the future fiscal space will be used for lump-sum transfers). The role of the monetary policy channel illustrated in KPS also conforms to the NMCM's prediction. The ZLB constraint plays an important role, especially when the fiscal shocks are introduced simultaneously. Analogously, when countries implement consolidation efforts alone, the area-level interest rates are only moderately affected.

On a country level, several discrepancies between the NMCM and KPS results arise, which can be partly attributed to the modelling approach and partly to parameter differences (e.g. price and wage stickiness parameters in the NMCM are on average lower than in the DSGE models). In majority of cases, however, the estimates of fiscal multipliers generated by the NMCM and KPS are within plausible ranges of values documented in the empirical studies.

Tables 2a – 2d report the comparison's summary for Germany, France, Italy, and Spain. The NMCM's multipliers[9] are assessed vis-à-vis the KPS results for permanent shocks. In case of government consumption, the KPS results are presented in ranges which correspond to results obtained under two alternative scenarios whereby the future fiscal space is financed either by lump-

[9] For Germany and France – an average of values reported in Section 3.2; for Italy and Span – ranges of values reported in Section 3.2.

sum taxes or by labour income taxes. The KPS consumption tax multipliers and labour income tax multipliers are reported only for the scenario where the lump-sum transfers adjust in the long run. Results of some available VAR studies are also reported in ranges.

Table 2a: Fiscal multipliers in Germany

	Gov. consumption		Consumption tax		Labour income tax	
	short-run	long-run	short-run	long-run	short-run	long-run
NMCM	-0.96	-0.72	-0.29	-0.71	-0.14	-0.33
KPS	-0.62 to -0.61	-0.24 to 0.06	-0.04	-0.13	-0.19	-0.29
VAR	-0.7 to -0.5	-1.27 to -0.27	-	-	-1.17 to 0.29	-1.08 to 0.59

In case of Germany, the NMCM estimate of government consumption multiplier over both, short- and medium-run horizon is somewhat higher as compared to KPS results, although still within ranges reported in empirical literature (see: Perotti; 2004, Heppke-Falk et al.;2006, Baum and Koester; 2011). The NMCM estimates of fiscal multipliers stemming from a permanent increase in indirect taxation are also larger than corresponding results presented in KPS. In turn, the labour income tax multipliers are similar in the two studies and fall within a range of estimates reported in the VAR literature (see: Perotti; 2004, Baum and Koester; 2011, Bénassy-Quéré and Cimadomo; 2012).

Table 2b: Fiscal multipliers in France

	Gov. consumption		Consumption tax		Labour income tax	
	short-run	long-run	short-run	long-run	short-run	long-run
NMCM	-0.86	-0.81	-0.18	-0.56	-0.08	-0.23
KPS	-0.97 to -0.82	- 0.82 to 1.28	-0.18	-0.61	-0.28	-1.24
VAR	-1.4 to -1.1	-0.5 to 0	-	-	-0.1	n.s.

In case of France, the NMCM estimate of government consumption multiplier is close to the values reported in KPS. VAR studies, in turn, tend to report larger multipliers for the short-run horizon but smaller for medium-run effects (see: Biau and Girard; 2005, Cléaud et al.; 2013). Looking at the multipliers triggered by an increase in consumption taxes in KPS and in the NMCM, they also seem to be similar. Labour tax increases in these two models yield, however, considerably different results, especially over the long-run horizon – being much smaller in the NMCM as compare to the KPS findings. A VAR-based result for the short-term multiplier is somewhere in between the NMCM and KPS, while the longer-run effects seem to be not significant (see: Biau and Girard; 2005).

Table 2c: Fiscal multipliers in Italy

	Gov. consumption		Consumption tax		Labour income tax	
	short-run	long-run	short-run	long-run	short-run	long-run
NMCM	-1.16 to -0.96	-1.03 to -0.64	-0.34 to -0.11	-0.68 to -0.13	-0.23 to -0.02	-0.34 to 0.12
KPS	-0.68 to -0.51	-0.58 to 0.54	-0.08	-0.36	-0.19	-0.91
VAR	-1.2	-1.7	-	-	0.16	-

In Italy, the range of the NMCM fiscal multipliers is relatively wide, reflecting the impact of the sovereign risk premium and the monetary policy. The NMCM multiplier for government consumption is significantly larger than KPS estimates, especially over the longer-run horizon where the KPS reports a positive impact of government spending cuts while the NMCM multipliers are still negative after 3-years. Both predictions fall short of the results found in VAR analysis (see: Giordano et al.; 2007). On the contrary, looking at the estimates of multipliers triggered by the consumption tax increases presented in KPS and those generated by the NMCM they appear to be similar. As regards labour tax hikes, the NMCM and KPS estimates are relatively similar over the short-run horizon but diverge in the long run perspective. Limited VAR evidence for the short-term effects of net tax increases in Italy suggests the multiplier to be significantly different though, suggesting even a different sign (see: Giordano et al.; 2007).

Table 2d: Fiscal multipliers in Spain

	Gov. consumption		Consumption tax		Labour income tax	
	short-run	long-run	short-run	long-run	short-run	long-run
NMCM	-1.4 to -1.08	-1.28 to -0.91	-0.59 to -0.31	-1.16 to -0.7	-0.39 to -013	-0.69 to -0.3
KPS	-0.57 to -0.48	-0.39 to 0.31	-0.16	0	-0.12	-0.53
VAR	-1.54 to -1.14	-1.04 to -0.58	-	-	0.05	0.39

Finally, the largest discrepancy between the NMCM and KPS results can be observed in case of Spain. In the NMCM, the multiplier of government consumption is estimated to be large and vary significantly depending on the sovereign risk premium and the monetary policy reaction. In addition, the impact of government cuts is relatively persistent and even after 3 years some scenarios generate multipliers above one. In contrast, KPS estimates of government spending multipliers for Spain are relatively small (the smallest among euro area countries). A VAR-based evidence appears to be close to the NMCM results (see: de Castro; 2006, de Castro and Hernandez de Cos; 2008, de Castro and Fernandez; 2011). The estimates of multipliers generated by an increase in indirect taxation in the NMCM also differ from the KPS values. In particular, the discrepancy widens over the long run. The results for Spain reported in KPS, unlike for other countries, do not progress over time. Finally, the NMCM and KPS results are quite aligned in case of labour taxation. Both models are, however, in contrast to the corresponding evidence in the VAR literature (see: de Castro; 2006).

4 Austerity measures 2011-14

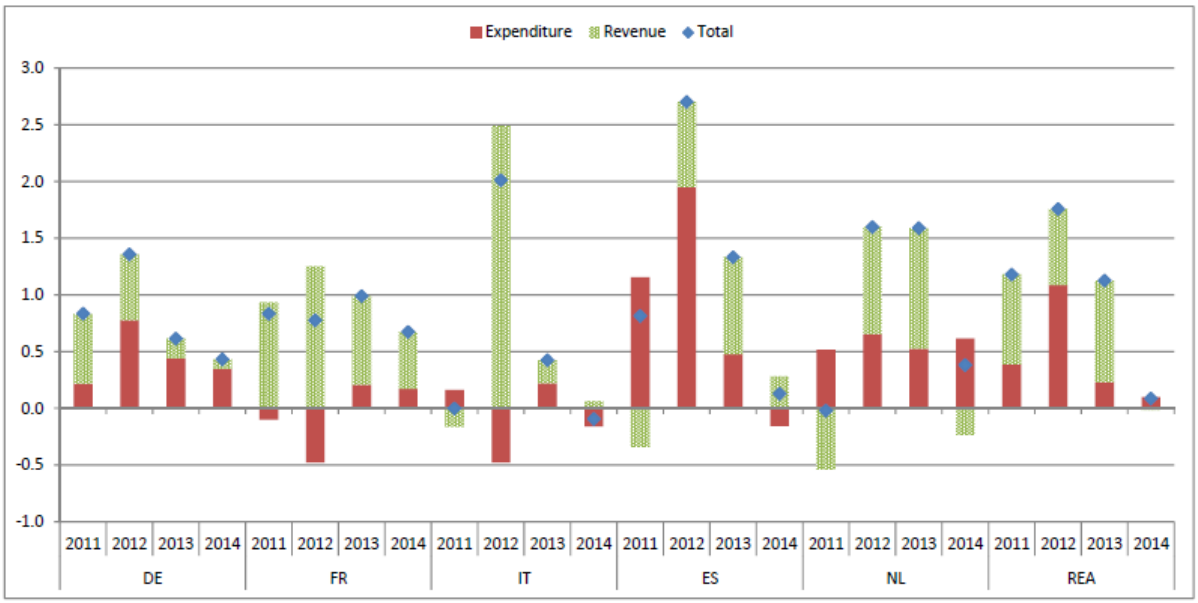
After having pinned down the model-specific responses to a number of standardised fiscal shocks, this section turns to the evaluation of 2011-14 austerity measures, taking into account the role of the sovereign risk premium and the monetary policy in determining their macroeconomic effects.

With the onset of the sovereign debt crisis, the governments of most euro area countries adopted a number of consolidation measures in order to reduce the domestic fiscal imbalances, which, in many

cases, arose due to massive government spending that followed the 2007-09 financial crisis. There is no easy way to measure these fiscal efforts, though. In general, two approaches for approximating a fiscal stance can be found in the literature: either as changes in cyclically adjusted primary balances (CAPB), referred to as a "top-down" approach, or via a narrative approach ("bottom-up"), which is based on the sum of the budgetary impact of the measures implemented by governments. Both of those measurements are associated with some shortcomings. In the "top-down" approach, the changes in CAPB can be driven by economic developments and not necessarily by the governments' actions. Moreover, as this method consists of subtracting the impact of a business cycle on the budget, it is subject to uncertainty associated with the estimates of the output gap. Instead, the "bottom-up" approach, suffers from the difficulty of defining the benchmark of "unchanged policy" against which the impact of the government actions is assessed (see e.g. EC, 2012).

The data used in this paper follow the "top-down" approach as the "bottom-up" data are not easily available to the public.[10] The aggregated data on public finances are, in turn, published by the European Commission in its semi-annual AMECO database. Chart 2 illustrates the amount of austerity measures implied by changes in structural balances of general government[11], based on the data published in the Spring 2015 vintage.

Chart 2: Changes in structural balances of general government *(as percentage of GDP)*



Source: European Commission (AMECO Spring 2015).

[10]For instance Attinasi et al. (forthcoming) use the "bottom-up" data obtained under a special discretion of the European System of Central Banks (ESCB) Working Group on Public Finance. Their estimates of the amount of fiscal measures adopted by euro area governments between 2010 and 2013 differ somewhat from the numbers derived via a "top-down" approach.

[11] This measure excludes some temporary changes in fiscal positions that are still captured in CAPB.

The chart clearly shows that the 2011-14 austerity measures have been distributed rather heterogeneously across time and countries. In Germany, the consolidation efforts were mainly expenditure driven, with a peak in 2012 and with declining revenue improvements thereafter. The year 2012 saw also the largest amount of consolidation measures being implemented in Italy, Spain and the smaller countries bloc, although the composition of those measures varied substantially. While in Italy the fiscal efforts were driven by the revenue-side improvements, the consolidation in Spain relied on the expenditure cuts. In turn, the measures implemented by the smaller countries were broadly balanced. France and the Netherlands also undertook substantial fiscal efforts in 2012 but a peak in those countries occurred in 2013. In case of France, the consolidation was heavily skewed towards the revenue measures, while in the Netherlands also the expenditure side played an important role.

4.1 Impact on growth

Having in mind the findings of Section 3.2 where the size of short- and long-term fiscal multipliers was shown to be instrument specific (with higher short-term multipliers assigned to expenditure measures), it becomes clear that the heterogeneity in distribution of the fiscal measures introduced in the euro area in years 2011-14 was likely to play an important role for determining their macroeconomic effects. Moreover, against the backdrop of economic and financial turbulences that accompanied those retrenchments, the impact of the sovereign risk premium and the interest rate channel on the final outcome of fiscal consolidation was also likely to be non-trivial. This section therefore aims at gauging the overall GDP effects stemming from the 2011-2014 austerity measures taking into account the possible impacts of these two channels.

In order to conduct the model-based analysis, the changes in governments' structural balances, as depicted in Chart 2, have been translated into a series of shocks that can be applied to the NMCM. As the available data breakdown consists only of "expenditure" and "revenue" packages and the model requires more detailed breakdown, it has been assumed that the expenditure-based improvements have been achieved by reducing government consumption, government investment, and transfers to households by the same amount. The revenue-side changes have been, in turn, equally divided into an increase in indirect and direct taxes. The shocks have been then constructed as an accumulation of the government's efforts by instrument. The accumulation approach reflects the fact that the observed austerity measures are assumed to be permanent (or at least persistent). It is also consistent with the very definition of the utilised measure of government's balances which captures solely the structural components of government's finances – i.e. it is corrected for the effects that can be attributed to the economic cycle and one-off events. Moreover, such an approach fulfils the purpose of this section as it aims to assess the impact of the consolidation measures rather than the impact of the actual fiscal stance, i.e. this section omits factors such as automatic fiscal stabilisers and temporary measures.

Finally, given that the fiscal consolidations occurred simultaneously in all euro area countries, the above-described shocks have been applied to all government instruments and all countries at the same time. For that reason, the size of fiscal multipliers operating in this exercise is somewhat different as compared to those reported in Section 3.2 as this time fiscal spillovers are present.

