OECD Economics Department Working Papers No. 1074

A Simple Fiscal Stress Testing Model: Case Studies of Austrian, Czech and German Economies

Ondra Kamenik,

Zdenek Tuma,

David Vavra,

Zuzana Smidova

https://dx.doi.org/10.1787/5k43nxm8hfvf-en

OECD

Unclassified **ECO/WKP(2013)66**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **01-Jul-2013**

English - Or. English

ECONOMICS DEPARTMENT

ECO/WKP(2013)66
Unclassified

A SIMPLE FISCAL STRESS TESTING MODEL - CASE STUDIES OF AUSTRIAN, CZECH AND GERMAN ECONOMIES

ECONOMICS DEPARTMENT WORKING PAPERS No. 1074

By Ondra Kamenik, Zdenek Tuma, David Vavra and Zuzana Smidova

All Economics Department Working Papers are available through OECD's Internet website at http://www.oecd.org/eco/Workingpapers

JT03342559

Complete document available on OLIS in its original format
This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

English - Or. English

ABSTRACT/RESUMÉ

A simple fiscal stress testing model - case studies of Austrian, Czech and German economies

This paper develops a simple model-based framework for stress testing fiscal consolidation strategies under different scenarios of future shocks. A baseline scenario assuming a gradual debt consolidation is presented and by assuming different future developments (*e.g.* lower potential growth) and/or model specification in terms of a fiscal rule confidence bands around the baseline are obtained. Trade-offs between costs and benefits are evaluated, in terms of cumulative output loss and primary surpluses, as well as political difficulty of fiscal strategies and risk of failed consolidation. The model is applied to Austria, Czech Republic and Germany.

This working paper relates to the 2013 *OECD Economic Surveys of Austria, Czech Republic and Germany*. (www.oecd.org/eco/surveys)

JEL classification codes: E62, E63, E65.
Keywords: Fiscal policy, debt consolidation, Central Europe, structural deficit.

****

Un modèle de simulation simple de crise budgétaire - études de cas des économies autrichienne, allemande et tchèque

Ce document de travail présente un modèle simple permettant de tester des stratégies de consolidation budgétaire face à différents scénarios de chocs futurs. Le scénario de référence suppose une consolidation progressive de la dette et présente différentes évolutions futures (exemple : potentiel de croissance inférieur) et /ou une spécification du modèle sous la forme de bandes de confiance des règles budgétaires autour du scénario de référence. Ce document évalue les compromis entre les coûts et les avantages en termes de perte cumulative de production et d'excédents primaires ainsi que la difficulté d'application des stratégies budgétaires d'un point de vue politique et le risque d'échec de la consolidation budgétaire. Le modèle est appliqué à l'Autriche, la République tchèque et l'Allemagne.

Ce document de travail a trait aux Etudes Economiques de l'OCDE de l'Autriche, de la République tchèque et de l'Allemagne, 2013.(www.oecd.org/eco/etudes)

Classification JEL: E62, E63, E65.
Mots clés : Politique budgétaire, consolidation de la dette, Europe centrale, déficit structurel.

© OECD (2013)

You can copy, download or print OECD content for your own use, and you can include excerpts from OECD publications, databases and multimedia products in your own documents, presentations, blogs, websites and teaching materials, provided that suitable acknowledgment of OECD as source and copyright owner is given. All requests for commercial use and translation rights should be submitted to rights@oecd.org

TABLE OF CONTENTS

Tables

Figures

Boxes

A SIMPLE FISCAL STRESS TESTING MODEL - CASE STUDIES OF AUSTRIAN, CZECH AND GERMAN ECONOMIES

by Ondra Kamenik, Zdenek Tuma, David Vavra and Zuzana Smidova[1]

Introduction

Given the importance of public policy debates about fiscal sustainability and consolidation paths in the wake of the financial crisis, there is surprisingly little in terms of forward-looking frameworks. Fiscal consolidation strategies are often discussed without considering the inter-linkages with the macroeconomic environment (Leeper, 2010). As a result, instead of being pro-active, fiscal policy debates merely react to unfolding events. Moreover, transparency of these debates and the accessibility of analytical tools lag behind those of monetary policy. In order to at least partially remedy the current situation, this paper develops a relatively simple framework for stress-testing fiscal consolidation strategies and rules as well as assessing medium-term fiscal sustainability, that would serve as a basis for more forward looking and pro-active debates about the set-up of fiscal strategies. There is also a focus on debt-management in terms of maturity and currency composition – an aspect that is often underappreciated. The evaluation of simulated fiscal scenarios is designed to look at three risks: output loss, political difficulty and the risk of consolidation failure. For each of these criteria we present probability fan charts.

The paper starts with a brief motivation and a description of the context that gave a rise to this idea. Then, it describes the workhorse model, its properties and behaviour on country-specific data. This is followed by results of simulations of various fiscal consolidation strategies and their stress-tests for the case studies of Austria, the Czech Republic and Germany. Finally, the paper concludes with potential policy implications. The appendices contain the details of the model, parameters, and a description of the country data.

Motivation and Background

There can hardly be more contrast between the quality of the analytical support given to monetary and fiscal policy making. Soon after the breakout of the crisis in 2008 monetary policy analysts started factoring into their forecasts assumptions about a declining level and/or growth rate of potential output – an important assumption for the right setting of monetary policy instruments. Yet the fiscal policy debates at the time were overwhelmed by the right size of the temporary fiscal stimulus and all but ignored the

1. Authors are members of the OGResearch development team, except for Zuzana Smidova, who is a member of OECD staff. The authors are grateful to Andreas Woergoetter, Artur Radziwill, Vlastimil Tesar, Jan Gregor and the participants of the seminar organized by the Ministry of Finance of the Czech Republic in Prague in June 2011 for encouragement, comments and support. Nonetheless, all the errors, omissions, views and representations remain with the authors and the OGResearch development team and do not necessarily represent the views of OECD or the Ministry of Finance of the Czech Republic. The research assistance of David Kocourek is gratefully acknowledged, as well as secretarial assistance of Sylvie Dewit. This research was funded by a voluntary contribution of the Czech Ministry of Finance to the OECD and the Secretary General priority fund.

implications of the same assumption for the medium-term sustainability of public debt. Had they not, the disastrous consequences for the Eurozone would have been apparent much earlier.

The situation has not improved much since. Policy makers continue to be taken by 'surprise' by the magnitude of a continuous decline in growth rates in countries with strict consolidation strategies being enforced by various programmes. Unlike monetary policy, fiscal policy seems to be backward-looking and pre-occupied by the current problems rather than medium-term sustainability. This partly reflects a lack of adequate analytical tools, but also data. As our experience from writing this paper shows, gaining access to a consistent set of data for three fiscally relatively sound economies – that of Austria, the Czech Republic, and Germany - was a cumbersome task.

Indeed, as Leeper (2010) points out: while monetary policy making is more of a science, fiscal policy is still more like alchemy. In an era when many central banks publish expected exchange and interest rate trajectories and publicly discuss their underpinnings, one is not able to obtain easily an official view on what the sustainable level of debt for a given country is for a given set of assumptions. EU countries are obliged by the Stability and Growth Pact and its recent upgrades to present medium-term debt projections in so-called Stability and Convergence programmes, while longer term developments have been simulated in Sustainability Reports (former Ageing Reports). The medium term in this case represents a three-year horizon and long-term sustainability reflects mainly population ageing issues. In our view, this is commendable but not enough and a general lack of transparency in terms of longer term national debt strategies unnecessarily adds to investor and public anxiety in the debate on sustainability of public finances and possibly narrows the conduct of fiscal policy to short term considerations.

Box 1 shows the importance of having consistent trajectories of fiscal and macroeconomic variables and how much insight can then be gained by using simple algebra. There are, however, limits on where one can go without a structural macroeconomic model. For instance, fiscal adjustments are likely to undermine growth and thus increase their vulnerability to interest rate changes. Changes in long-term macroeconomic fundamentals must be adequately expressed in the assumptions about interest rates, inflation, and exchange rates. The interest rate cost of servicing debt is endogenous to the credibility of fiscal consolidation and probably in a non-linear fashion.

Box 1. Simple debt-deficit arithmetic

The following tables illustrate a simple debt-deficit arithmetic with the formula outlined below describing the accumulation of the government debt/GDP ratio:

$$Debt - to - GDP = (1 + nominal\ interest\ rate)/[(1 + inflation\ rate) * (1 + GDP\ growth\ rate)] * Debt - to - GDP(-1) + Primary - Deficit - to - GDP$$

The equation allows computing a deficit value consistent with maintaining a given debt value (relative to GDP). It also implies that if nominal interest rates exceed the rate of nominal GDP growth, the debt-to-GDP ratio becomes explosive and management of the ratio requires persistent primary surpluses.

Table B.1 shows the application of the equation to the stylized situation in the EU before and after the monetary union. The euro gave indebted countries with high currency risks (expressed in high interest rate premiums) a false sense of fiscal security, as the drop in interest rates exceeded that in inflation and nominal GDP growth. As a result, the debt became sustainable even with continued primary deficits, and a sizable fiscal consolidation (*e.g.* a halving of the debt) was achievable by just running a primary balance on average.

The financial crisis destroyed the illusion of fiscal sustainability, because it altered the balance between interest rate costs and nominal GDP growth. By reducing potential growth rates the crisis made fiscal consolidation near impossible, even if interest rates had stayed low. The need to run large and continued primary surpluses in order to make current debt sustainable becomes immediately apparent.

Table B.1 Stylized debt and deficit arithmetic for selected EU countries

Target/initial debt (% of GDP)	Scenario	Interest rate (% p.a.)	GDP growth (% p.a.)	Inflation (% p.a.)	Primary Surplus required to keep the target debt (% of GDP)	No of years to have the debt in an austerity program	Annual primary surplus required to have the debt (% of GDP)
100	South Europe Pre-EMU	7	4	3	0.0	25	2.0
100	South Europe EMU Pre-Crisis	3	4	2	-2.8	25	-0.1
100	South Europe Post-Crisis	7	2	1	3.9	25	5.1
40	Czech Republic	3.5	2	2	-0.2	20	1.0
70	Germany	3.5	2	2	-0.3	20	1.8
70	Austria	3.5	2	2	-0.3	20	1.8

Source: Authors' calculations

Such simple calculations also show that escaping from the situation can be done quickly only by dramatically reducing the size of the debt. While longer-term solutions rest in supporting real growth and competitiveness, in the short term, all workable solutions must start by writing off significant parts of the debt.

Table B.2 shows that the solutions based on a marginal reduction of interest rates and/or higher inflation are not going to alleviate the fiscal burden substantially. The consolidation would still be practically and politically impossible - judging by the size of the annual primary surplus needed for a sustainable debt reduction. Aside from being unrealistic, such a fiscal restriction would almost surely fail to bring about higher growth - the only long-term solution to the dilemma.

On the other hand, the table gives examples of workable solutions that involve a forceful reduction of the interest rate burden to zero (*e.g.* by IFIs acquiring the entire debt amount and reducing the interest rate burden) or the write-off of more than half of the debt.

Table B.2 Stylized arithmetic scenarios of debt reduction

Target/initial debt (% of GDP)	Scenario	Interest rate (% p.a.)	GDP growth (% p.a.)	Inflation (% p.a.)	Primary Surplus required to keep the target debt (% of GDP)	No of years to have the debt in an austerity program	Annual primary surplus required to have the de (% of GDP)
120	Remedy: reduced interest rates	5	2	1	2.3	30	3.8
120	Remedy: reduced rates and higher inflation	5	2	3	0.0	30	2.0
120	Remedy: IFLs restructure through subsidized interest	0	2	1	-3.5	30	-0.5
50	Remedy: write-off	5	3	2	0.0		
50	Remedy: write-off and drachma	7	4	3	0.0		

Source: Authors' calculations

Although illuminating, such considerations are potentially flawed, because they ignore the linkages between the fiscal consolidation and economic development. For instance, the fiscal consolidation scenarios in involving massive public savings for a generation work with an unchanged 2% growth rate assumption. In truth, the high primary surpluses are almost surely going to lead to a protracted recession, at least in the short to medium term. Besides, the changes in inflation and real interest rates implied by the various scenarios are surely going to be reflected in the real exchange rate or risk premiums over the long term. The table also ignores the endogenous response of the interest rate to the credibility of the fiscal consolidation and how recessions and boom affect the capacity to enact fiscal consolidation.

Our model makes macroeconomic and fiscal variables consistent with one another, while abstracting from details, *e.g.* the way tax revenues are raised and expenditures spent. It tracks the maturity structure of government debt in different currencies and the yield curve. A fiscal rule determines the deficit and the terms structure and currency with which it is financed. It is coupled with a monetary policy rule, an uncovered interest parity condition, and a New-Keynesian Phillips curve. The semi-structural model setup allows for a variety of structural features, like shortcuts with non-Ricardian effects, crowding out of capital, debt-sensitive risk and term premiums, greater willingness to adjust structural deficits if the debt is high, among others. While the model borrows many ideas and implications from dynamic stochastic general equilibrium (DSGE) models, it is much more malleable, as it avoids the complexities involved in the rigorous derivation, calibration, and data testing of DSGE models. Thus the main advantage of our framework is in providing consistent trajectories of macroeconomic and fiscal variables at relatively limited costs in terms of model complexity and input requirements.

The semi-structural form of the model allows for a wide range of policy experiments, consistency checks, and risk analyses. It can be used for assessing the stochastic performance of deficit-debt fiscal rules, the optimal currency and maturity composition of the debt, the effects of non-linear thresholds (such as the zero interest rate bound or risk premium formation) on fiscal consolidation, the effects of changing macroeconomic fundamentals, interactions with monetary policy, and much more. This makes it potentially a very useful advisory tool for policy makers and numerous fiscal councils that are currently being set up. Furthermore, a user-friendly web portal has been developed to operate this model to facilitate its use.[2]

The experimental application of the framework on the data of the Czech Republic, Austria, and Germany provides a good illustration of what kind of conclusions and observations could be made:

- First, the absence of long-term debt-anchoring fiscal policies is the most visible in the Czech Republic, despite having the lowest debt levels among the three economies. However, Austria too would benefit from reducing its relatively high debt levels, because otherwise it faces a high risk that its interest costs rise above nominal income growth in the future. Germany, on the other hand, reaping the benefits of ultra-low risk premiums, has the least need for a change in its fiscal behaviour. Germany is also best positioned to withstand the likely drop in nominal income growth related to lower labour supply growth that is likely to hit the three economies in the coming decades. The only medium-term risks for Germany are in the high roll-over risk of its short-term debt and the sizeable share of non-securitized debt (NSD).

- Second, reducing the relative debt levels in Austria and stabilizing them in the Czech Republic will be difficult to achieve in the next two decades. Large and persistent primary surpluses will be required in both countries, testing the political resolve to continue with the consolidation with the adverse impacts on output and employment. Moreover, there is a large probability the consolidation will not succeed and the relative debt levels will actually increase despite the economic sacrifices.

- Third, while counter-cyclical fiscal behaviour (adjusting structural deficits downwards during booms and vice versa) is a more secure way of fiscal consolidation than pro-cyclical rules, the policy costs associated with the implied persistent primary surpluses are very high. The benefits

[2] For further details of this feature of the model and access to it, please contact the authors at OGResearch (david.vavra@ogresearch.com)

of reducing the debt – in terms of lower interest rates and higher growth – will only be manifested in a very long-term. Pro-cyclical rules, on the other hand, require much less political resolve, as they entail periods of both primary surpluses and deficits, but face a much higher probability of a failure.

Systematic fiscal rules and institutions

The model framework has been designed to assist in the functioning of an expert fiscal council – a council that works more like an advisory body to fiscal policymakers, rather than as a legal constraint on their behaviour (Box 2). User-friendliness, flexibility of switching assumptions, and accessibility through a web portal are necessary features that make such a framework an attractive tool for communicating medium-term fiscal trends and issues among various institutions and the public. The model gives policy makers control over the following parameters defining a fiscal consolidation strategy: the target debt level, the rule for structural deficits (both relative to GDP), and the maturity and currency composition of new debt. While the debt and deficit rule define the main features of a consolidation strategy, the other two serve as fine-tuning levers affecting the vulnerability of the debt to sudden exchange rate and interest rate changes, *i.e.* the robustness of fiscal consolidation.

The target debt level is a product of a political consensus, taking into account such issues as interest rate sensitivity to debt and the likelihood of reaching a critical level in adverse situations. The importance of sustainable long-term debt targets has been emphasized by a number of studies and policy institutions (see *e.g.* Sutherland *et al*, 2012, for an OECD analysis of medium-term fiscal sustainability). Rogoff and Reinhardt (2010) emphasized the adverse growth effects of high debt, estimating the threshold level of debt negatively affecting growth at 90% of GDP. Although the evidence has been questioned since (Herndon *et al*, 2013), the general arguments behind the long-term debt targets are still valid, as is Rogoff and Reinhardt's finding that excessively high debt levels depress growth. This attitude has been adopted by a number of policy making institutions, such as the IMF or OECD. For instance, the OECD analysis from 2012 analyses consolidation plans necessary to bring the gross debt levels of its member states to 50% of GDP by 2050.

The target debt level must be credible to anchor fiscal expectations (Leeper, 2010) – that is achievable and sustainable given the political consensus, the structural features and size of the economy, and the shocks affecting it. In that respect, that the country size matters and "one-size-fits-all" prescriptions, such as the Maastricht criteria, may not add to fiscal credibility. For instance, smaller countries or countries with a worse fiscal track-record must aim at lower relative debt levels than larger countries in order to reduce the risk of triggering a hostile market response. For instance, the Czech Republic – despite having relatively good fiscal discipline – would in a fiscal crisis run into financing difficulties at a lower debt level than, say, Germany or France. Such risks are embodied in our framework by a non-linear response of interest rates to a debt beyond a certain threshold. For these reasons, we set the target debt levels in our simulations to 30% of GDP for the Czech Republic, 45% for Austria, and 65% for Germany even if these thresholds are below the current debt levels of the three countries.

The centrepiece of the fiscal consolidation mechanism in our framework is the fiscal rule governing behaviour of structural deficits according to the target debt level. The rule is flexible and takes into account additional factors, such as the initial size of the debt and the state of the business cycle. As a result, the speed of convergence implied by the rule can be flexibly adjusted according to circumstances and policymakers' preferences.

There is no clear consensus on the role of various fiscal rules and their institutional underpinnings (see Box 2). Drawing from the experience with monetary policy rules, we consider it vital for any such rule to be transparent, understandable to the public, and easy to check. Only under such conditions can we expect enough pressure from the public for the implementation of the rule and accountability of public institutions for it. For instance, a rule imposing a structural fiscal balance is not very transparent owing to the complicated and non-unique methodology of business cycle adjustment. This would inevitably threaten to turn public discussions about fiscal sustainability into a technocratic debate of what a structural deficit is, as has often been the case.

The fiscal rule in our framework governs the behaviour of structural deficits so as to stabilize the debt-to-GDP ratio in the medium-term. Such rules are transparent, understandable, and easily checkable. At the same time, while they help anchor medium-term fiscal developments, they also allow for enough fiscal manoeuvring in the short term. A debt-based rule gives the fiscal authority enough freedom to ignore temporary shocks, but compels it to fight permanent ones by adjusting the structural deficits. Once the debt is off-balance, the authority must choose a trajectory of primary and structural deficits leading the debt back to the target. The trajectory must be credible, but also reflect the particular country's public preferences.

As already mentioned above, our framework is designed as a tool allowing policymakers and the public to choose among many possible trajectories of fiscal variables according to their preferences regarding the implied macroeconomic variables and their stochastic distributions. Each fiscal consolidation scenario can be characterized by many indicators and their distributions. For instance, we measure the speed of adjustment by the expected number of years before the target debt level is reached. For the costs of consolidation we take the expected output loss relative to potential output or the expected number of years for which output is below its potential. Each of these indicators has its probabilistic distribution too.

The political difficulties with consolidation can be described in several dimensions as well. For instance, the expected average primary surplus or the number of years with a positive primary surplus give an idea about how realistic it is that the society will endure the consolidation. The probability that the debt will actually increase rather than decrease during the consolidation can measure the risk of a failure. Finally, the probability that nominal GDP growth will fall short of interest costs at some point during the consolidation highlights the risks that the program will lose credibility in the eyes of the financial markets. Our framework does not solve the issue of which institution should make the choices among the fiscal consolidation strategies and look after their implementation, or how the underlying fiscal rules should be applied in practice.

Although the rule's function in the model is similar to that of a Taylor rule in monetary policy models, we do not necessarily want to take that analogy too far; fiscal rules should serve as guidance rather than a constraint. Fiscal policy independence (or perhaps better put, "autonomy") can never match that of monetary policy. Fiscal policy - *i.e.*, the redistribution of income and taxes - is less about technocratic professionalism than monetary policy is. It is the core embodiment of the democratic sovereignty of a country, and hence outsourcing fiscal policy cannot work in practice. The credibility of any fiscal consolidation scenario will always depend on the will of the people and their political representation. Fiscal responsibility should therefore be a part of a society-wide consensus, and hence should properly function within the conventional governmental institutions, such as finance ministries.

At the same time, however, fostering fiscal responsibility would benefit from services of an "expert council" offering an independent, forward-looking view of medium-term fiscal developments. Such a council could have the form of an independent "fiscal institute", functioning more as a think-tank than a procedural element of fiscal policy decision-making.

Box 2. Institutionalizing Fiscal Rules

The sustainability of fiscal policies – i.e., the long-term capacity to service debt – is under a permanent threat from the so-called "deficit bias". Democratically elected governments prefer public deficits to surpluses owing to the limited time spans, re-election pressures, and vested interests of their sponsors (Wyplosz, 2005).

Indeed, there is some – albeit inconclusive – empirical evidence of such a bias. IMF (2010) finds that fiscal adjustments are usually followed by recessions, which may explain the reluctance to undergo adjustments. Alesina (2010), on the other hand, studies fiscal adjustments after the Second World War, and – using a different definition of fiscal adjustment period than the IMF – finds that fiscal adjustments are not systematically followed by recessions. There are also theoretical arguments in favour of expansionary effects of a fiscal contraction, although the empirical evidence is scant, especially in the short to medium term.

Irrespective of the inconclusive empirical evidence, various fiscal rules have been designed to mitigate the effects of a deficit bias by constraining the fiscal behaviour of democratically elected governments. Such rules can be classified according to several criteria (see *e.g.* Wyplosz, 2005, or Kopits and Symansky, 1998). The most common is perhaps the distinction among the *(i)* budget deficit rules, *(ii)* debt rules, *(iii)* borrowing rules, and *(iv)* multi-annual spending limits.