The model-based estimates of resulting GDP effects are presented in Table 3. These estimates have been derived assuming various types of reactions of the sovereign risk premium and the monetary policy, analogous to the analysis presented in Section 3.2.[12] The scenarios therefore combine two possible monetary policy responses (accommodative and non-accommodative) with two types of the sovereign risk premium behaviour (endogenous and exogenous). Differently to Section 3.2, the size of the sovereign risk premium shock has been increased to 300 basis points in order to approximate better the increase in government bond yields observed between 2010 and mid-2012. The assumption about no "flight to safety" behaviour has been, however, maintained and therefore the yields on government bonds in Germany, France and Netherlands are not affected in this exercise.

Clearly, none of these scenarios matches fully the actual behaviour of the sovereign risk premium and the monetary policy during the 2011-14 period but they provide plausible benchmarks and thus allow for a broad assessment of the macroeconomic effects stemming from the fiscal measures implemented during that period.

Table 3: Impact of 2011-14 discretionary fiscal measures on GDP *(percentage deviation from baseline levels)*

	Euro area				**Germany**				**France**			
	2011	2012	2013	2014	2011	2012	2013	2014	2011	2012	2013	2014
	Accomodative monetary policy											
Endogenous risk premium	-0.3	-1.0	-1.5	-1.7	-0.3	-1.2	-1.7	-2.1	-0.1	-0.2	-0.8	-1.2
Shock to risk premium	-0.6	-1.4	-1.9	-2.1	-0.3	-1.2	-1.8	-2.1	-0.1	-0.2	-0.9	-1.3
	Non-accomodative monetary policy											
Endogenous risk premium	-0.3	-0.8	-1.2	-1.4	-0.3	-1.1	-1.6	-1.9	-0.1	-0.1	-0.6	-1.0
Shock to risk premium	-0.5	-1.2	-1.7	-1.8	-0.3	-1.1	-1.6	-2.0	-0.1	-0.1	-0.7	-1.1
	Italy				**Spain**				**Netherlands**			
	2011	2012	2013	2014	2011	2012	2013	2014	2011	2012	2013	2014
	Accomodative monetary policy											
Endogenous risk premium	-0.1	0.0	-0.4	-0.3	-1.0	-2.9	-3.6	-3.5	-0.3	-0.8	-1.4	-2.1
Shock to risk premium	-0.7	-1.1	-1.5	-1.4	-1.7	-4.2	-4.9	-4.5	-0.3	-0.9	-1.6	-2.2
	Non-accomodative monetary policy											
Endogenous risk premium	-0.1	0.2	0.0	0.3	-0.9	-2.5	-3.0	-2.8	-0.3	-0.7	-1.3	-1.9
Shock to risk premium	-0.6	-0.7	-1.0	-0.9	-1.6	-3.7	-4.1	-3.8	-0.3	-0.8	-1.4	-2.1

The heterogeneity of the estimates reported in Table 3 reflects the amount, the timing, and the distribution of implemented measures (see Chart 2). For instance Germany and France implemented a similar amount of fiscal adjustments (of about 1% of GDP) in the first two years, but with a different distribution. As the fiscal efforts in Germany concentrated on the expenditure side, their negative

[12] With an exception of the scenario where the sovereign risk premium is not affected by the fiscal measures. The latter is omitted as it was shown to generate the multipliers falling within the range of other scenarios.

short-term impact was larger than in France where the consolidation efforts were mainly revenue driven. The difference in estimated output effects echoes well the fact that the expenditure measures are associated with higher short-term multipliers than the revenue measures. Likewise, Italy and Spain saw similar (and the largest) improvements in their fiscal balances in the year 2012 but achieved through a different combination of measures. In Italy, the change came from the revenue improvements and thus was accompanied by a moderate impact on GDP growth. Spain, in contrast, embarked mainly on expenditure cuts and as such observed larger short-term output losses. In these two countries, however, the final outcome of consolidation measures has been significantly affected by the sovereign risk premium and the monetary policy channels. If accounting for an endogenous reaction of the sovereign risk premium to improved economic fundamentals and incorporating the impact of non-standard monetary policy measures (approximated by a Taylor-type reaction of the policy rates), an overall impact of austerity measures introduced in Italy turns out to be (slightly) positive. The finding is not surprising given the sensitivity of this country to changes in interest rates as well as considering the highly non-linear relationship between the sovereign risk premium and the level of debt-to-GDP ratio, which is by far the largest in Italy. In Spain, the difference in estimated impact of fiscal measures which can be attributed to the sovereign risk premium and the monetary policy is also large and amounts to 1.7% deviation of GDP from its baseline levels.

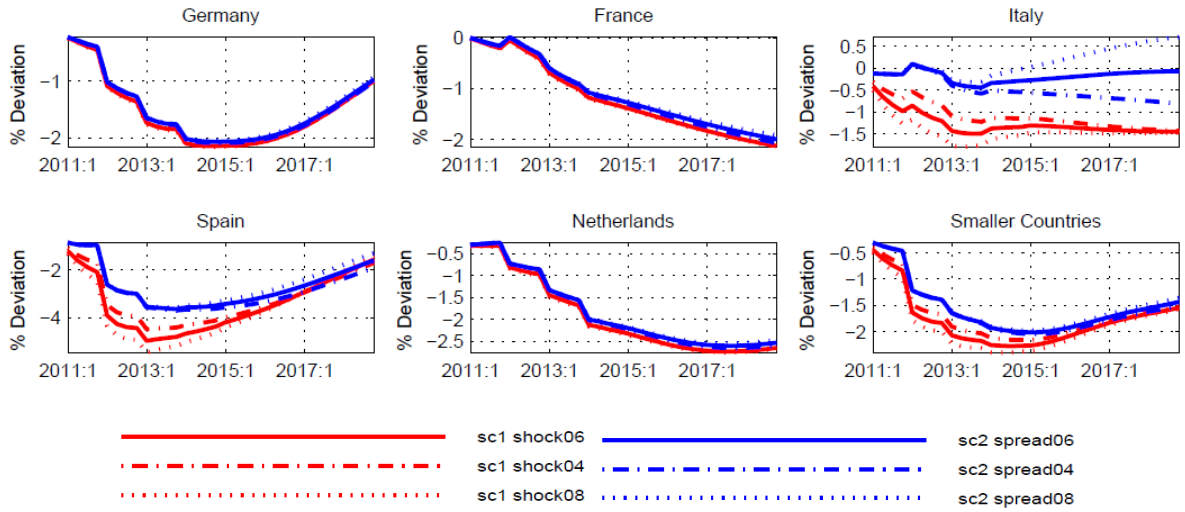
4.2 Robustness analysis: key parameters

The previous section illustrates the uncertainty around the estimates of output effects of fiscal measures that can arise due to different reactions of the sovereign risk premium (endogenous vs exogenous) and the monetary policy (accommodative vs non-accommodative). This section examines to which extent this uncertainty can be attributed to the specific modelling choices adopted in this paper. In particular, as the degree of pass-through between public and private financing condition is calibrated, a sensitivity analysis with respect to this parameter is conducted. To this aim, Figure 2 illustrates possible deviations of GDP from its baseline levels, depending on a degree of pass-through between public and private finance strains. The baseline simulation assumes that 60% of changes in financing conditions of the public sector are transmitted to the private sector borrowing costs. A somewhat more upbeat scenario incorporates a degree of 80%, while a more conservative approach assumes 40% pass-through.

In order to illustrate better the time dynamics implied by different types of measures that have been adopted during the period 2011-14 (with decreasing fiscal multipliers on the expenditure side and increasing multipliers of the revenue measures), Figures 2 and 3 cover an extended horizon (up to 2018). For the simulation purposes it was therefore assumed that the measures implemented in 2014 will remain in place for another four years. More detailed results of these simulations are presented in Annex 1, Figures A1-A12.

The results depicted in Figure 2 show that the degree of pass-through is indeed relevant in case of an abrupt shock to the sovereign risk premium as the parameter determines the speed of transmission between public and private financing conditions. The parameter is less relevant for the scenarios where the sovereign risk premium responds endogenously to changes in the debt-to-GDP ratio as the reaction of the risk premium is more gradual. Nevertheless, the level of pass-through might exert significant impact on the medium-term dynamics, especially in Italy and Spain where the sensitivity of investment to financing conditions is high.

Figure 2: Impact of 2011-14 discretionary fiscal measures on GDP: robustness analysis with respect to the degree of pass-through between public and private financing conditions
(percentage deviation from baseline levels)



Red lines correspond to the scenarios where the sovereign risk premium is subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reactions.

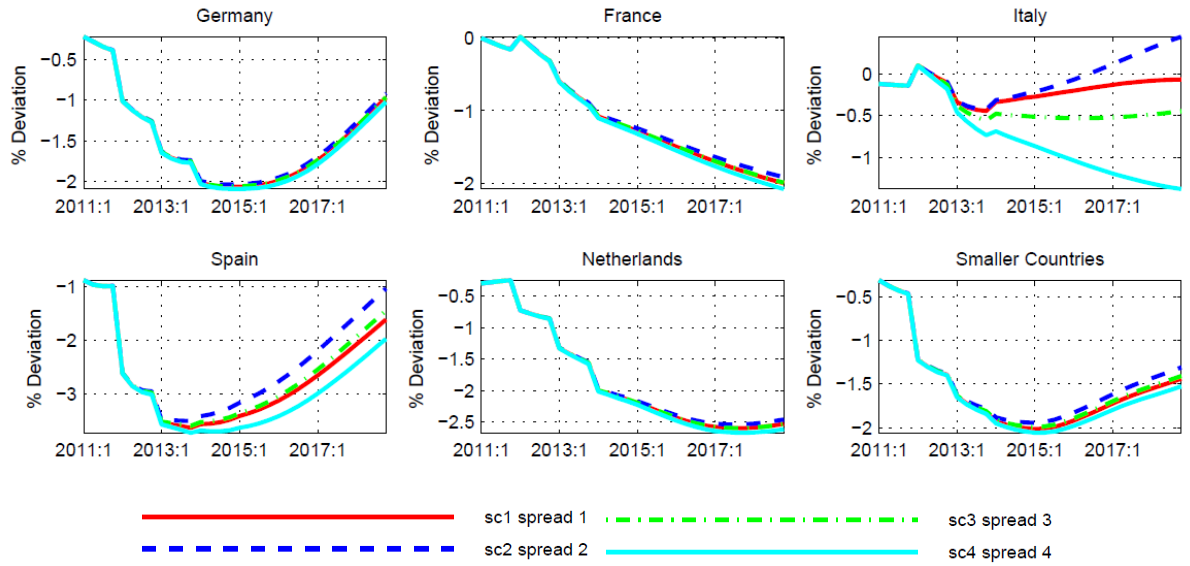
Moreover, given that the functional relationship between the sovereign risk premium and the debt-ratios used in the baseline simulations has been estimated in times of financial markets turmoil and prior to the ECB's announcement of the Outright Monetary Transactions in August 2012, it is likely to have changed since then. In fact, Roeger and in 't Veld (2013) illustrate that in the post-OMT world the relationship still holds although the curve is flatter. It means that the reaction of the risk premium to changes in the debt-to-GDP ratio was stronger in the pre-OMT environment. In this context, the baseline results presented in this paper that refer to the period as of mid-2012 might not reflect well the post-OMT dynamics. On the other hand, the high non-linearity captured by the baseline specification describes well the financial environment in place during the initial period of the austerity (2011-12). In order to illustrate to which extent the change in the curvature of this relationship might affect the estimates of the austerity's output effects, three alternative approximations, as estimated by Roeger and in 't Veld (2013), are evaluated. The corresponding formulas are:

$$\text{Scenario 2: } RP = (0.1331 * b^2 - 12.69 * b + 339.15)$$
$$\text{Scenario 3: } RP = (0.0992 * b^2 - 9.604 * b + 296.15)$$
$$\text{Scenario 4: } RP = (0.0444 * b^2 - 4.4081 * b + 130.51)$$

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

Figure 3 shows the evolution of GDP (expressed in percentage deviation from the baseline levels) implied by these alternative specifications. Note that Scenario 1, corresponds to the baseline specification, as described in Section 3.1.

Figure 3: Impact of 2011-14 discretionary fiscal measures on GDP: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure 3 reveals that the exact specification of the relationship between the sovereign risk premium and the debt-to-GDP ratios does not seem to exhibit significant differences over the short term but contributes significantly to the medium-run results. Such behaviour is indeed in line with the findings illustrated in Section 3.2, where the size of medium-run multipliers, especially revenue based, was found to be largely dependent on the risk premium behaviour. Nonetheless, an overall finding of this section confirms that the uncertainty due to parameters and modelling choices is smaller than the uncertainty due to a miss-specification of the sovereign risk premium reaction (endogenous vs exogenous) and the monetary policy response (accommodative vs non-accommodative), especially in the short run.

4.3 Further robustness check: interest payments

An interesting finding emerges from the sensitivity analysis conducted in Section 4.2, which suggests that the evolution of debt-to-GDP ratio is highly sensitive to the reaction of the sovereign risk premium (see Figures A1-A12 in Annex 1). In the scenario where the risk premium is assumed to be driven by an exogenous shock, the debt-to-GDP ratio in some countries increases above the baseline in spite of the on-going consolidation, suggesting (temporarily) self-defeating fiscal efforts. This result needs to be interpreted with caution, though.