Debt rules limit or target the stock of gross/net government liabilities as a proportion of GDP. Sometimes, the debt ceilings are binding. In the US, for instance, the debt ceiling is at the discretion of Congress. However, in practice, the effectiveness of such rules in removing deficit bias is eroded by frequent and flexible changes in the rules. A special category of debt rules are so-called "reserve rules", which target the stock of reserves of extra-budgetary contingency funds (such as social security funds) as a proportion of annual benefit payments.

Budget deficit rules take on various forms accentuating the balance between the overall, structural, and current revenues and expenditures. They typically stipulate limits on the (structural) deficit or permit borrowing only for capital expenditures (in the case of current revenues rules). Many such variants are practiced around the world. For instance, Switzerland pursues a balanced budget over the business cycle, Chile commits to a structural surplus of 1% of GDP, and the UK follows a golden rule under which the current budget must be in balance over the economic cycle as a whole. Typically, however, there are no sanctions imposed for breaching the rule. An exception is the Stability and Growth Pact in the European Union, which is a special case combining a deficit with a debt rule and which involves sanctions – that is at least in principle.

The borrowing rules stipulate limits on government borrowing from domestic sources, including the central bank. Sometimes, the limit is specified as a proportion of past government revenues or expenditures. Multi-annual spending limits – aside from fostering a fiscal discipline – are also used to limit the size of government per se. They try to avoid mismatches between growth in spending and revenues, such as in the Netherlands (Bos, 2007).

Since all the above rules (with the exception of the Stability and Growth Pacts) represent voluntary restrictions imposed by the government itself, they are a no guarantee against the deficit bias as such. Indeed, the frequency of changes to the US debt ceiling and the erosion of sanctions under the Stability and Growth Pact serve as examples of these shortcomings.

As a consequence of frequent transgressions of the rules, many countries have moved toward institutionalizing the rules, i.e., putting autonomous fiscal institutions in charge of enforcing them, in order to minimize political pressures and make the commitments credible.

Two types of such institutions – commonly referred to as fiscal boards – have been proposed or used in practice: fiscal policy committees and fiscal advisory bodies. While the former are seen as being equivalent to monetary policy committees, with binding powers over public spending or deficits, the latter act more as advisory bodies with regard to the direction and medium-term prospects of public finances.

There are many theoretical debates about the merits of each of these fiscal board types. The proponents of fiscal policy committees (FPCs) make an analogy to the success achieved by autonomous committees in charge of monetary policy (see *e.g.* Wyplosz, 2005 and 2008). They argue that satisfying the fiscal intertemporal budget constraint necessarily involves a redistribution between present and future generations, and as such should not be constrained by the powers of democratically elected governments. FPCs should protect future generations from the profligacy of present governments.

The proponents of fiscal boards as softer advisory bodies, on the other hand, argue that ultimately the will to comply with the rules and fulfil the fiscal commitments rests with the government (Hagemann, 2010). If FPCs' decisions are considered too restrictive, they will be disbanded with a detrimental effect on the credibility of fiscal policies, as happened in Hungary recently (OECD, 2012).

Furthermore, designing FPCs as monetary policy committees risks giving them a very narrow mandate of targeting a specific variable. While this is desirable for monetary policy, fiscal policy has many more objectives. The sole objective of FPCs should be to achieve fiscal sustainability, i.e., the ability to serve the debt (Calmfors, 2010). There are many paths of fiscal variables satisfying the intertemporal budget constraint, and the government alone should decide on the actual debt trajectory, according to its preferences, considering such factors as social efficiency, intergenerational equity, and the need for precautionary savings to cope with unexpected contingencies. The role of the FPC should then be to provide an assessment, whether government policy is moving fiscal balances closer ot further away from sustainability.

Main features of the model

This section explains the workhorse model equations and the economics behind them. A complete list of equations, observed variables, exogenous shocks, and parameters with their definitions can be found in the Appendix. The model was designed to meet the analytical requirements of medium-term fiscal experiments and, at the same time, to be easily operable. It falls into the family of semi-reduced form models with non-Ricardian and neo-Keynesian features and borrows many ideas and implications from dynamic stochastic general equilibrium (DSGE) models.

There are five basic building blocks in the model: fiscal policy (identities and transmission channels), monetary policy, supply side, demand side and nominal prices. In the main text we concentrate on the fiscal behavioural equations and their transmission to the rest of the economy. For full details of the other building blocks (monetary policy, supply and demand side) and identities (nominal prices, debt accumulation, external sector and exchange rate) we refer the reader to the full model code in the Annex 1.

Advantages and disadvantages of our modelling strategy

Our model is not a well specified DSGE model, which turns out to be one of its main advantages for a number of reasons. Firstly, it speeds up coding and changing model specifications according to practical needs. Secondly, it is much easier to bring such a model to a specific set of data. Thirdly, this kind of model can be more easily operated, as it abstracts from many details stemming from the insistence on micro-foundations in the DSGE literature. Moreover, the "right" specification of micro-foundations is often up for a debate. Notably, the current literature still struggles to match basic business cycle correlations, explain historically observed financial market premiums, observed real exchange rate trends, trade and re-exports. In addition, calibration of "deep" parameters in DSGE models is often ad hoc in the same way as in a semi-structural model.

However, there clearly are also disadvantages of the chosen modelling approach and given the nature of the paper (focus on fiscal indicators) they need to be flagged upfront. These can be summarized as follows. There are certain 'features of the model that ignore the nature of a shock and so further refinement of these features and parameters could be desirable, according to circumstances. For instance, the fiscal multiplier is fixed in our model, irrespective of the way the money are spent. However, we try to overcome this shortcoming by expertly relating the multiplier's size in every economy to two factors. Firstly, by considering the way how extra deficit is created, i.e. whether this comes from higher public investment (a higher multiplier) or higher social benefits (a lower multiplier), see Barrell *et al* (2012). Secondly, the size of the fiscal multiplier also depends on the position of the economy in the business cycle (Leeper, 2010) and its preference for imported durables versus domestic value added. For instance, a small open economy with a high import propensity and low import substitutability will have lower multipliers than a large closed economy (Barrel *et al*, 2012; Coenen, 2010). Other pre-determined features include the long-term responses of output growth, the real exchange rate and interest rate of public debt. In each case we try to calibrate the response according to our perception of the underlying causes.

Another serious limitation of our approach is the focus on aggregate fiscal variables, such as debts and deficits, and a complete neglect of the sources of revenues or expenditures that produce these deficits. This approach is motivated by our focus on the high level fiscal decisions that are crucial to fiscal sustainability: the decisions about the deficits and debts, while the decisions about individual fiscal instruments are secondary for this purpose. We are therefore not able to provide any guidance on fiscal policy instruments like taxation systems and direction of fiscal spending. However, a number of studies have found out that the composition of fiscal revenues and expenditures is an important factor of the success and durability of fiscal consolidations (*e.g.* Sutherland *et al*., 2012, Barrel *et al*, 2012). We abstract from these effects.

Fiscal Policy

The behaviour of the fiscal authority in the model consists of several decisions: a target level of debt, a fiscal rule representing a systematic behaviour of the structural deficit, ad hoc discretionary changes in primary deficits, and currency and maturity composition of new debt. These four variables represent the fiscal instruments/levers that a policymaker can use in influencing the properties of fiscal consolidation programs.

The deficit is set so that the debt-to-GDP ratio converges to some target. This is done by splitting the deficit dynamics into two levels. In the first level the deficit deviates from a structural deficit by the effect of automatic stabilizers and a transitory deviation from target debt. In the second level, the structural deficit slowly accommodates to the changes of a theoretical deficit consistent with the debt target and nominal income expectations. Finally, the shares of newly allocated debt to the different maturities and currencies are additional instruments fine tuning the properties of a medium-term fiscal strategy.

The basic policy lever in the model is the decision about the level of structural deficit - sd_t. It is assumed to slowly converge to a long-run sustainable deficit sd_t^{tar}(see later), according to the following fiscal rule:

$$sd_t = a_t^{sd} \cdot (sd_{t-1} + f_4 \cdot \widehat{NY}_t) + (1 - a_t^{sd}) \cdot sd_t^{tar} + \sigma_{sd} \cdot \varepsilon_t^{sd} \tag{1}$$

This convergence assumes systematic fiscal policy which makes sure that the structural deficit is close to sustainable levels (represented here by a variable sd_t^{tar}). The convergence can be disturbed by the fiscal policy's preference for either pro-cyclicality or counter-cyclicality using $f_4 \cdot \widehat{NY}_t$. The sign of f_4 decides whether fiscal policy is pro- or counter-cyclical. Furthermore, the fiscal authority can adjust the trajectory of structural deficits through ad hoc adjustments – $\sigma_{sd} \cdot \varepsilon_t^{sd}$. The speed of convergence governed by a_t^{sd} can be adjusted according to the debt size. We explain this non-linear feature later on.

The long-run structural deficit, or a sustainable deficit, sd_t^{tar} is the level of deficit consistent with a particular level of debt b_t^{tar} and nominal income growth expectations, $\Delta^e ny_t$:

$$sd_t^{tar} = b_t^{tar} \cdot (1 - 1/exp\,(\Delta^e ny_t/100)) \tag{2}$$

We interpret b_t^{tar} as a long-term debt target, either explicitly or implicitly. Sustainable deficits are such that keep the actual debt on the target level. However, on their own, they do not guarantee that the target debt level will be achieved, if the initial level of debt is higher (or lower) than the target level.

The target level of debt is a policy choice variable. However, when estimating such hypothetical debt target levels in countries which formally do not have such targets, we use a general random-walk specification:

$$b_t^{tar} = b_{t-1}^{tar} + \sigma_{b^{tar}} \cdot \varepsilon_t^{b^{tar}} \tag{3}$$

Given the target debt level, an upward revision in nominal income growth leads to a higher long-run sustainable structural deficit $\mathrm{sd}_t^{\mathrm{tar}}$, as fiscal policy may afford running higher deficit, since the past debt is cancelled by the higher growth. The formulation of (2) comes from the debt accumulation identity:

$$b_t = d_t + b_{t-1}/\exp((ny_t - ny_{t-1})/100) + \sigma_b \cdot \varepsilon_t^b\ . \tag{4}$$

The debt accumulation equation expresses everything in ratios to the nominal GDP and therefore the previous period debt must be offset by nominal growth. The equation is not an identity in a strict sense – it has a residual term $\sigma_b \cdot \varepsilon_t^b$, which is necessary to explain the discrepancy between the observed debt and deficit data.[3] The sustainable deficit is derived by solving this equation in the steady state. Actual growth of nominal income is replaced by expectations in (2) to account for possible myopic illusion of high nominal income growth driving current fiscal behaviour.

Having defined the path of the structural deficit, the actual deficit (d_t) will deviate from the structural deficit by the effect of automatic stabilizers and other temporary fiscal discretions:

$$d_t = sd_t - f_1 \cdot \hat{y}_t - f_2 \cdot b_t^{dev} + \sigma_d \cdot \varepsilon_t^d \tag{5}$$

where $f_1 \cdot \hat{y}_t$ measures the effect of automatic stabilizers throughout the business cycle using the output gap $\hat{y}_t$ as an estimate of the business cycle. In addition, we add a term reacting to the deviation of future debt levels from the target debt, $f_2 \cdot b_t^{dev}$, helping to achieve convergence of debt to the debt target. This term assumes a systematic and responsible fiscal policy will adjust deficits more forcefully, if the target level of debt is far away. Finally, the shock term $\sigma_d \cdot \varepsilon_t^d$ provides room for temporary discretion that is not captured by the systematic rules in (5) and (1).