It is known in the literature that higher fiscal multipliers result in smaller debt-reducing power of fiscal measures. A number of recent papers (e.g. Gros, 2011; Boussard et al. 2012; Eyraud and Weber, 2013) provide evidence that the debt ratio does not necessarily decrease one-to-one with the fiscal tightening. Eyraud and Weber (2013) show that with multipliers already close to 1, fiscal consolidation is likely to raise the debt ratio in the short run - the effect which they find to be more pronounced when consolidation is persistent and in the countries with high level of public debt. Boussard et al. (2012) estimate that the time period necessary for a fiscal consolidation to have a favourable effect on the debt ratio is about two to three years, unless the multipliers are very large and persistent. In the latter case, if in addition financial markets are highly myopic, the consolidation might even turn out to be self-defeating.

Against this background and recalling the results presented in Section 3.2 where the shock to the sovereign risk premium was shown to increase the size of fiscal multipliers (sometimes above 1), the evolution of debt ratios depicted in Figures A1-A12 appear to be consistent. The shock to the risk premium leads to higher multipliers and higher multipliers drive up the debt-ratios, especially in highly indebted countries like Italy or Spain. Nonetheless, the fact that the evolution of debt-to-GDP ratio appears to be invariant to changes in the pass-through parameter suggests that there are also other forces at play, namely the governments' interest payments.

It is another well-known fact that the modelling of interest payments in structural models is a highly challenging task as the proper implementation requires detailed knowledge of the government debt structure. In practise, the standard approach adopted in most structural models (including the NMCM) to approximate the government's net interest payments is rather simplistic. Usually it is assumed that at time t, the government pays interest on the outstanding amount of debt at time t-1. The approach mimics a schedule where the government issues one-period bonds to finance their debt. This assumption is, however, far too simplistic to match the data as the debt structure of most advanced economies is complex. The debt securities issued by governments have different maturity schedules, different values of coupon payments, different redemption types etc. The interest paid on outstanding bonds might be fixed (agreed at issuance) or floating (usually calculated based on some index value

plus fixed spread agreed at the issuance). To calculate the governments' interest payments it is therefore essential to collect all this information.

To illustrate the relevance of all these factors, the ECB' Centralised Securities Database (CSDB)[13] can be used to retrieve all necessary details and perform back-of-the-envelope calculations of the interest payments dynamics. The CSDB serves as a central depository for all information about debt securities issued by euro area residents (including general government). The data are updated with a daily frequency and are available for each security that has an International Securities Identification Number (ISIN) code.

Following Cornejo Perez et al. (2015), the outstanding amounts (At) at the end of period t are calculated by adding to the outstanding amounts (At-1) at the end of previous period (t-1) the securities issued (It) in period t (issuances) and deducting the securities that matured (Rt) in the period t (redemptions).

$$A_t = \sum_{n=1}^{N} face.value_n$$
$$A_t = A_{t-1} + I_t + R_t$$

For each security, the nominal yield is defined in per annum terms and comprises the coupon rate and any difference between the stated redemption price at maturity and the issue price (i.e. discount or premium). The discount (or premium) is linearly spread (accrued) as interest over the full lifetime of the debt security.

$$nom.yield = coupon.rate + 365 * \frac{(redemption.price - issue.price)}{original.maturity}$$

The average nominal yield is then calculated using the face value as the weighting factor:

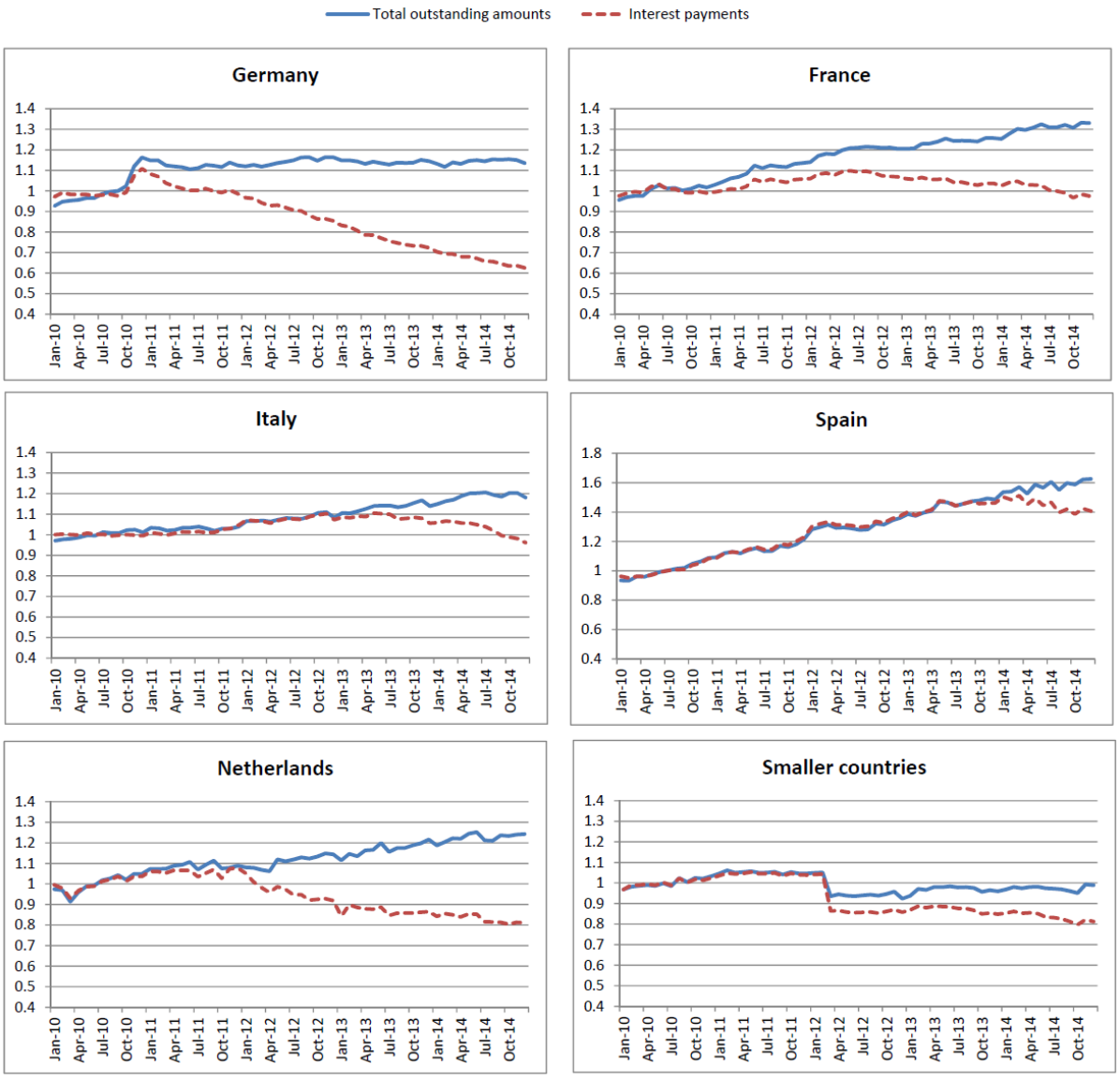
$$ave.nom.yield = \sum_{i=1}^{N} \frac{nom.yield_i * face.value_i}{\sum_{r=1}^{N} face.value_r}$$

There are therefore two driving forces that determine debt servicing needs: the total outstanding amounts of government debt securities and the average nominal yields. To disentangle the contribution of these two factors during the period 2011-14, Figure 4 illustrates the evolution of total outstanding amount of government bonds and the nominal interest payments normalised with respect to their average value in 2010.

[13] For more information see the publication "The centralised securities database in brief" (ECB, 2010).

Figure 4 shows the interest payments in Germany and France were declining with respect to the outstanding amounts as of early 2011, suggesting that their average nominal yield were declining during that period. In the Netherlands and the smaller countries bloc, the decoupling between the growth in outstanding amounts and the growth in the interest payments started somewhat later in 2012. In Italy and Spain, in turn, the interest payments grew at the speed of the outstanding amounts until 2013. The results therefore indicate that the impact of the sovereign risk premium on the average nominal yield was positive (decreasing interest payments) in all countries except Italy and Spain. In the latter the effect was negligible until 2013 and became positive thereafter.

Figure 4: Total outstanding amounts of government bonds and interest payments *(normalised with 2010 average, percentage points)*



Source: ECB and own calculations.

5 Conclusions and the remaining caveats

The approach adopted in this paper introduces a yet another angle to study the size of fiscal multipliers. Indeed, there is a broad consensus across the recent literature that fiscal multipliers are time varying and state dependent - larger during crisis as compared to normal times. This paper, however, shows that even during downturns, the multipliers can vary, depending on financial markets' sentiments in place and their pricing of the sovereign default risk. The model-based simulations show that in times of adverse financial markets' conditions, when monetary policy is constrained by its zero lower bound and the sovereign risk premium does not respond to expected improvements in the fiscal positions, the fiscal multipliers can be large and the beneficial effects of fiscal consolidation might take some time to materialise, especially in countries with a high level of public debt. However, the paper also illustrates that when financial markets price the risk of sovereign default adequately to the improvements in countries' fiscal positions and the monetary policy is allowed to react (including non-standard monetary policy measures), the opposite dynamics are true.

The paper also shows that the composition of fiscal measures is a key for determining the overall outcome of fiscal consolidations. When assessing the GDP effects of austerity programs implemented in the euro area over the 2011-14 period, the paper illustrates the country-level outcomes and attributes them to the choice of adopted measures. The model-based analysis reveals that the expenditure-driven retrenchments are more costly in the short-term as compared to the revenue-driven measures. In particular, a revenue-based consolidation combined with an endogenous reaction of the sovereign risk premium that responds to changes in the debt ratio is shown to be associated with much smaller fiscal multipliers as compared to the expenditure cuts. It is exemplified in the case of austerity measures implemented in Italy and Spain in 2012. Although both countries implemented a similar amount of fiscal discipline, the NMCM results suggest that Italy observed smaller output losses stemming from the fiscal consolidation (of about -1.4% to 0.3% of GDP) as it opted for revenue improvements. At the same time, as Spain embarked on expenditure cuts, which are associated with large short-term multipliers, the estimated output effects stemming from the austerity measures in Spain is assessed to be between -4.5% and -2.8%.

Finally, given the direct link between fiscal multipliers and debt dynamics, namely the higher the multiplier, the smaller debt-reducing power of fiscal consolidation, the findings presented in the paper demonstrate that the financial markets' sentiments can influence the evolution of debt-to-GDP ratios. As the sovereign risk premium increases, the costs of government borrowing and the amount of interest payments rise. Such an increase in the governments' interest payments might, at times, counterbalance the efforts spent on reducing the public debt. This finding, however, should be read with caution as the modelling of interest payments in structural models is rather simplistic and does not reflect fully the actual debt dynamics. Namely, standard macroeconomic models lack a proper

pass-through between the sovereign risk premium and the nominal interest payments, which depends on a number of factors, such as debt maturity, coupon structure (fixed vs floating agreements) as well as the ability of government to exercise early redemption options. The contemporaneous changes in the interest rates can therefore feed into interest payments only when the average maturity of outstanding government bonds is relatively short or when the share of floating-coupon bonds is large. Such factors are, however, rarely accounted for in macroeconomic models.

References

Afonso, A., Baxa, J. & Slavik, M., 2011. "Fiscal developments and financial stress: a threshold VAR analysis". *ECB Working Paper 1319.*.

Aizenman, J., Hutchison, M. & Jinjarak, Y., 2013. "What is the risk of European sovereign debt defaults? Fiscal space, CDS spreads and market pricing of risk". *Journal of International Money and Finance,* 34(C), pp. 37-59.

Ardagna, S., Caselli, F. & Lane, T., 2007. "Fiscal Discipline and the Cost of Public Debt Service: Some Estimates for OECD Countries". *Journal of Macroeconomics: Topics in Macroeconomics.*

Attinasi, M. G., Checherita, C. & Nickel, C., 2009. "What explains the surge in euro area sovereign spreads during the financial crisis of 2007-09?". *ECB Working Paper 1131.*

Attinasi, M. G., Lalik, M. & Vetlov, I., forthcoming. "Fiscal Spillovers in the Euro Area". *ECB Working Paper.*

Auerbach, A. & Gorodnichenko , Y., 2012a. "Fiscal Multipliers in Recession and Expansion". *In "Fiscal Policy after the Financial Crisis", National Bureau of Economic Research,* pp. 63-98.

Auerbach, A. & Gorodnichenko, Y., 2012b. "Measuring the Output Responses to Fiscal Policy". *American Economic Journal: Economic Policy,* 4(2), pp. 1-27.

Baldacci, E. & Kumar, M., 2010. "Fiscal Deficits, Public Debt, and Sovereign Bond Yields". *IMF Working Paper 10/184.*

Batini, N., Callegari , G. & Melina, G., 2012. "Successful Austerity in the United States, Europe and Japan". *IMF Working Paper 12/190.*.

Baum, A. & Koester, G. B., 2011. "The impact of fiscal policy on economic activity over the business cycle - evidence from a threshold VAR analysis". *Discussion Paper Series 1: Economic Studies, Deutsche Bundesbank, Research Centre.*

Baum, A., Poplawski-Ribeiro, M. & Weber, A., 2012. "Fiscal Multipliers and the State of the Economy". *IMF Working Paper 12/286.*

Beirne, J. & Fratzscher, M., 2013. "Pricing of sovereign risk and contagion during the European sovereign debt crisis". *ECB Working Paper 1625.*

Bénassy-Quéré , A. & Cimadomo, J., 2012. "Changing patterns of fiscal policy multipliers in Germany, the UK and the US". *Journal of Macroeconomics,* 34(3), pp. 845-873.

Biau, O. & Girard, E., 2005. "Politique budgétaire et dynamique économique en France. L'approche var structurel". *Revue économique,* Volume 55, pp. 755-756.

Blanchard, O. & Leigh, D., 2013. "Growth Forecast Errors and Fiscal Multipliers". *IMF Working Paper 13/001.*

Borgy, V., Laubach, T., Mésonnier, J.-S. & Renne, J.-P., 2011. "Fiscal Sustainability, Default Risk and Euro Area Sovereign Bond Spreads Markets". *Banque de France, Working paper No. 333.*

Boussard, J., de Castro, F. & Salto, M., 2012. "Fiscal Multipliers and Public Debt Dynamics in Consolidations". *European Economy - Economic Papers 460.*

Christiano, L. J., Eichenbaum, M. & Rebelo, S., 2011. "When is the Government Expenditure Multiplier Large?". *Journal of Political Economy,* 119(1), pp. 78-121.

Cléaud, G., Lemoine, M. & Pionnier, P. A., 2013. "Which size and evolution of the government expenditure multiplier in France (1980-2010)?". *Documents de Travail de la DESE - Working Papers of the DESE, Institut National de la Statistique et des Etudes Economiques, DESE.*

Coenen, G. et al., 2012. "Effects of fiscal stimulus in structural models". *American Economic Journal: Macroeconomics,* 4(1), pp. 22-68.

Cogan, J., Cwik, T., Taylor, J. B. & Wieland, V., 2010. "New Keynesian versus old Keynesian government spending multipliers". *Journal of Economic Dynamics and Control,* 34(3), pp. 281-295.

Cornejo Perez, A., Diz Dias, J. & Hartwig Lojsch, D., 2015. "New and timely statistical indicators on government bond securities". *ECB Statistics Paper Series No. 8.*

Corsetti, G., Kuester, K., Meier, A. & Müller, G., 2013. "Sovereign Risk, Fiscal Policy, and Macroeconomic Stability". *The Economic Journal,* 123(566), pp. F99-F132.

Corsetti, G., Meier, A. & Müller, G., 2012. "What determines government spending multipliers?". *Economic Policy,* 27(72), p. 521–565.

Cwik, T. & Wieland, V., 2011. "Keynesian government spending multipliers and spillovers in the euro area". *Economic Policy,* 26(67), pp. 493-549.

de Castro, F., 2006. "The macroeconomic effects of fiscal policy in Spain". *Applied Economics,* Volume 38, pp. 913-924.

de Castro, F. & Fernández, L., 2011. "The Effects of Fiscal Shocks on the Exchange Rate in Spain". *Banco de España Working Paper No. 1121.*

de Castro, F. & Hernández de Cos , P., 2008. "The economic effects of fiscal policy: The case of Spain". *Journal of Macroeconomics,* Volume 30, pp. 1005-1028.

De Grauwe, P. & Ji, Y., 2013a. "From Panic-Driven Austerity to Symmetric Macroeconomic Policies in the Eurozone". *JCMS: Journal of Common Market Studies,* Volume 51, pp. 31-41.

De Grauwe, P. & Ji, Y., 2013b. "Self-fulfilling crises in the Eurozone: an empirical test". *Journal of International Money and Finance,* Volume 34, pp. 15-36.

De Santis, R., 2012. "The euro area sovereign debt crisis: Safe haven, credit rating agencies and the spread of the fever from Greece, Ireland and Portugal". *ECB Working Paper 1419.*

DeLong, J. & Summers, L., 2012. "Fiscal policy in a depressed economy". *Brookings Papers on Economic Activity, Spring.*

Di Cesare , A., Grande, G., Manna, M. & Taboga, M., 2012. "Recent estimates of sovereign risk premia for euro-area countries". *Bank of Italy, Questioni di Economia e Finanza (Occasional Papers) 128.*

Dieppe, A., Gonzales-Pandiella, A., Hall, S. & Willman, A., 2013. "Limited information minimal state variable learning in a medium-scale multi-country model". *Economic Modelling,* Volume 33, pp. 808-825.

Dieppe, A., Gonzales-Pandiella, A. & Willman, A., 2012. "The ECB's New Multi-Country Model for the euro area: NMCM - Simulated with rational expectations". *Economic Modelling,* Volume 29, pp. 2597-2614.

Dieppe, A., Gonzalez Pandiella, A., Hughes Hallett, A. & Warmedinger, T., 2013b. "Costs and benefits of different timing of fiscal consolidation in a monetary union". *mimeo.*

Dieppe, A., Guarda, P. & Other Contributors, 2015. Public debt, population ageing and medium-term growth. *ECB Occasional Paper - 165.*

EC, 2012. "Report on Public finances in EMU".

EC, 2013a. "European Economic Forecast – Autumn 2013". *European Economy, No 7/2013, November.*

EC, 2013b. "Report on Public Finances in EMU".

ECB, 2010. "The centralised securities database in brief". *ECB website.*

ECB, 2012. "The role of fiscal multipliers in the current consolidation debate". *ECB Monthly Bulletin, December.*

ECB, 2014a. "Fiscal multipliers and the timing of consolidation". *ECB Monthly Bulletin, April.*

ECB, 2014b. "The retail bank interest rate pass-through: The case of the euro area during the financial and sovereign debt crisis". *ECB Occasional Paper 155.*

Erceg, C. & Lindé, J., 2010. "Is There a Fiscal Free Lunch in a Liquidity Trap?". *CEPR Discussion Paper 7624.*

Eyraud, L. & Weber, A., 2013. "Eyraud, Luc and Weber, Anke, The Challenge of Debt Reduction During Fiscal Consolidation". *IMF Working Paper 13/67.*

Giordano, R., Momigliano, S., Neri, S. & Perotti, R., 2007. "The effects of fiscal policy in Italy: Evidence from a VAR model". *European Journal of Political Economy,* Volume 23, pp. 707-733.

Gros, D., 2011. "Can Austerity Be Self-Defeating?". *Economic Policy, CEPS Commentaries.*

Harjes, T., 2011. "Financial Integration and Corporate Funding Costs in Europe after the Financial and Sovereign Debt Crisis". *In IMF Country Report No. 11/186, International Monetary Fund.*

Heppke-Falk, K. H., Tenhofen, J. & Wolff, G. B., 2006. "The macroeconomic effects of exogenous fiscal policy shocks in Germany: a disaggregated SVAR analysis". *Journal of Economics and Statistics,* Volume 230.

in 't Veld, J., 2013. "Fiscal consolidations and spillovers in the Euro area periphery and core". *European Economy - Economic Papers 506.*

Jorda, O. & Taylor, A., 2013. "The time for austerity: estimating the average treatment effect of fiscal policy". *Working Paper Series 2013-05, Federal Reserve Bank of San Francisco.*

Kilponen, J., Pisani, M. & Schmidt, S., 2015. "Comparing fiscal multipliers across models and countries in Europe". *ECB Working Paper 1760.*

Laubach, T., 2009. "New evidence on the interest rate effects of budget deficits and debt". *Journal of the European Economic Association,* Volume 7, p. 858–885.

Leeper, E. M., Traum, N. & Walker,, T. B., 2011. "Clearing up the fiscal multiplier morass". *NBER Working Papers, No 17444.*

Locarno, A., Notarpietro, A. & Pisani, M., 2013. "Sovereign risk, monetary policy and fiscal multipliers: a structural model-based assessment". *Bank of Italy Working Paper No. 943.*

Lorenzoni, G. & Werning, I., 2014. Slow Moving Debt Crises. *Northwestern University, Working Paper.*

Nickel, C. & Tudyka, A., 2013. "Fiscal stimulus in times of high debt: reconsidering multipliers and twin deficits". *ECB Working Paper 1513.*

Perotti, R., 2004. "Estimating the effects of fiscal policy in OECD countries". *Proceedings, Federal Reserve Bank of San Francisco.*

Roeger, W. & in 't Veld, J., 2013. "Expected sovereign defaults and fiscal consolidations". *European Economy - Economic Papers 479.*

Spilimbergo, A., Symansky, S. & Schindler, M., 2009. "Fiscal multipliers". *IMF Staff Position Notes 09/11.*

Wieland, V., 2010. "Fiscal stimulus and the promise of future spending cuts". *International Journal of Central Banking,* 6(1).

Zoli, E., 2013. "Italian Sovereign Spreads: Their Determinants and Pass-through to Bank Funding Costs and Lending Conditions". *IMF Working Paper 13/84.*

Annex

Table A1: Impact of fiscal consolidation on GDP, by fiscal instruments: Germany *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.97	–0.82	–0.72	–0.70	–0.59	–0.37
Government investment	–0.80	–0.66	–0.54	–0.49	–0.36	–0.16
Personal transfers	–0.20	–0.38	–0.45	–0.47	–0.48	–0.43
Direct taxes	–0.14	–0.26	–0.32	–0.34	–0.36	–0.33
Net indirect taxes	–0.29	–0.58	–0.71	–0.76	–0.78	–0.71
Shock to risk premium						
Government consumption	–0.98	–0.85	–0.74	–0.71	–0.59	–0.37
Government investment	–0.82	–0.69	–0.56	–0.51	–0.37	–0.17
Personal transfers	–0.22	–0.41	–0.48	–0.49	–0.49	–0.43
Direct taxes	–0.15	–0.29	–0.34	–0.36	–0.37	–0.34
Net indirect taxes	–0.30	–0.61	–0.74	–0.78	–0.79	–0.71
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.94	–0.78	–0.71	–0.69	–0.55	–0.34
Government investment	–0.78	–0.62	–0.54	–0.49	–0.34	–0.14
Personal transfers	–0.20	–0.37	–0.44	–0.46	–0.46	–0.41
Direct taxes	–0.13	–0.25	–0.31	–0.33	–0.35	–0.32
Net indirect taxes	–0.28	–0.55	–0.68	–0.74	–0.75	–0.67
Shock to risk premium						
Government consumption	–0.95	–0.80	–0.73	–0.71	–0.57	–0.36
Government investment	–0.79	–0.64	–0.56	–0.51	–0.36	–0.16
Personal transfers	–0.21	–0.39	–0.46	–0.48	–0.48	–0.42
Direct taxes	–0.14	–0.27	–0.33	–0.35	–0.36	–0.33
Net indirect taxes	–0.29	–0.57	–0.71	–0.77	–0.77	–0.69

Table A2: Impact of fiscal consolidation on GDP, by fiscal instruments: France *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.86	–0.78	–0.80	–0.81	–0.82	–0.82
Government investment	–0.74	–0.65	–0.65	–0.63	–0.61	–0.59
Personal transfers	–0.13	–0.26	–0.35	–0.42	–0.48	–0.53
Direct taxes	–0.07	–0.15	–0.21	–0.26	–0.31	–0.34
Net indirect taxes	–0.18	–0.39	–0.55	–0.67	–0.77	–0.85
Shock to risk premium						
Government consumption	–0.87	–0.81	–0.83	–0.84	–0.84	–0.84
Government investment	–0.75	–0.68	–0.67	–0.66	–0.63	–0.61
Personal transfers	–0.14	–0.28	–0.38	–0.45	–0.51	–0.56
Direct taxes	–0.08	–0.18	–0.24	–0.29	–0.34	–0.38
Net indirect taxes	–0.19	–0.42	–0.59	–0.71	–0.81	–0.89
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.85	–0.77	–0.79	–0.81	–0.82	–0.82
Government investment	–0.73	–0.64	–0.64	–0.63	–0.61	–0.58
Personal transfers	–0.12	–0.25	–0.35	–0.42	–0.48	–0.52
Direct taxes	–0.07	–0.15	–0.21	–0.26	–0.30	–0.34
Net indirect taxes	–0.18	–0.39	–0.54	–0.66	–0.76	–0.84
Shock to risk premium						
Government consumption	–0.86	–0.78	–0.81	–0.83	–0.84	–0.85
Government investment	–0.74	–0.65	–0.66	–0.65	–0.64	–0.62
Personal transfers	–0.13	–0.27	–0.37	–0.44	–0.51	–0.56
Direct taxes	–0.08	–0.17	–0.23	–0.29	–0.33	–0.37
Net indirect taxes	–0.19	–0.41	–0.57	–0.70	–0.81	–0.89

Table A3: Impact of fiscal consolidation on GDP, by fiscal instruments: Italy *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–1.01	–0.86	–0.70	–0.59	–0.45	–0.26
Government investment	–0.85	–0.67	–0.47	–0.30	–0.11	0.15
Personal transfers	–0.07	–0.09	–0.01	0.11	0.25	0.44
Direct taxes	–0.02	0.01	0.12	0.27	0.43	0.63
Net indirect taxes	–0.12	–0.20	–0.15	–0.02	0.13	0.32
Shock to risk premium						
Government consumption	–1.22	–1.21	–1.03	–0.92	–0.81	–0.72
Government investment	–1.06	–1.03	–0.85	–0.72	–0.60	–0.49
Personal transfers	–0.28	–0.48	–0.46	–0.41	–0.38	–0.36
Direct taxes	–0.23	–0.38	–0.34	–0.27	–0.23	–0.21
Net indirect taxes	–0.34	–0.63	–0.68	–0.69	–0.69	–0.70
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.96	–0.77	–0.64	–0.52	–0.36	–0.15
Government investment	–0.81	–0.59	–0.43	–0.27	–0.06	0.20
Personal transfers	–0.06	–0.08	–0.01	0.11	0.24	0.42
Direct taxes	–0.02	0.01	0.11	0.25	0.39	0.58
Net indirect taxes	–0.11	–0.18	–0.13	–0.01	0.12	0.31
Shock to risk premium						
Government consumption	–1.16	–1.10	–0.99	–0.92	–0.80	–0.70
Government investment	–1.01	–0.93	–0.82	–0.72	–0.60	–0.48
Personal transfers	–0.27	–0.43	–0.42	–0.41	–0.38	–0.35
Direct taxes	–0.22	–0.34	–0.31	–0.27	–0.24	–0.21
Net indirect taxes	–0.33	–0.57	–0.63	–0.67	–0.68	–0.68