The sum of all discretionary elements in the decisions about the debt target, structural and actual deficits define what we call a fiscal impulse, d_t^{imp}. We use the impulse elsewhere in the model in describing the short-run effects of fiscal policy on output. The impulse contains all the active movements in the deficit to GDP ratio. These include the innovation to the deficit to GDP ratio (discretionary shock), a shock to the structural deficit and the shock to debt target:

$$d_t^{imp} = \sigma_d \cdot \varepsilon_t^d + \sigma_{sd} \cdot \varepsilon_t^{sd} + 0.4 \cdot \sigma_{b^{tar}} \cdot \varepsilon_t^{b^{tar}} \tag{6}$$

[3] The discrepancy in the data stems from the valuation effects of gross debt and the change of the stock of gross assets.

Finally, the remaining fiscal instruments include the choice of maturity and currency composition of the newly issued debt. We take a simplifying assumption that the newly issued debt can be allocated into 1Y, 3Y, 10Y domestic currency papers, and into 5Y foreign currency (FCY) paper. In the model these choices are expressed in terms of shares of new debt ($h_t^{1Y}, h_t^{3Y}, h_t^{10Y}$ and h_t^{fcy}). By default, they are modelled as random walks, but can assume any other form depending on the policies applied:

$$h_t^{1Y} = h_{t-1}^{1Y} + \sigma_{h_1} \cdot \varepsilon_t^{\mathrm{h1}} \tag{7}$$

$$h_t^{3Y} = h_{t-1}^{3Y} + \sigma_{h_3} \cdot \varepsilon_t^{h3} \tag{8}$$

$$h_t^{10Y} = h_{t-1}^{10Y} + \sigma_{h_{10}} \cdot \varepsilon_t^{h10} \tag{9}$$

The rest of the new debt is allocated in a 5Y FCY paper.

$$h_t^{fcy} = 1 - h_t^{1Y} - h_t^{3Y} - h_t^{10Y} \tag{10}$$

Fiscal Policy Transmission and Feedback Loops

The fiscal policy decisions have both short and long-term effects on the rest of the model economy. The short-term (Keynesian) effect on domestic output works through the fiscal impulse entering the output gap equation:

$$\hat{y}_t = k_1 \cdot E_t[\hat{y}_{t+1}] + k_2 \cdot \hat{y}_{t-1} - k_3 \cdot (lr_t - \overline{lr_t}) + k_4 \cdot \hat{z}_t + k_5 \cdot \widehat{y_t^*} + k_6 \cdot d_t^{imp} + \sigma_{\hat{y}} \cdot (\varepsilon_t^{\hat{y}} + \gamma_{g,\hat{y}} \cdot \varepsilon_t^{g}) \tag{11}$$

This equation is a standard New-Keynesian formulation of the IS curve, featuring the leads and lags of the output gap, the deviation of real interest and real exchange rates from their long-term trends ($lr_t - \overline{lr_t}$ and $\hat{z}_t$ respectively), the foreign output gap $\widehat{y_t^*}$, and the fiscal impulse d_t^{imp}.

In the long-term, fiscal decisions also affect real interest and exchange rates, and output growth. These non-Ricardian effects of fiscal policy are captured through the effect of the debt on various risk and term premiums in the model. First, the term and currency premiums (modelled as AR(1) processes about a steady state) are sensitive to the debt level:[4]

$$tprem3_t = \rho_{tprem3} \cdot tprem3_{t-1} + (1 - \rho_{tprem3}) \cdot (tprem3_{ss} + \mathrm{p}_1 \cdot (\mathrm{b_t} - \mathrm{b_{ss}^{tar}})) + \sigma_{tprem3} \cdot \varepsilon_t^{tprem3} \tag{12}$$

$$prem_t = \rho_{prem} \cdot prem_{t-1} + (1 - \rho_{prem}) \cdot (prem_{ss} + \mathrm{p}_4 \cdot (\mathrm{b_t} - \mathrm{b_{ss}^{tar}})) + \sigma_{prem} \cdot \varepsilon_t^{prem} \tag{13}$$

[4] $tprem3$ measures the term premium between a 3Y and a 1Y paper. A similar equation exists for a 10Y paper.

Both these premiums affect the long-term real interest rate via two channels: the term premium by shaping the slope of the real yield curve and the currency premium by affecting the trend level of real interest rates. For instance, the 3-year real interest rate is defined as:

$$r3_t = 1/3 \cdot (r_t + E_t[r_{t+1}] + E_t[r_{t+2}]) + tprem3_t, \tag{14}$$

(15)

and the trend of short-term real interest rates is given by the real exchange rate parity equation as:

$$\bar{r}_t = E_t[\bar{z}_{t+1}] - \bar{z}_t + \bar{r}^*_t + prem_t \ .$$

The expected change in long-term real interest rates ($\Delta\overline{lr}_t$) is the source of a crowding out effect on economic potential ($\bar{y}$):

$$\bar{y}_t = \bar{y}_{t-1} + g_t - p_5 \cdot \Delta\overline{lr}_t/8 + \sigma_{\bar{y}} \cdot \varepsilon^y_t \tag{16}$$

Potential output growth is driven by the long-term growth rate g_t modelled as an AR(1) process (equation (55) in the appendix) and the effects of crowding out of capital.[5] If the long equilibrium real rates increase ($\Delta\overline{lr}_t > 0$), then the marginal productivity of capital increases, which is consistent with a lower level of capital. The lower level of capital translates, in this model, into a lower level of potential output. The change in long-term real interest rate ($\Delta\overline{lr}_t$) captures the effect of term and currency premiums above.

The second long-term effect of a government debt is on the real exchange rate. In the model, the real exchange rate depends on the level of government debt, as higher interest costs of higher debt needs to be balanced (in the long run) by a better trade balance, which is consistent with a relatively depreciated real exchange rate. Otherwise, the equilibrium real exchange rate changes by the exogenous growth rate g^z_t modeled as an AR(1) process around a non-zero steady state as:

$$\bar{z}_t = \bar{z}_{t-1} + g^z_t + p_3 \cdot (b_t - b_{t-1}) \tag{17}$$

Systematic fiscal policy reaction

In summary, the fiscal authority in the model responds systematically to the following variables: the output gap ($\hat{y}_t$), the deviation of a debt to the target (b^{dev}_t), and nominal income growth – expected and actual ($\Delta^e ny_{t+1}$ and $\widehat{NY}_t$). Besides, it makes discretionary decisions about the level of the debt target (b^{tar}_t), and structural and total deficits (sd_t and d_t).

$$d_t = sd_t - f_1 \cdot \hat{y}_t - f_2 \cdot b^{dev}_t + \sigma_d \cdot \varepsilon^d_t \tag{18}$$

$$sd_t = a^{sd}_t \cdot (sd_{t-1} + f_4 \cdot \widehat{NY}_t) + (1 - a^{sd}_t) \cdot sd^{tar}_t + \sigma_{sd} \cdot \varepsilon^{sd}_t \tag{19}$$

[5] Potential output is driven by two kinds of shocks. The direct impact in equation (54) (see Annex 1) is a level shock $\sigma_y \cdot \varepsilon^y_t$ which represents a permanent technology improvement. The indirect impact through long-term growth rate (g_t) has a growth rate shock capturing lasting gradual improvements of the potential. This changes prospects of future nominal income and for the given target debt, it causes a revision in the sustainable level of deficits. This will trigger a change in the behaviour of the government. If this shock is offset either by the level shock or the growth rate shock in the next period, then it simulates an effect of an expectation shock.

$$sd_t^{tar} = b_t^{tar} \cdot (1 - 1/exp\,(\Delta^e ny_t/100)) \tag{20}$$

$$\Delta^e ny_t = 0.2 \cdot (ny_t - ny_{t-1}) + 0.8 \cdot E_t[\Delta^e ny_{t+1}] \tag{21}$$

$$b_t^{dev} = 0.2 \cdot (b_t - b_t^{tar}) + 0.8 \cdot E_t[b_{t+1}^{dev}] \tag{22}$$

$$b_t^{tar} = b_{t-1}^{tar} + \sigma_{b^{tar}} \cdot \varepsilon_t^{b^{tar}} \tag{23}$$

Monetary Policy

The model features standard New-Keynesian monetary policy mechanisms. These mechanisms incorporate various monetary and exchange rate regimes – from inflation targeting (IT) in the Czech Republic to a hard peg of Austria. The key equations in the monetary block are those governing the behaviour of short-term money market rates (the Taylor rule (24)) and the exchange rate (the UIP condition, 25):

$$i_t = u_1 \cdot i_{t-1} + (1 - u_1) \cdot (\overline{r_t} + \pi_t^{tar} + u_2 \cdot (E_t[\pi_{t+1}^{cpi}] - E_t[\pi_{t+1}^{tar}]) + u_3 \widehat{y_t}) + \sigma_i \cdot \varepsilon_t^i \tag{24}$$

$$i_t = E_t[\Delta \mathrm{s}_{t+1}] + i_t^* + prem_t + \sigma_s \cdot \varepsilon_t^s \tag{25}$$

Jointly these equations describe monetary policy in an IT regime, such as in the Czech Republic, or in the Eurozone whose monetary policy is assumed to be close to IT.[6] Monetary authority adjusts the short-term market interest rates (i_t) in response to the expected deviation of inflation from the target (π_t^{tar}) and the output gap. The exchange rate then freely floats responding to the relative interest rate differential and the risk premium. We apply this approach to the Czech Republic and Germany.

For credible pegs (Austria), the Taylor rule is replaced by an equation specifying a constant exchange rate ($\Delta \mathrm{s}_t = 0$). The UIP condition in such cases defines the level of the domestic interest rates on the basis of foreign interest rates and the risk premium.

Inflation is governed by a Phillips curve – its default linear version looks as follows:

$$\pi_t^{cpi} = e_1 \cdot \pi_t^{e,cpi} + (1 - e_1 - e_2) \cdot \pi_{t-1}^{cpi} + e_2 \cdot \pi_t^{imp} + e_3 \cdot \widehat{y_t} + \sigma_\pi \cdot (\varepsilon_t^\pi - \gamma_{\bar{y},\pi} \cdot \varepsilon_t^y) \tag{26}$$

Inflation's main driving factors are expectations ($\pi_t^{e,cpi}$), imported inflation (π_t^{imp}) and the output gap ($\widehat{y_t}$) as a proxy for demand pressures and marginal costs. For policy experiments involving the interactions between monetary and fiscal policy we make the relationship between inflation and output non-linear (see later).

[6] We ignore the more recent modifications and innovations of monetary policy since the crisis. We believe our modelling of the monetary policies in Austria as a hard peg and in Germany as an IT are good enough approximations in a long-term horizon.

Non-linear elements of the model

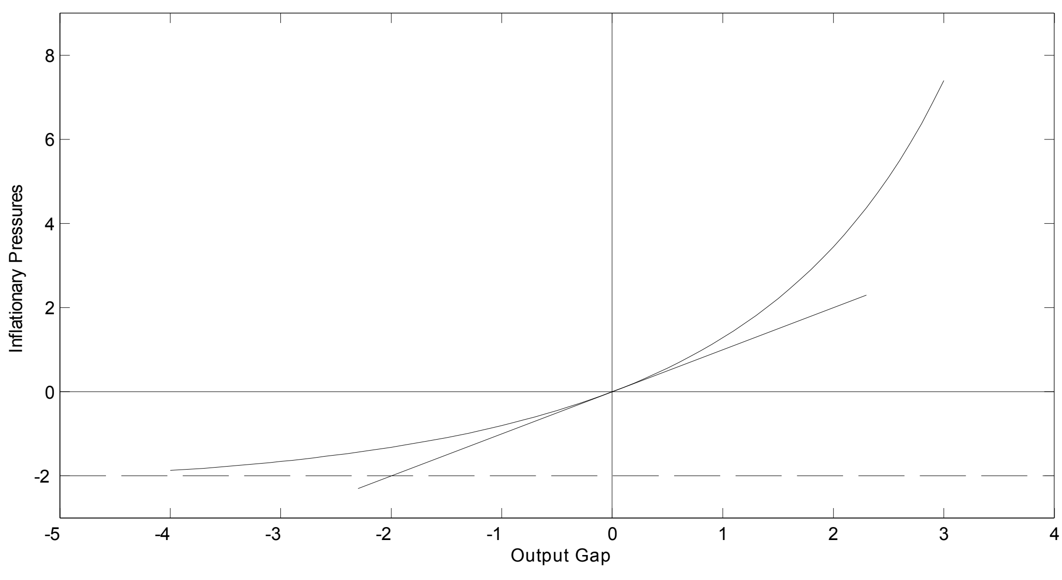
While the model is mostly linear, it is extended by several policy important non-linear relationships: a convex Phillips curve, the zero interest rate floor, and the sensitivity of the structural deficit convergence to the level of debt. The first two of these non-linear features relate to monetary policy and provide an important realism to experiments involving a possible monetary policy response to fiscal issues, such as a temporary increase in the inflation target or the impossibility to counter/accommodate fiscal induced contraction at close-to-zero rates. The non-linearity in the rule for the structural deficit brings in a likely reaction of financial markets, when the debt is too high, forcing a faster consolidation.

Convexity of the Phillips curve

The linear version of the Phillips curve (26) is extended by replacing $e_3 \cdot \widehat{y_t}$ with $e_3\left(1+\left(\frac{\gamma_{up}}{\gamma_{lo}}-1\right)e^{\widehat{y_t}/10}\right)\frac{\gamma_{lo}\widehat{y_t}}{\gamma_{up}-\widehat{y_t}}$. The new term introduces a convex response of inflationary pressures to the output gap as depicted in Figure 1).

The motivation for this extension is an asymmetry of the price pressures induced by excess demand, when prices tend to increase faster than they tend to fall in excess supply of the same degree. This implies that running temporarily higher inflation has real costs.

Figure 1: Non-convex Phillips curve



Source: Authors' calculations

The convex term in Figure 1 has the following properties. The left part of the curve converges to -2 as the output gap goes to minus infinity. The right part goes asymptotically to plus infinity as the output gap approaches + 6 percent. The tangent at zero has a derivative equal to one so that the linear approximation of the term multiplied with coefficient e_3 is equivalent to the linear version of the model $e_3 \cdot \widehat{y_t}$.

Zero interest rate floor

The zero interest rate floor extension replaces the Taylor rule with the following equation

$$i_t = smax(u_1 \cdot i_{t-1} + (1 - u_1) \cdot (\overline{r_t} + \pi_t^{tar} + u_2 \cdot (E_t[\pi_{t+1}^{cpi}] - E_t[\pi_{t+1}^{tar}]) + u_3 \widehat{y_t}) + \sigma_i \cdot \varepsilon_t^i, 0) \qquad (27)$$

where $smax$ is a smooth approximation of the max operator. A similar thing is done for the equation defining the foreign nominal interest rates: its linear equation (39) (see Annex 1) is replaced with

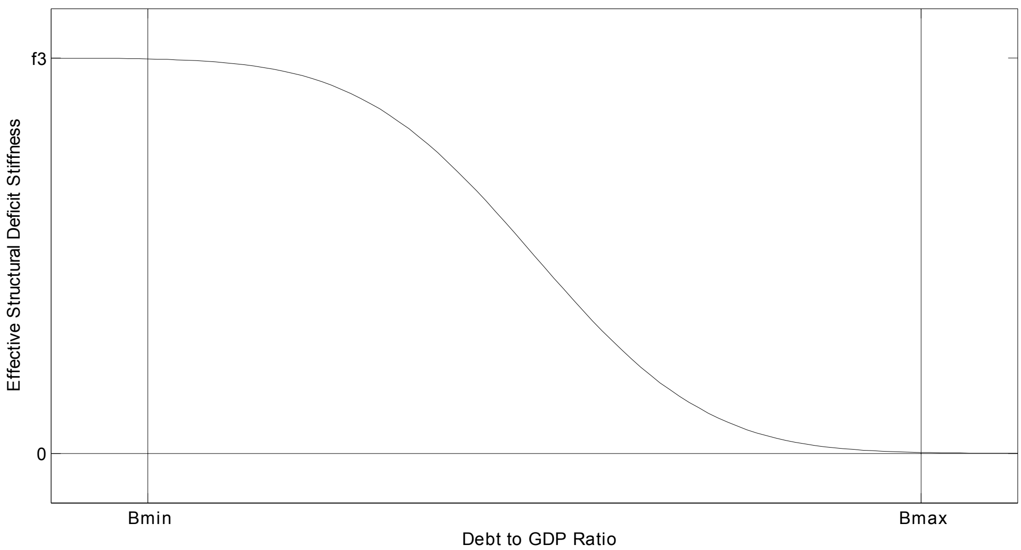
$$i_t^* = smax(r_t^* + E_t[\pi_{t+1}^*], 0.5) \qquad (28)$$

In this case we do not allow the foreign interest rate to go below 0.5 percent per annum, as the main ECB's policy rate seemed (at the time of the writing) to have an implicit floor of 1 percent per annum.

Non-linear speed of adjustment in the structural deficit rule

We assume that if the debt-to-GDP ratio increases above some levels, there is an increasing pressure from financial markets and international organizations to accommodate structural deficits faster to the sustainable levels consistent with growth expectations and the debt target. In normal times, the pace of the structural deficit (sd_t) accommodation to the structural deficit consistent with fundamentals (sd_t^{tar}) is governed by coefficient a_t^{sd} as in equation (1). In order to model this non-linearity we make a_t^{sd} depend on the debt to GDP ratio. The function is depicted in Figure 2.

Figure 2: Structural deficit stiffness



Source: Authors' calculations

For debt less than $Bmin$, a_t^{sd} is constant. If the debt to GDP ratio increases, then the coefficient approaches zero, and for the debt higher than $Bmax$ it is zero. This means that the structural deficit will be equal to the structural deficit consistent with the fundamentals.

Interpreting recent economic data

The model has been, for purely presentational purposes, applied to the data of Austria, the Czech Republic and Germany[7]. We use the Kalman smoothing technique in which a linearized form of the model is connected with the observed data and the unobserved components and shocks are estimated using the maximum likelihood method. In other words, the Kalman smoother searches for the most likely historical realization of unobserved variables and shocks (including the very initial period) so that the model equations would hold and the observed variables would equal to the observed values. Note that the number of shocks is greater than the number of observed variables. The observable series in each country model are listed in Annex 3.

This Kalman filtering method is conditioned by the calibrated parameters as described in Annex 2. The parameters were calibrated, including the relative size of the shock's standard deviations. However, the overall uncertainty of the model's fit to data has been estimated by the maximum likelihood method.

Estimating debt targets

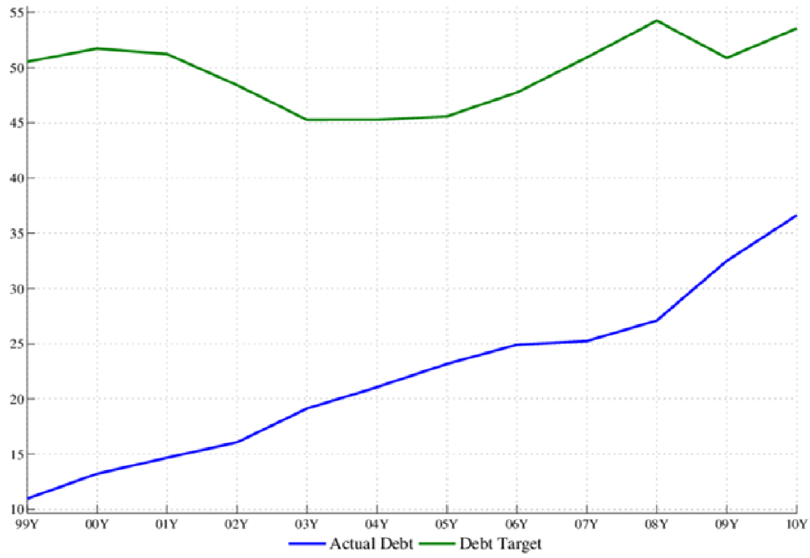
The model allows for estimating hypothetical debt targets and sustainable structural deficits that would have been consistent with the observed fiscal behaviour (and other observed data). By comparing these estimates to the actual evolution of fiscal variables we can infer about sustainability of current fiscal policies.

The absence of long-term debt-anchoring fiscal policies is the most visible in the Czech Republic, despite having the lowest debt levels (Figure 3). The model-estimated debt targets for Austria and Germany have been stable (and decreasing in the case of Germany) and close to the actual debt levels (Figure 4 and Figure 5). On the other hand, the Czech fiscal behaviour in the last decade has corresponded to a much higher debt target (not far from that of Austria and Germany) than the observed low debt levels would suggest. Figure 3 also shows that the estimated debt target was far above the actual (and rising) debt in the last decade. For Austria, the estimated debt targets were relatively stable, but above the EU's Stability and Growth Pact benchmark of 60% of GDP. In the case of Germany, the model interprets the historical data as if there would have been a declining debt target in the last decade.

[7] Results of these model simulations do not necessarily coincide with positions of the OECD secretariat, the Secretary General or OECD member countries. The full responsibility of authors applies and any mistakes or mis-interpretations are their exclusive responsibility.