Table A4: Impact of fiscal consolidation on GDP, by fiscal instruments: Spain *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–1.15	–1.06	–0.91	–0.82	–0.66	–0.47
Government investment	–1.04	–0.92	–0.74	–0.61	–0.43	–0.22
Personal transfers	–0.23	–0.46	–0.51	–0.50	–0.44	–0.37
Direct taxes	–0.14	–0.28	–0.30	–0.29	–0.25	–0.19
Net indirect taxes	–0.33	–0.67	–0.77	–0.77	–0.70	–0.60
Shock to risk premium						
Government consumption	–1.40	–1.49	–1.28	–1.10	–0.85	–0.59
Government investment	–1.29	–1.35	–1.11	–0.89	–0.62	–0.36
Personal transfers	–0.49	–0.89	–0.88	–0.79	–0.64	–0.50
Direct taxes	–0.39	–0.71	–0.69	–0.60	–0.48	–0.37
Net indirect taxes	–0.59	–1.10	–1.16	–1.10	–0.95	–0.79
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–1.08	–0.96	–0.85	–0.74	–0.57	–0.38
Government investment	–0.97	–0.83	–0.69	–0.55	–0.36	–0.16
Personal transfers	–0.22	–0.42	–0.46	–0.46	–0.39	–0.31
Direct taxes	–0.13	–0.26	–0.28	–0.26	–0.22	–0.16
Net indirect taxes	–0.31	–0.61	–0.70	–0.70	–0.62	–0.51
Shock to risk premium						
Government consumption	–1.31	–1.33	–1.19	–1.04	–0.79	–0.55
Government investment	–1.21	–1.20	–1.03	–0.85	–0.58	–0.33
Personal transfers	–0.45	–0.80	–0.80	–0.75	–0.61	–0.47
Direct taxes	–0.37	–0.63	–0.62	–0.57	–0.46	–0.35
Net indirect taxes	–0.55	–0.99	–1.06	–1.03	–0.90	–0.74

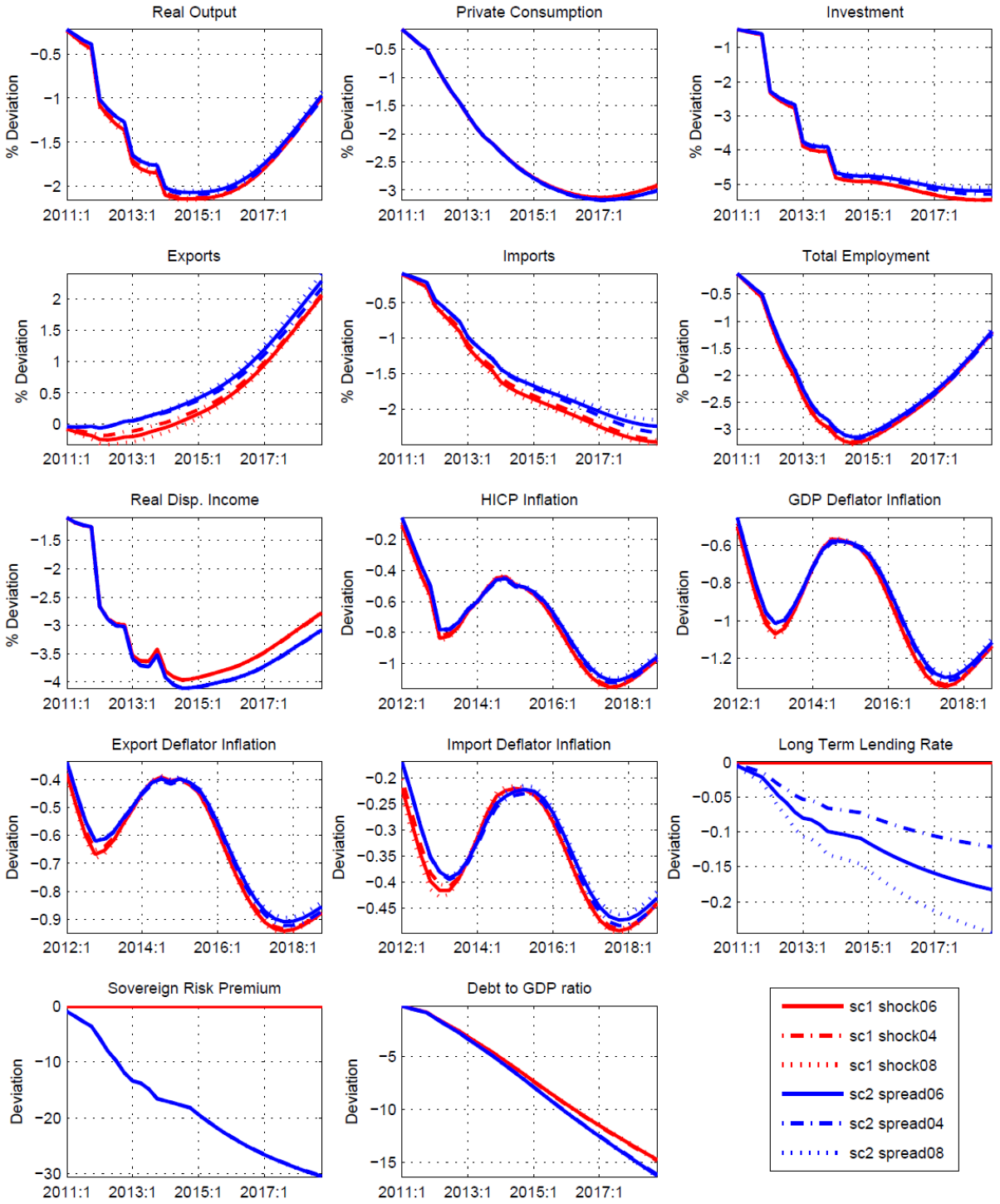
Table A5: Impact of fiscal consolidation on GDP, by fiscal instruments: Netherlands *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.86	–0.77	–0.82	–0.86	–0.84	–0.77
Government investment	–0.61	–0.49	–0.49	–0.48	–0.44	–0.36
Personal transfers	–0.12	–0.26	–0.35	–0.41	–0.46	–0.49
Direct taxes	–0.10	–0.20	–0.27	–0.33	–0.38	–0.40
Net indirect taxes	–0.16	–0.34	–0.46	–0.56	–0.65	–0.69
Shock to risk premium						
Government consumption	–0.87	–0.80	–0.85	–0.89	–0.86	–0.78
Government investment	–0.62	–0.52	–0.52	–0.51	–0.46	–0.38
Personal transfers	–0.14	–0.29	–0.38	–0.44	–0.49	–0.51
Direct taxes	–0.11	–0.23	–0.30	–0.36	–0.40	–0.42
Net indirect taxes	–0.17	–0.37	–0.50	–0.59	–0.67	–0.71
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.85	–0.77	–0.82	–0.86	–0.84	–0.76
Government investment	–0.60	–0.48	–0.49	–0.49	–0.43	–0.36
Personal transfers	–0.12	–0.25	–0.34	–0.41	–0.46	–0.49
Direct taxes	–0.09	–0.20	–0.27	–0.33	–0.38	–0.40
Net indirect taxes	–0.15	–0.33	–0.46	–0.56	–0.64	–0.69
Shock to risk premium						
Government consumption	–0.86	–0.79	–0.85	–0.89	–0.86	–0.79
Government investment	–0.61	–0.51	–0.52	–0.51	–0.46	–0.38
Personal transfers	–0.13	–0.28	–0.37	–0.44	–0.49	–0.51
Direct taxes	–0.11	–0.22	–0.30	–0.36	–0.40	–0.42
Net indirect taxes	–0.17	–0.35	–0.49	–0.59	–0.67	–0.71

Table A6: Impact of fiscal consolidation on GDP, by fiscal instruments: Smaller countries bloc *(percentage deviation from baseline levels following a permanent 1% of GDP reduction in government deficit)*

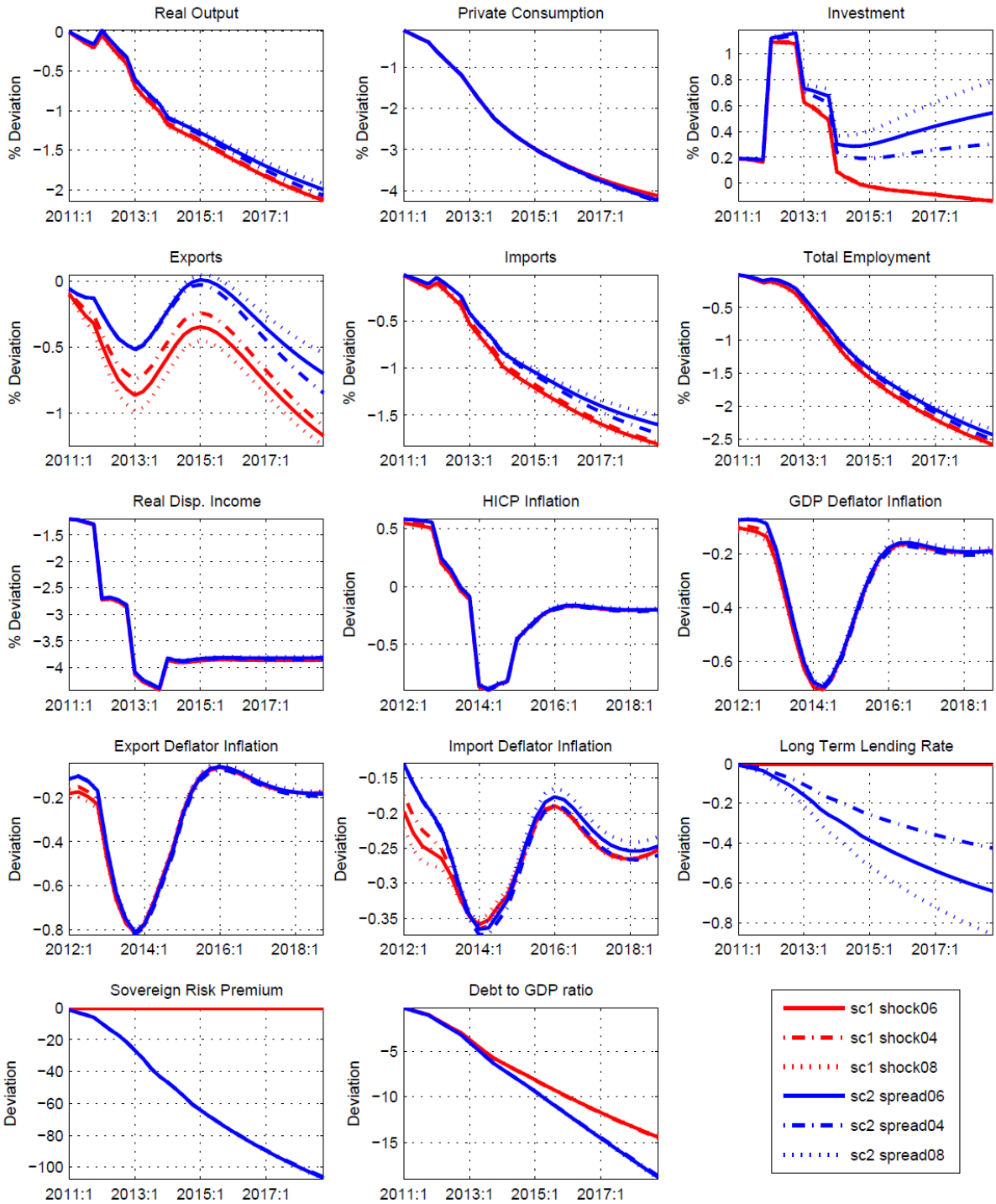
	2011	2012	2013	2014	2015	2016
Accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.95	–0.81	–0.70	–0.66	–0.54	–0.42
Government investment	–0.62	–0.51	–0.44	–0.41	–0.32	–0.24
Personal transfers	–0.08	–0.14	–0.15	–0.14	–0.16	–0.22
Direct taxes	–0.00	–0.01	–0.03	–0.05	–0.06	–0.08
Net indirect taxes	–0.34	–0.59	–0.63	–0.62	–0.58	–0.48
Shock to risk premium						
Government consumption	–1.04	–0.94	–0.81	–0.74	–0.58	–0.43
Government investment	–0.71	–0.65	–0.55	–0.48	–0.37	–0.26
Personal transfers	–0.17	–0.28	–0.25	–0.22	–0.21	–0.24
Direct taxes	–0.09	–0.15	–0.14	–0.13	–0.12	–0.10
Net indirect taxes	–0.43	–0.72	–0.74	–0.70	–0.63	–0.51
Non-accomodative monetary policy						
Endogenous risk premium						
Government consumption	–0.94	–0.78	–0.69	–0.65	–0.52	–0.41
Government investment	–0.61	–0.49	–0.43	–0.40	–0.31	–0.24
Personal transfers	–0.08	–0.14	–0.14	–0.14	–0.16	–0.21
Direct taxes	–0.00	–0.01	–0.03	–0.04	–0.06	–0.07
Net indirect taxes	–0.34	–0.57	–0.61	–0.61	–0.56	–0.47
Shock to risk premium						
Government consumption	–1.02	–0.90	–0.79	–0.73	–0.57	–0.43
Government investment	–0.69	–0.62	–0.54	–0.48	–0.36	–0.26
Personal transfers	–0.17	–0.26	–0.24	–0.22	–0.21	–0.24
Direct taxes	–0.09	–0.14	–0.13	–0.13	–0.12	–0.11
Net indirect taxes	–0.43	–0.70	–0.72	–0.70	–0.63	–0.51