Figure 3: Czech Republic - Debt and Debt Target

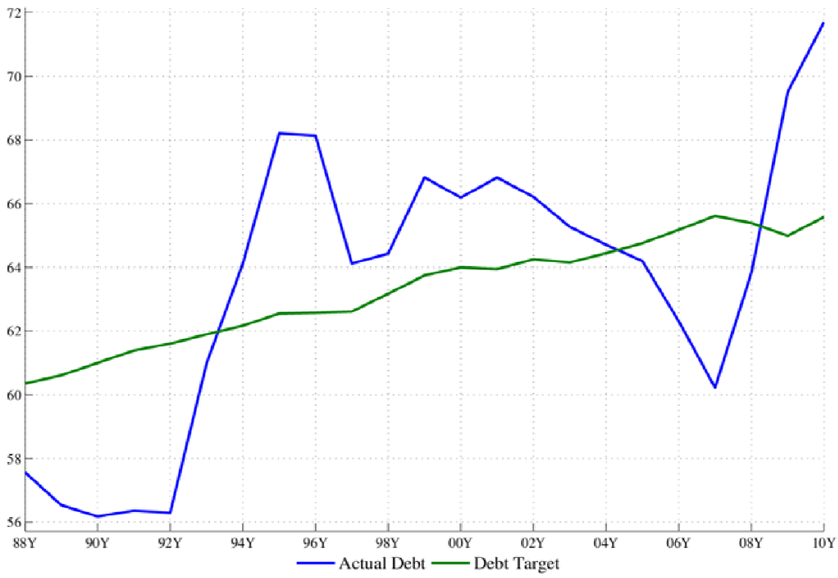
% of GDP



Source: Authors' calculations

Figure 4: Current debt levels for Austria - higher than the estimated target, implying a need for a short-term fiscal restriction

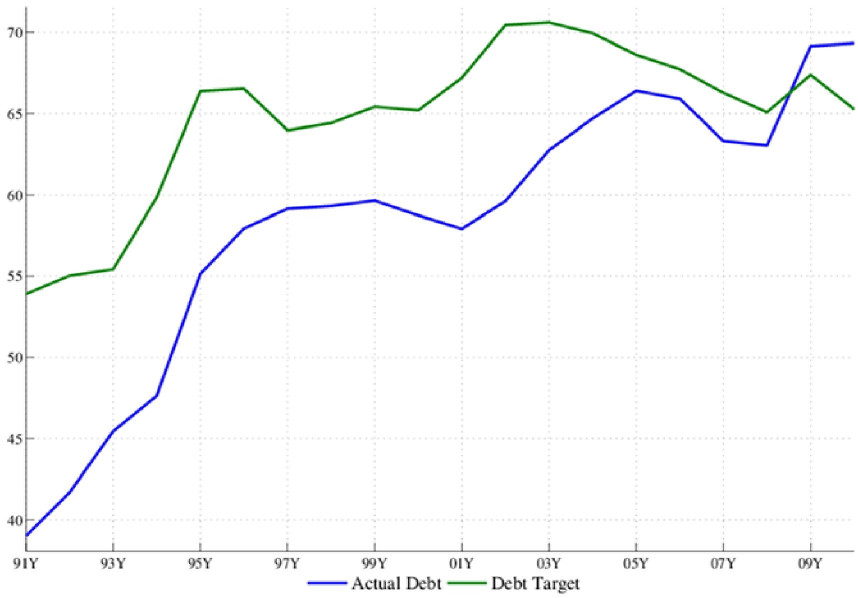
% of GDP



Source: Authors' calculations.

Figure 5: German debt levels rising and above the 60% benchmark

% of GDP



Source: Authors' calculations.

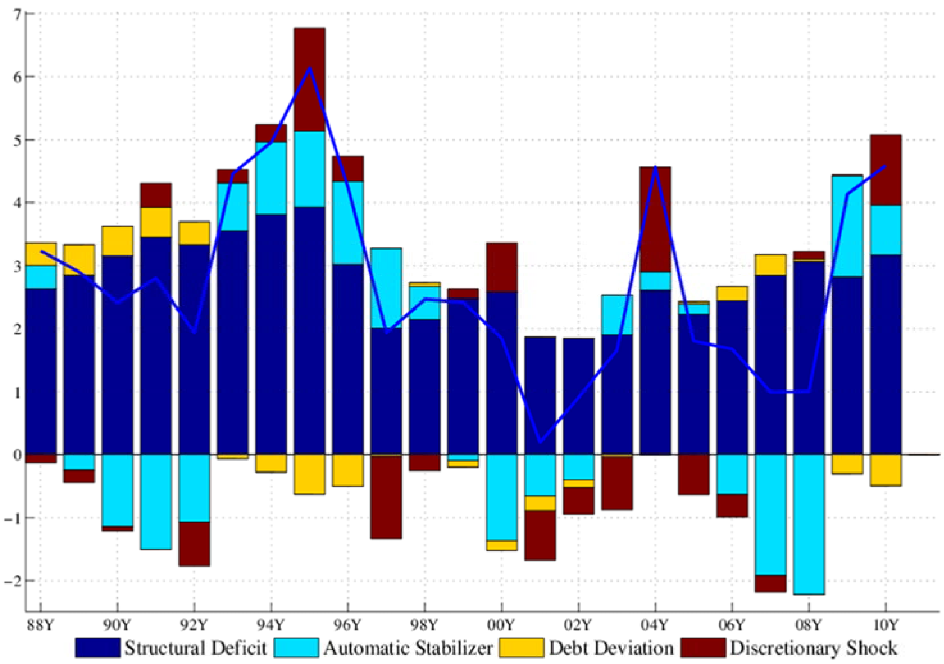
Reaction to crisis

The model can also be applied to interpret the fiscal behaviour and its short-term and long-term implications during specific periods of time. Of particular interest is the reaction of fiscal policy to the financial crisis of 2008-9.

All three economies responded to the financial crisis by a mix of short-term fiscal expansion and medium-term austerity. The estimates of debt targets declined during the crisis, reflecting a drive for a medium-term fiscal consolidation (illustrated in Figures 3, 4 and 5 above). Austria and the Czech Republic applied short-term discretionary stimuli on the top of automatic stabilizers, which helped in smoothing the impact of the crisis on the real economy (see Figures 7 and 10 for the Czech Republic and Figures 6 and 9 for Austria).

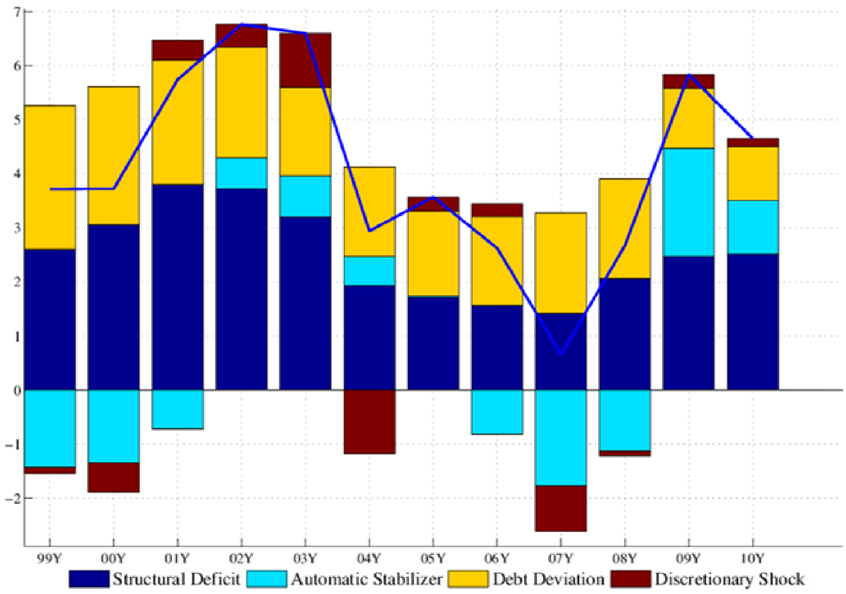
On the other hand, Germany applied a short-term discretionary restriction to reduce the deficits that were being driven up by the impact of automatic stabilizers (Figures 8 and 11). Unlike Austria and the Czech Republic, Germany therefore did not use additional fiscal levers to alleviate its economy of the crisis pressure. As the German economy consistently outperformed most other economies, this observation hints at the likely presence of non-Keynesian effects of fiscal consolidation.

Figure 6: In Austria- high total deficit a product of automatic stabilizers and small discretion



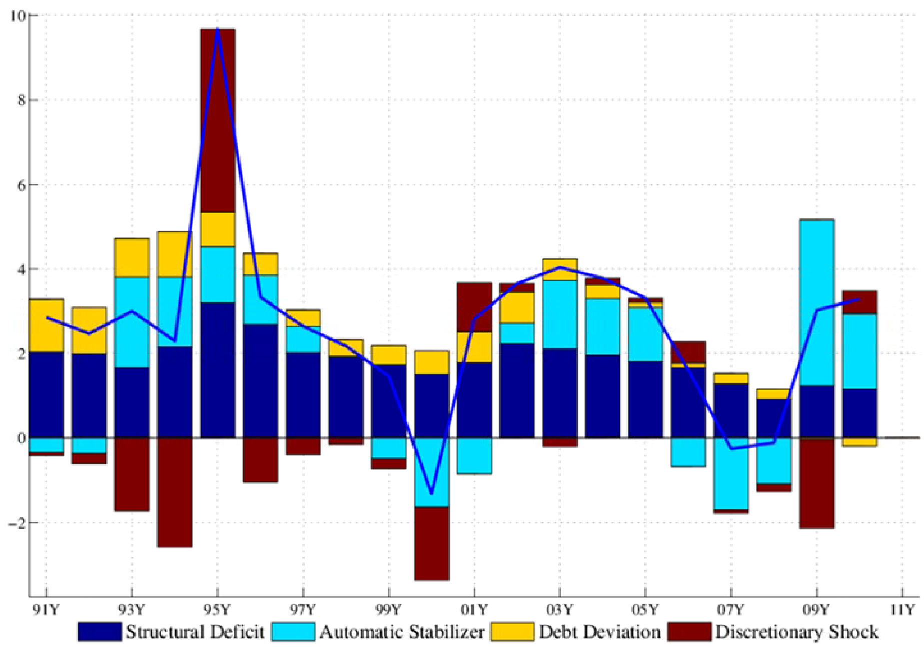
Source: Authors' calculations.

Figure7: Czech Republic - Combined effect of ad hoc fiscal impulses an important stabilizer during the crisis



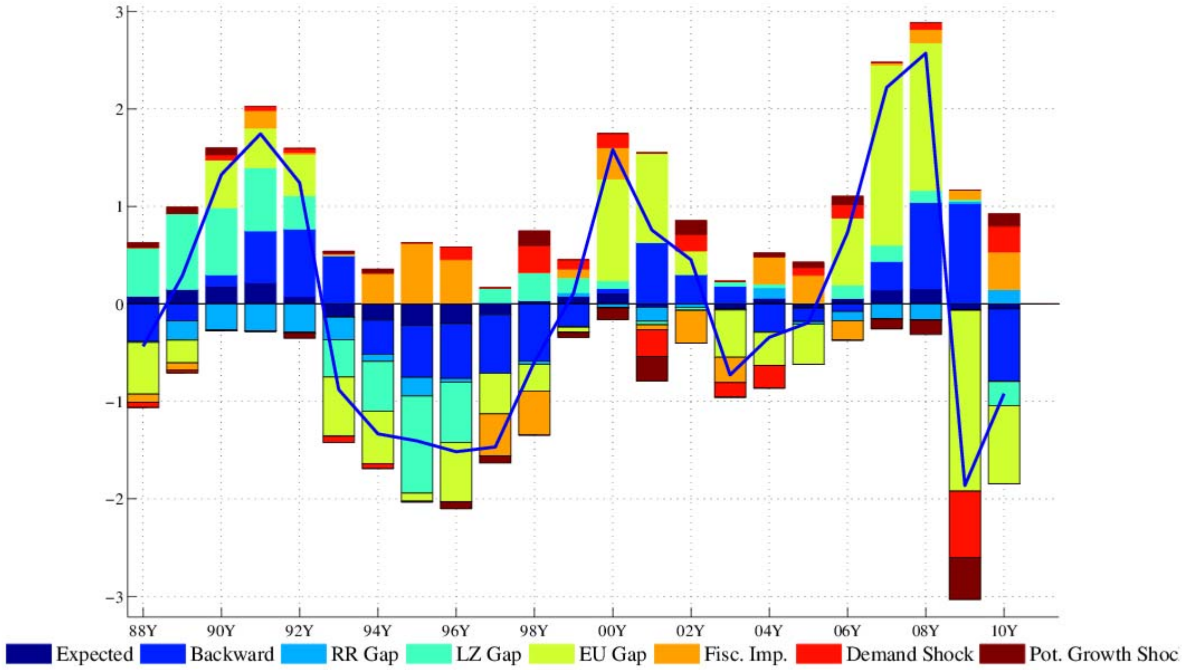
Source: Authors' calculations.