Figure A1: Impact of 2011-14 discretionary fiscal measures on key economic variables in Germany: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



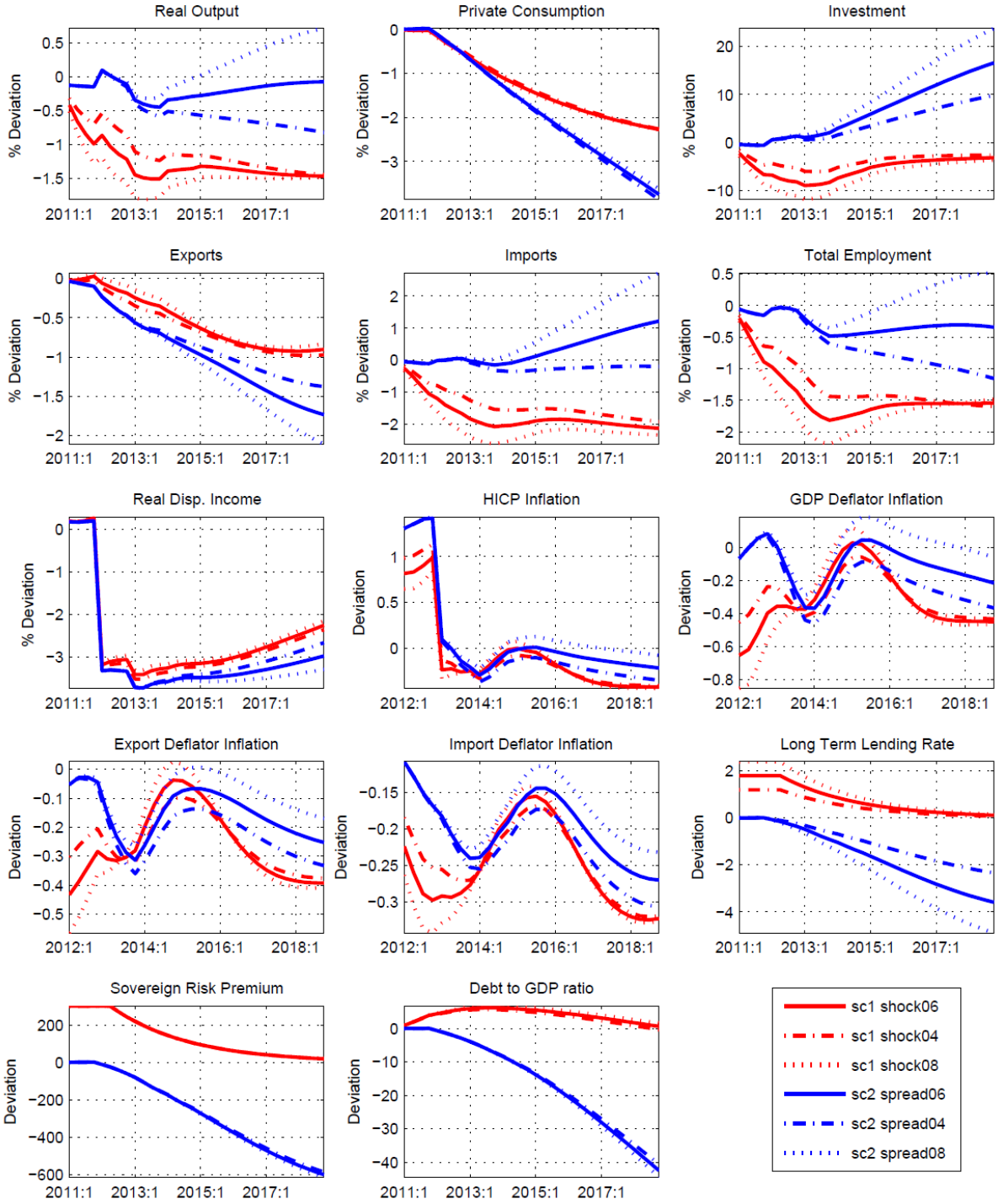
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A2: Impact of 2011-14 discretionary fiscal measures on key economic variables in France: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



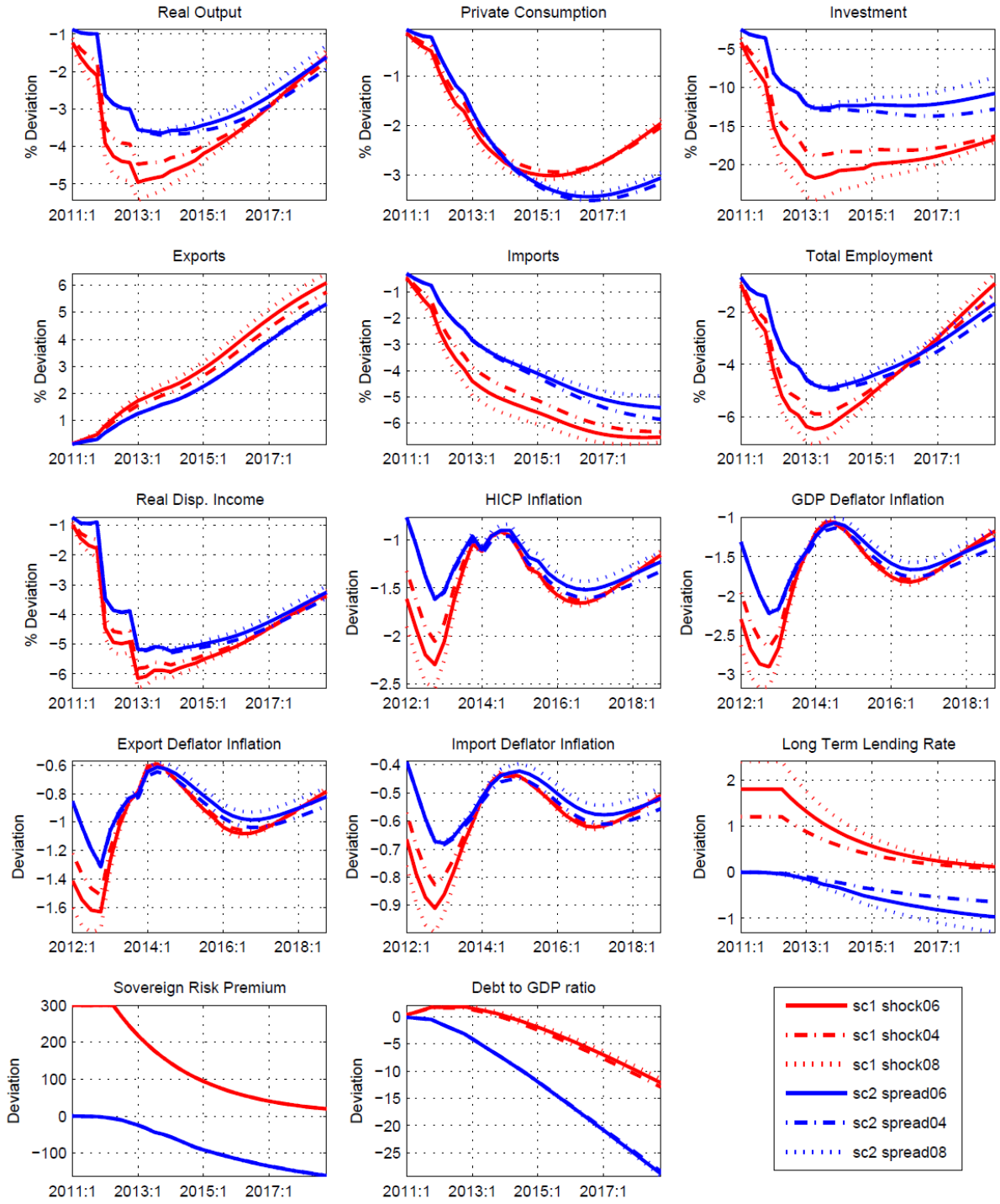
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A3: Impact of 2011-14 discretionary fiscal measures on key economic variables in Italy: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



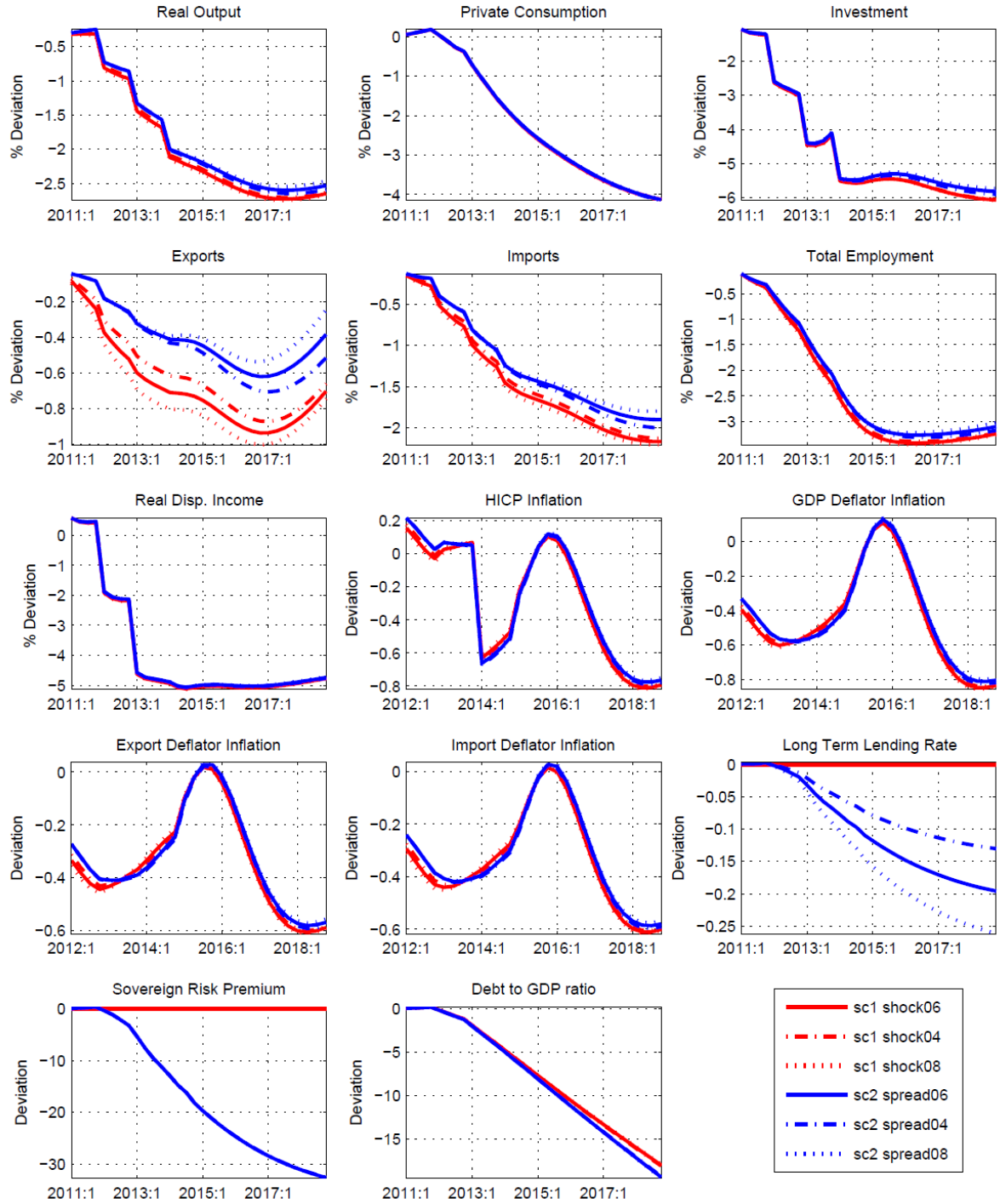
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A4: Impact of 2011-14 discretionary fiscal measures on key economic variables in Spain: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