Figure 8: Germany - Short-term austerity at work even during the crisis



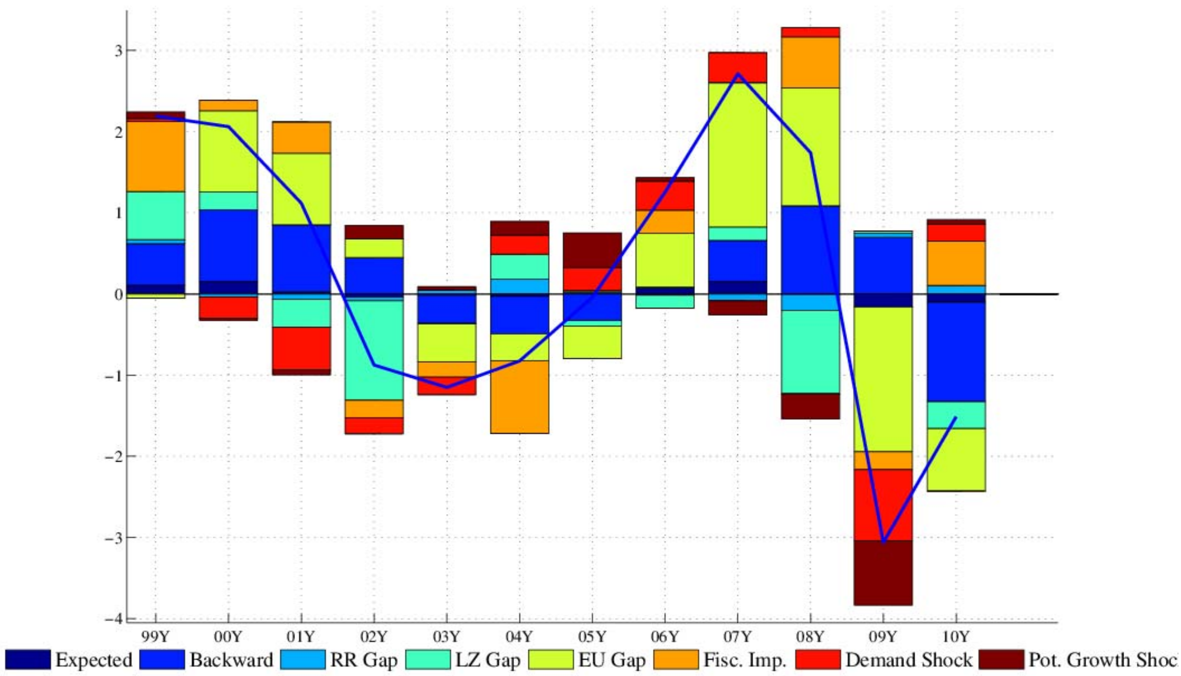
Source: Authors' calculations.

Figure 9: Austria



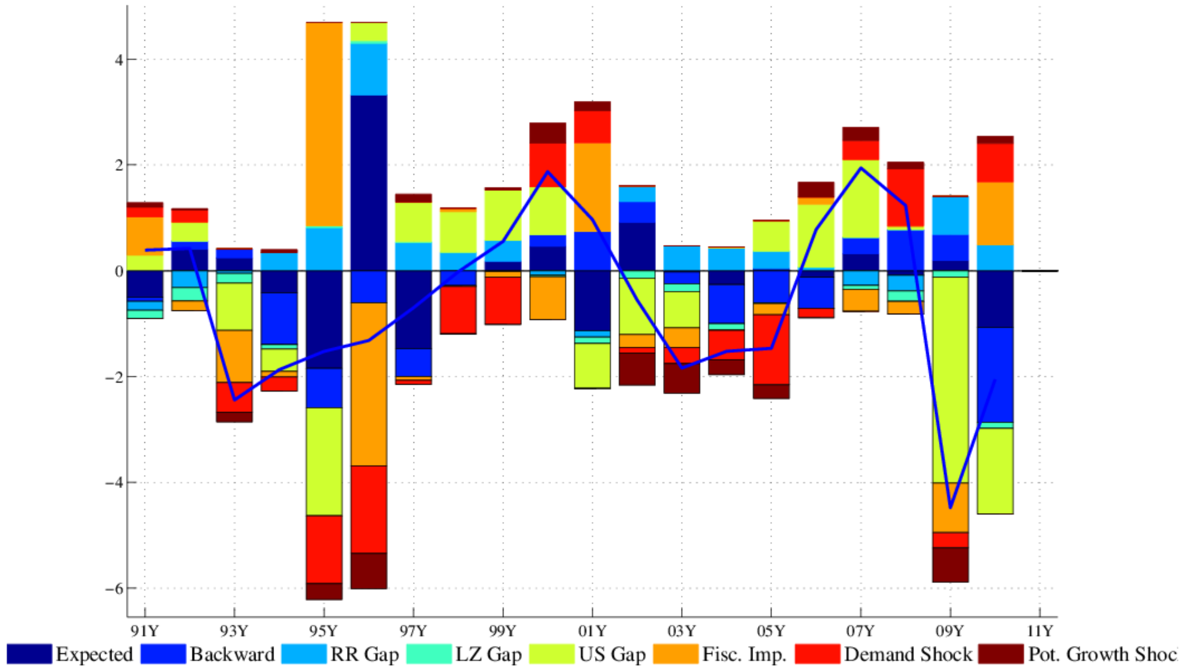
Source: Authors' calculations.

Figure10: Czech Republic



Source: Authors' calculations.

Figure 11: Germany



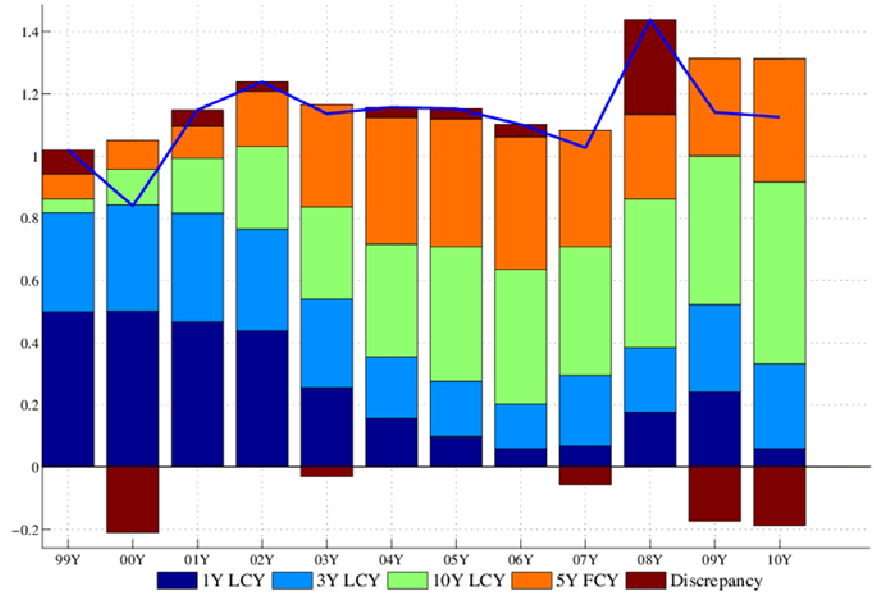
Source: Authors' calculations.

Fiscal vulnerabilities

The model's application to data has revealed several important features that make the fiscal position in each country vulnerable to future shocks.

Germany is the most exposed to the roll-over risk on short-term debt and also has a sizeable share of non-securitized debt (NSD). On the other hand, Austria and the Czech Republic have been increasing the maturity of the debt, and Austria has also reduced the share of its NSD. The Czech Republic is becoming more vulnerable to the exchange rate risk due to the increasing foreign exchange component of its debt (Figure 12).

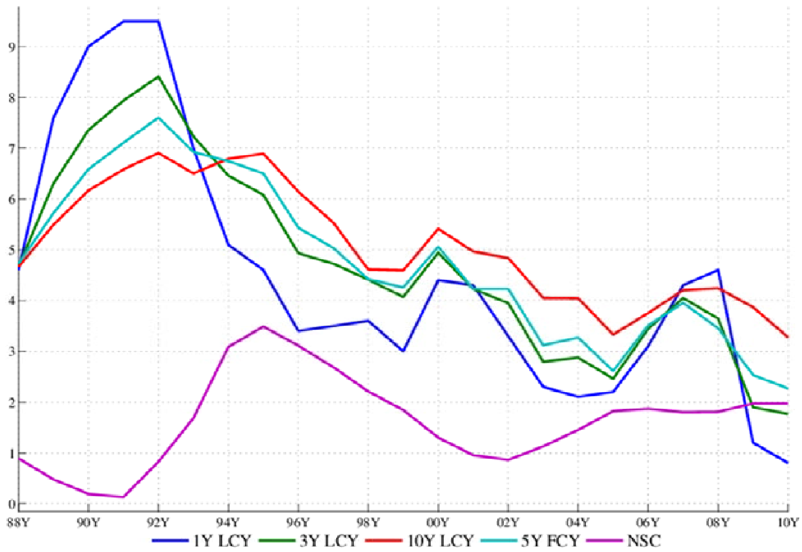
Figure 12: Czech Republic - interest costs reflect the growing duration and euroization of debt



Source: Authors' calculations.

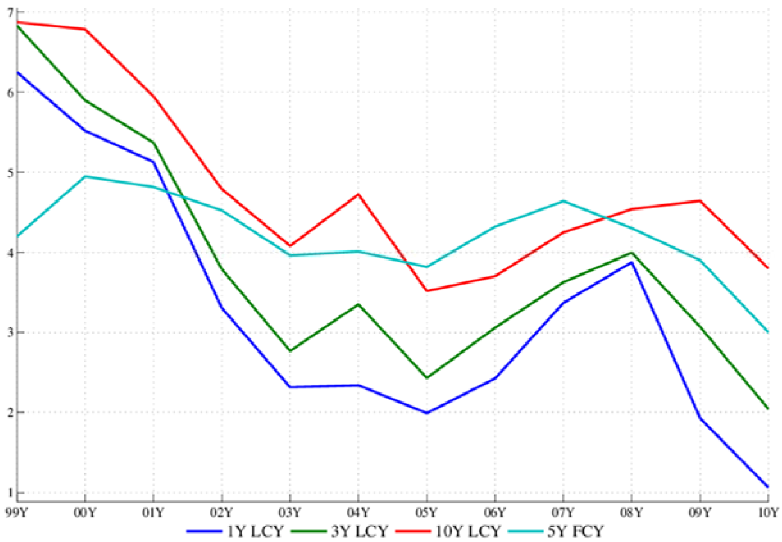
Austria and the Czech Republic face a serious risk of debt interest rates exceeding nominal income growth in the future, which could adversely affect their fiscal consolidation efforts. This is because in the coming years the slowdown of nominal income growth in both countries is highly likely, owing to protracted low inflation and an expected reduction in labour supply growth (Figures 13 and 14). Moreover, the interest rate premiums paid on debt in both countries are likely to increase in the future from the very low recent levels. In the Czech Republic, because of unsustainable fiscal policies, in Austria, because of high debt levels and evaporation of the premium reducing EMU effect.