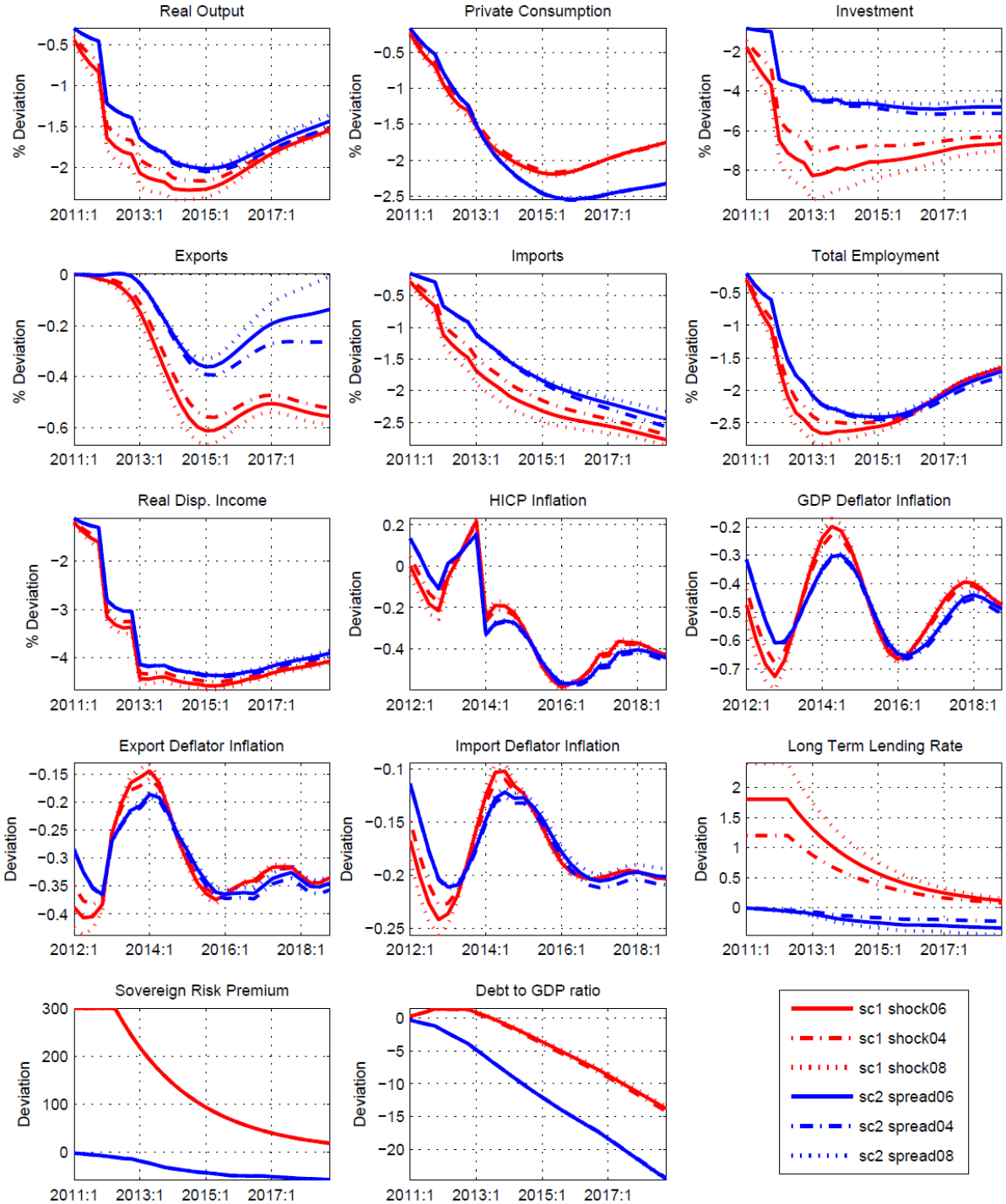
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A5: Impact of 2011-14 discretionary fiscal measures on key economic variables in Netherlands: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



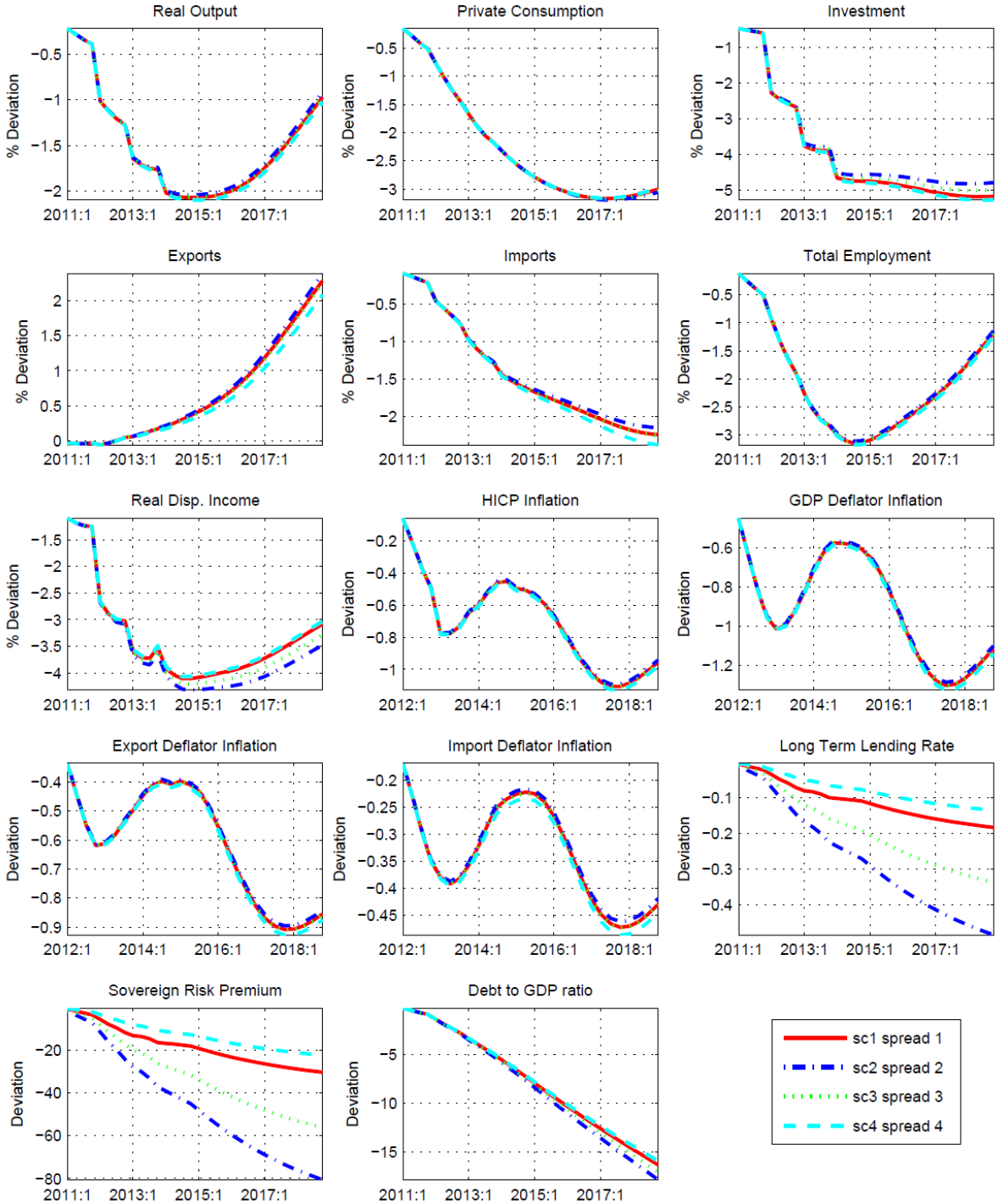
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A6: Impact of 2011-14 discretionary fiscal measures on key economic variables in smaller countries bloc: robustness analysis with respect to the degree of pass-through between public and private financing conditions *(percentage deviation from baseline levels)*



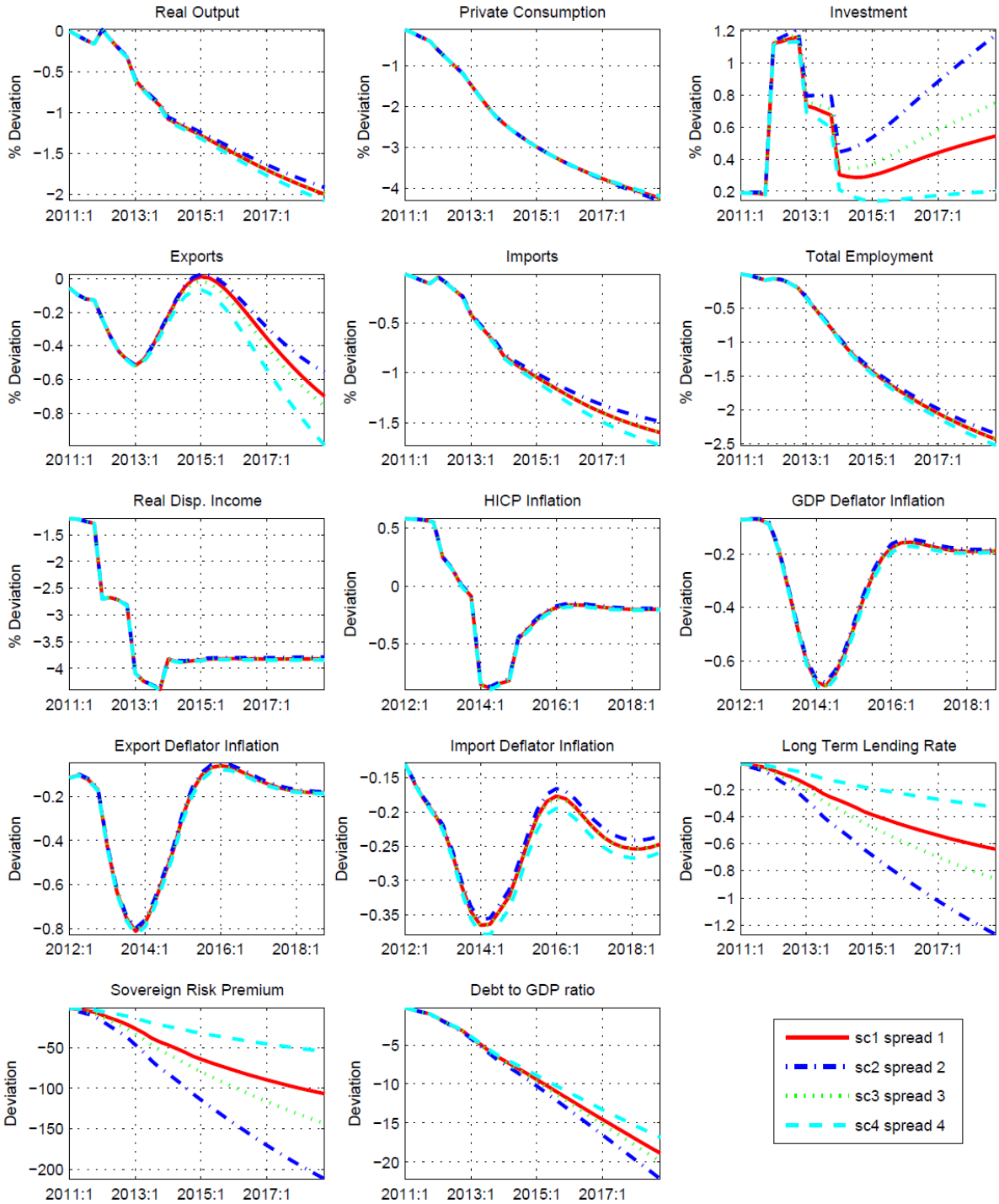
Red lines correspond to the scenarios where the sovereign risk premium is a subject to an exogenous shock. Blue lines refer to the scenarios with endogenous risk premium reaction.

Figure A7: Impact of 2011-14 discretionary fiscal measures on key economic variables in Germany: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



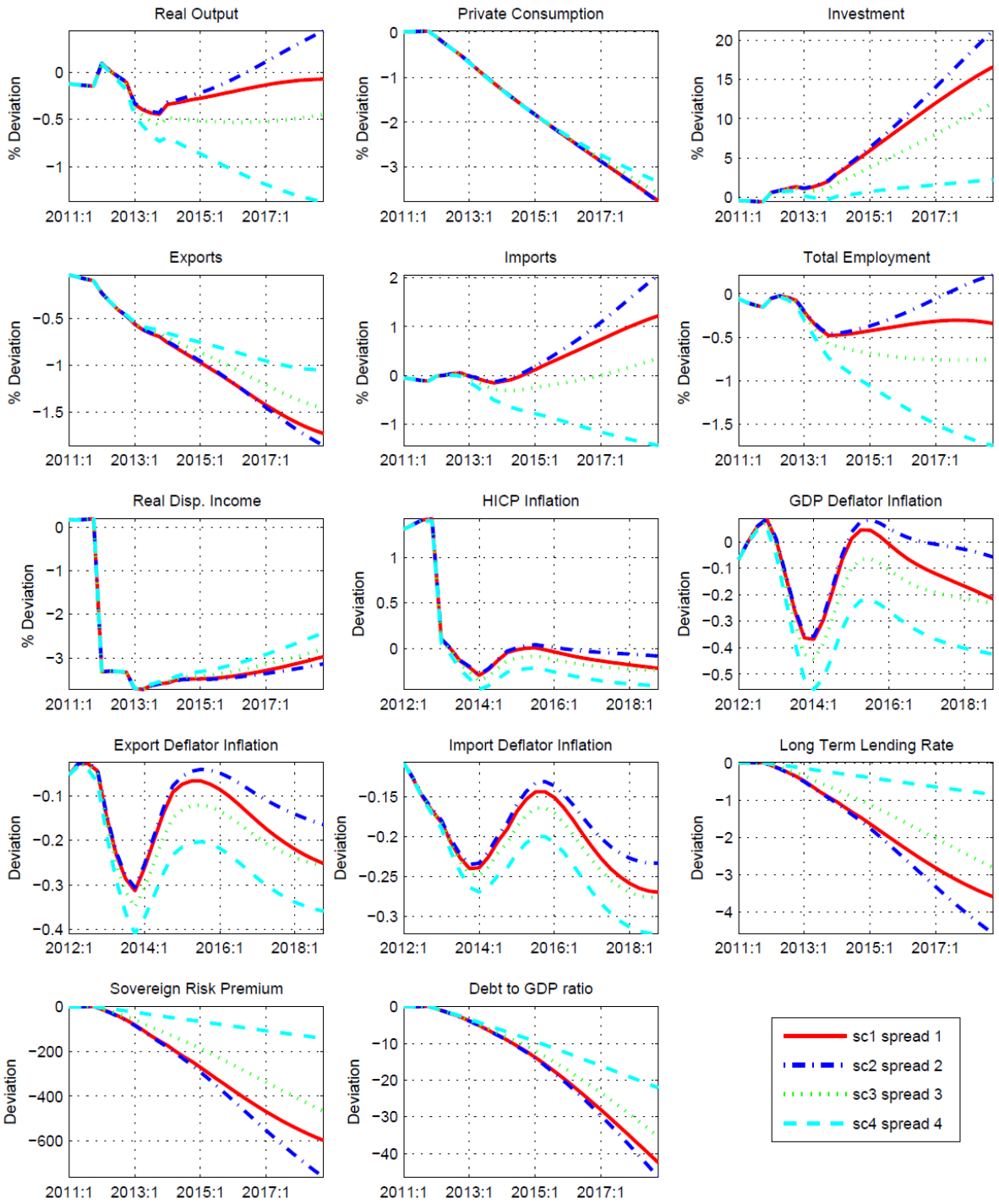
Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure A8: Impact of 2011-14 discretionary fiscal measures on key economic variables in France: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



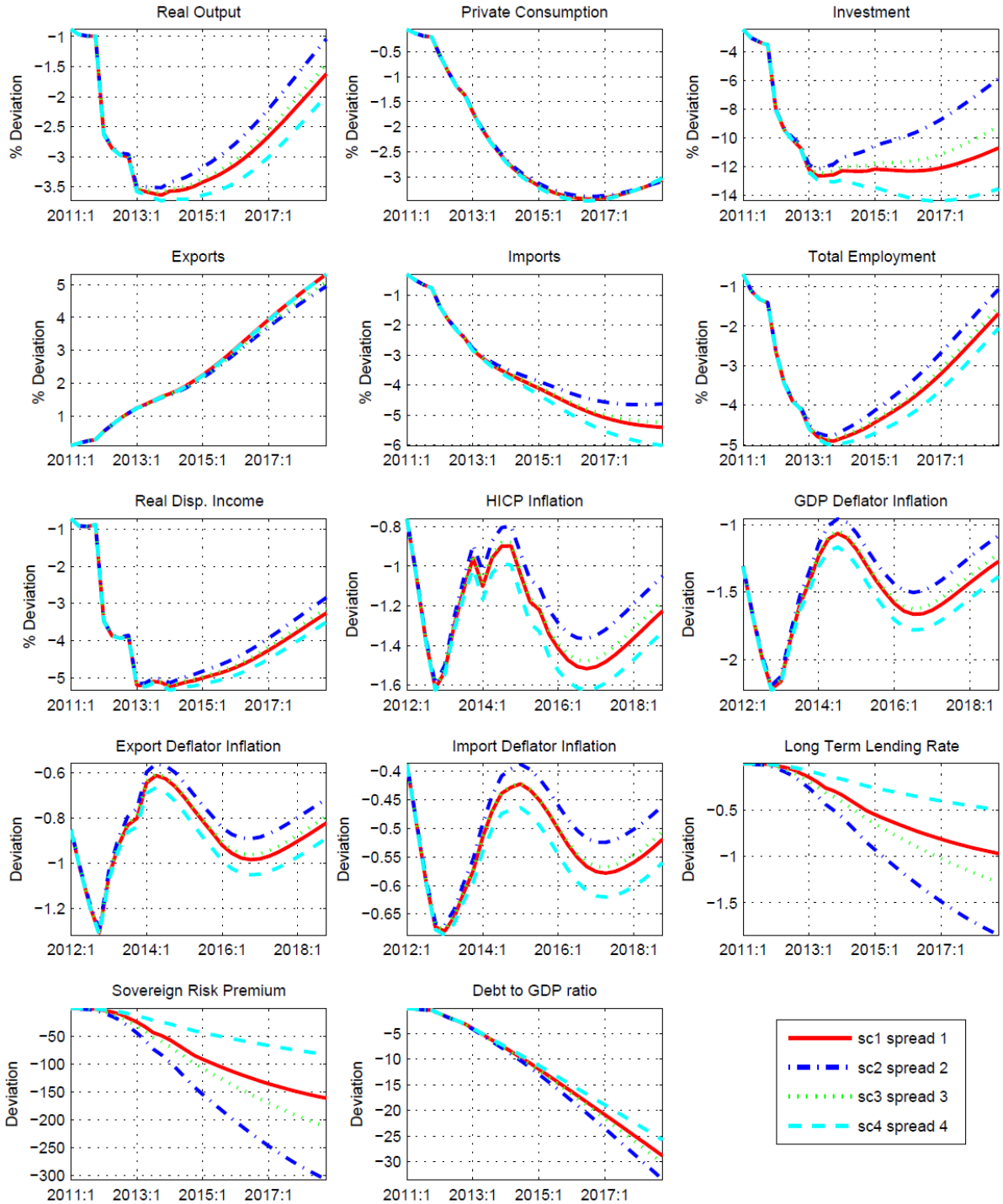
Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure A9: Impact of 2011-14 discretionary fiscal measures on key economic variables in Italy: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



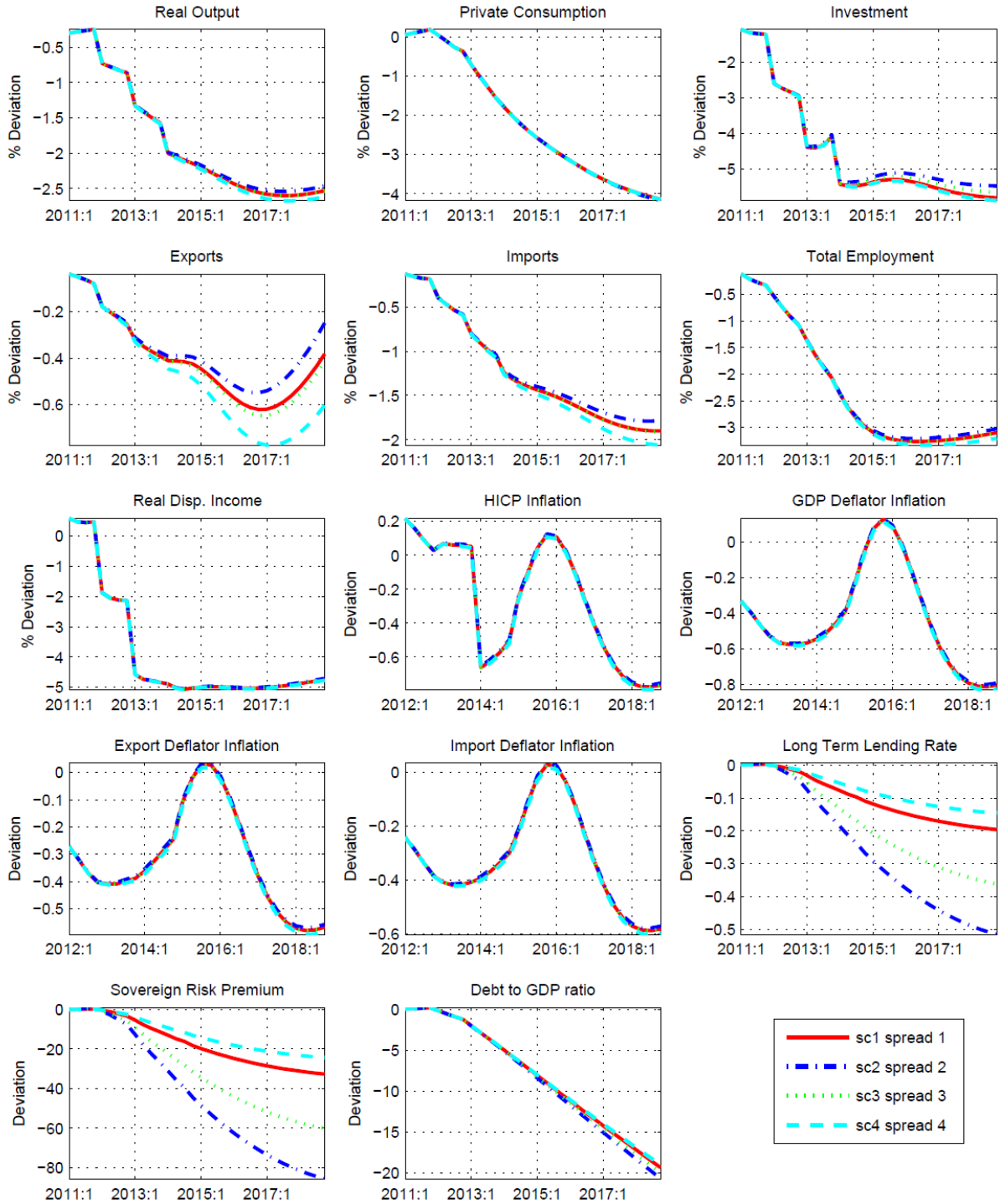
Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure A10: Impact of 2011-14 discretionary fiscal measures on key economic variables in Spain: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



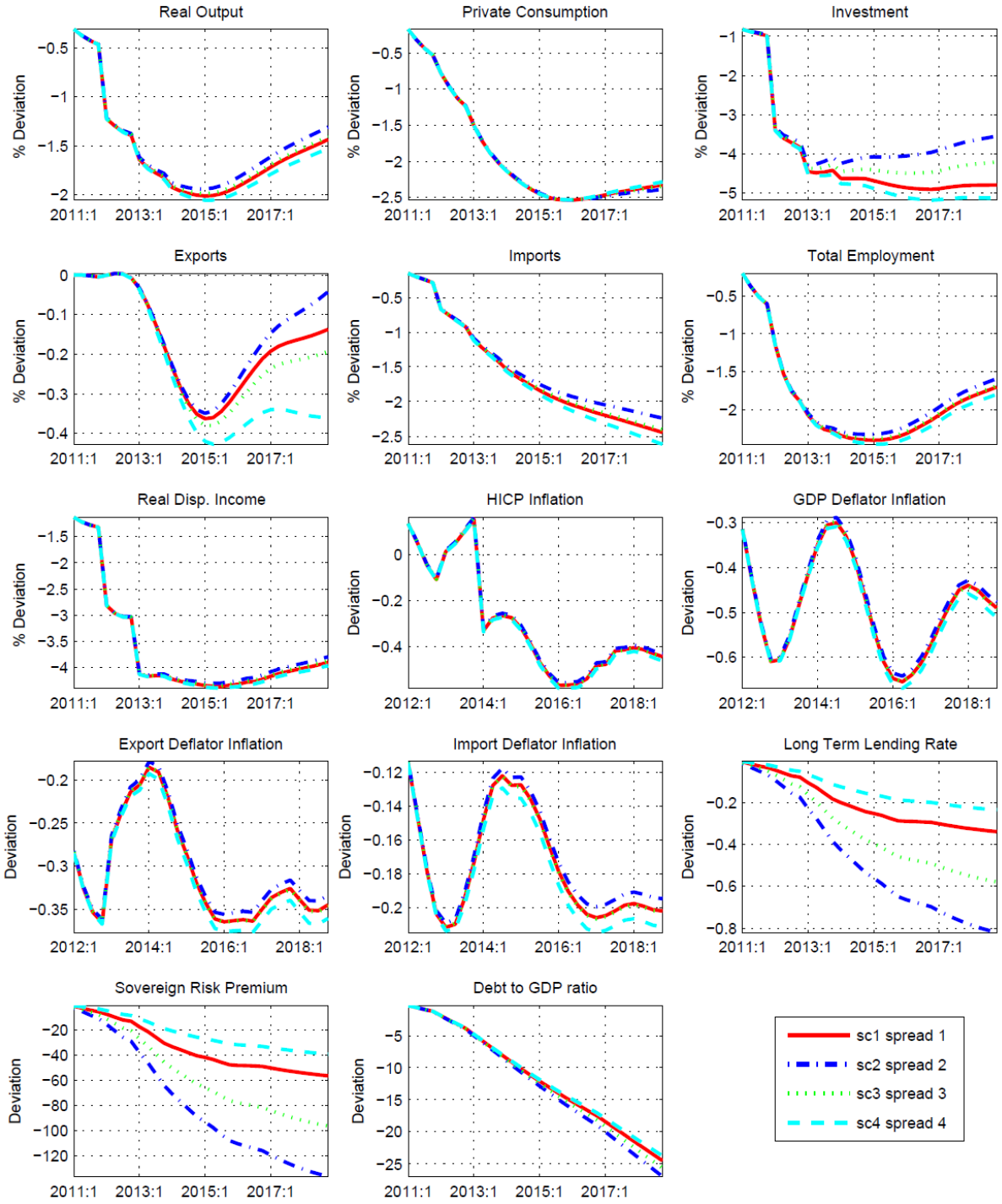
Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure A11: Impact of 2011-14 discretionary fiscal measures on key economic variables in Netherlands: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Figure A12: Impact of 2011-14 discretionary fiscal measures on key economic variables in smaller countries bloc: robustness analysis with respect to the functional specification of the relationship between the sovereign risk premium and the debt ratios *(percentage deviation from baseline levels)*



Red line (scenario 1) corresponds to the baseline specification of the sovereign risk premium channel (as in Corsetti at al.; 2013). Dark blue (scenario 2), green (scenario 3), and light blue (scenario 4) refer to alternative specifications of the sovereign risk premium channel (as in Roeger and in 't Veld; 2013).

Magdalena Lalik
Directorate General Research, European Central Bank, Frankfurt am Main, Germany; email: magdalena.lalik@ecb.europa.eu

Postal address	60640 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Website	www.ecb.europa.eu

ISSN	1725-2806 (pdf)	DOI	10.2866/957627 (pdf)
ISBN	978-92-899-2738-3 (pdf)	EU catalogue No	QB-AR-17-028-EN-N (pdf)