Figure 13: Austria - effective interest rate still below expected nominal GDP growth, although the balance is fragile



Source: Authors' calculations.

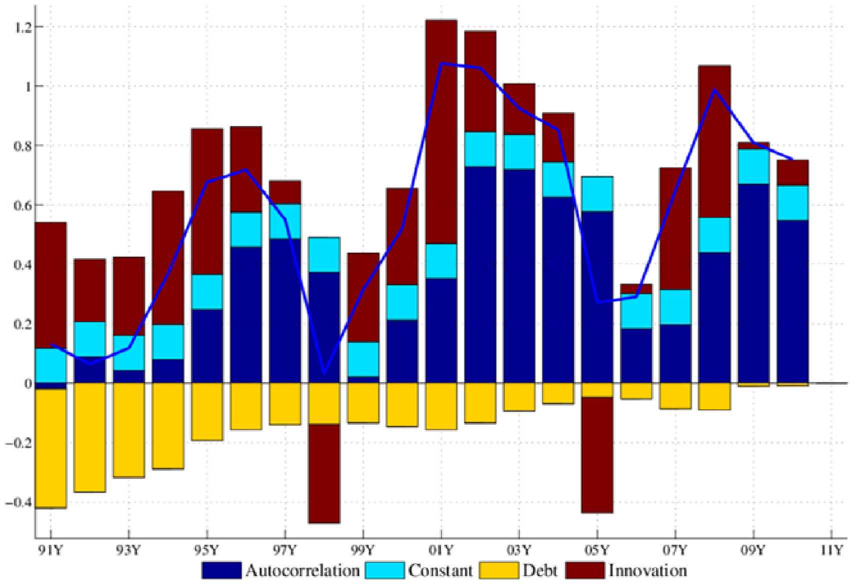
Figure 14 Czech Republic - effective interest rates below nominal GDP growth, but term premiums increasing recently



Source: Authors' calculations.

Germany, on the other hand, is partially sheltered from this risk because of the extremely low (occasionally negative) risk premiums it pays on its debt – thanks to the flight-to-quality and fiscal risk elsewhere in the euro area (Figure 15).

Figure 15: Germany - Fall in risk premiums an ad hoc factor working despite high debt levels



Source: Authors' calculations.

Fiscal scenarios and stress-tests

Going forward, the economies can adjust their fiscal behaviour in a number of ways. These involve a fall in the long-term debt-to-GDP target ratios, changing the maturity and currency composition of the debt and applying various fiscal rules for its structural deficits (alongside discretionary changes in primary deficits). In our experiments we have focused on changes in the debt target ratios and fiscal rules.

For each economy we construct a baseline scenario and simulate the confidence bands around it. This exercise alone provides a basic fiscal stress test, as it shows how the baseline scenario (which is, in our view, the most likely future development) is robust under different shocks.

For the German and Austrian economies the baseline scenario is built on the assumption that the currently estimated debt targets of about 65% will be preserved in the future. This is motivated by the strong fiscal record of these economies that have kept their debt levels around this level for a long-period. However, unlike Germany which has ultra-low risk premiums, Austria is facing a serious risk of a slowdown in nominal output growth and rising risk premiums. We therefore also construct an alternative debt-consolidation scenario for Austria in which the debt target declines to 40% of GDP, which is lower than the 50% target assumed in long-term OECD projections for its member countries (Sutherland *et al*, 2012).

For the Czech economy, on the other hand, we construct a baseline with the target debt level of 30% GDP – down by about 10 pp from the current level and 25 pp from the estimated current target level. In the Czech case the need for long-term fiscal consolidation is overwhelming and we therefore set our baseline as a debt consolidation scenario, which is not, nonetheless, very ambitious. Yet, it will imply a large change in policies in order for the target level of debt to drop from 55% of GDP today to 30% in 2030.

The forecasts are evaluated on the horizon from 2011 to 2030. The last observed data points are from 2010, but for each country we condition the forecasts also on the now-cast information about 2011 and beyond, and on the forecast for the external sector variables till 2014.[8]

For each forecast variable we also compute (non-linear) confidence bands so that we can examine how the distributions of the variables change based on different assumptions about the model variables or equations. As the model fiscal rule implies a trade-off between costs (primary surpluses) and benefits (lower debt, higher real output) of a consolidation strategy, we choose a few statistics to evaluate this trade-off. These statistics help to asses a scenario conditioned on the chosen fiscal rule from three perspectives: costs and benefits, political risks, and the risk of the debt consolidation failure.

The costs and benefits of a fiscal consolidation are expressed in terms of output measured by the average growth rate and the cumulative output loss to a chosen trend growth (2%). The political risks are viewed through primary surplus indicator: the number of years of positive primary surplus and an average primary surplus over the entire period. The primary surpluses tend to be politically sensitive and difficult to achieve over a sustained period of time. The risk of a debt consolidation failure is evaluated by the probability of the end-point debt level being higher than the initial level before the consolidation. A supplementary statistics to the risk of consolidation failure is the probability of an effective interest rate being larger than growth. If an economy is operating in such an environment, then debt cannot be stabilized without significant primary surpluses on top of the systematic fiscal rule.

The results summarizing the baseline scenarios are in the following Tables 1-3 and the statistics are supplemented by charts showing the uncertainty bands around the projections of the main variables, as well as a distribution of the cumulative output loss and of primary surpluses over the entire forecast horizon (Figures 16, 17 and 18).

Table 1 - Summary of statistics for baseline, counter-cyclical and pro-cyclical models for Austria

Statistics	2011-2030			
	Baseline	Counter-cyc.	Pro-cyc.	DC
Final Debt Target (% GDP)	65	40	40	40
Average growth (%)	1.5	1.6	1.5	1.5
Cumulative output loss from 2% trend (%)	10.2	8.9	9.6	9.3
Average interest cost (% of GDP)	2.7	2.2	2.5	2.3
Number of years of primary surplus	10.1	12.9	10.9	12.1
Average primary surplus (% of GDP)	0.1	0.8	0.5	0.6
Probability of eff. int. rate being larger than growth	0.53	0.47	0.52	0.5
Probability of end point debt increase	0.54	0.07	0.25	0.1

Note: Comparison of summary of statistics for the baseline, counter-cyclical (C.-c.), pro-cyclical (P.-c.), and debt consolidation (DC) scenarios

Source: Authors' calculations.

[8] These assumptions are available from the authors on request.

Table 2 - Summary statistics for baseline, counter-cyclical and pro-cyclical models for Germany

Statistics	2011-2030			
	Baseline	Counter-cyc.	Pro-cyc.	DC
Final Debt Target (% GDP)	65	65	65	65
Average growth (%)	1.6	1.6	1.6	1.2
Cumulative output loss from 2% trend (%)	7.7	7.6	7.8	15.2
Average interest cost (% of GDP)	2.3	2.2	2.5	2.3
Number of years of primary surplus	10.9	11.4	10.5	11.3
Average primary surplus (% of GDP)	0.2	0.4	0.1	0.3
Probability of eff. int. rate being larger than growth	0.59	0.57	0.60	0.70
Probability of end point debt increase	0.47	0.4	0.54	0.54

Note: Comparison of summary of statistics for baseline, counter-cyclical (C.-c.), pro-cyclical (P.-c.), and debt consolidation (DC) scenarios

Source: Authors' calculations.

Table 3 - Summary of statistics for baseline, counter-cyclical and pro-cyclical models for the Czech Republic

Statistics	2011-2030			
	Baseline	Counter-cyc.	Pro-cyc.	DC
Final Debt Target (% GDP)	30	30	30	30
Average growth (%)	1.5	1.5	1.5	0.2
Cumulative output loss from 2% trend (%)	9.8	10.2	10.1	35.5
Average interest cost (% of GDP)	1.9	1.9	2.2	2.1
Number of years of primary surplus	11.4	12.2	9.7	13.3
Average primary surplus (% of GDP)	0.3	0.7	0.1	0.9
Probability of eff. int. rate being larger than growth	0.54	0.56	0.54	0.67
Probability of end point debt increase	0.37	0.31	0.57	0.44

Note: Comparison of summary of statistics for baseline, counter-cyclical (C.-c.), pro-cyclical (P.-c.), and debt consolidation (DC) scenarios

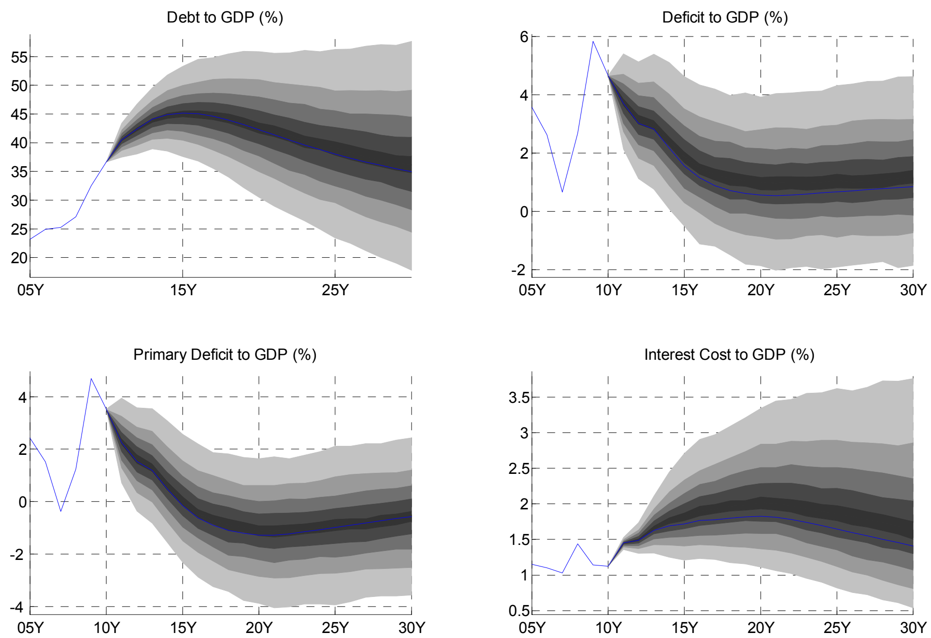
Source: Authors' calculations.

Czech Republic

Table 3 provides the summary statistics for the baseline and other scenarios run for the Czech economy. The first impression is that reducing the debt target to 30% should not be too difficult. As the average nominal income growth rate in the baseline (circa 3.5% p.a.) exceeds the interest rate, the debt-to-GDP ratio is gradually being eroded. Relatively small primary surpluses occur in less than a half of the forecast period and average growth of 1.5% – not far from the estimated potential of 2% – does not imply too much sacrifice in terms of output either. As such, the consolidation strategy should be politically feasible. And there is also a solid chance that the consolidation will succeed – the probability that the end-forecast debt will be lower than the current debt level is more than 60%.

However, this unambitious baseline also shows clear risks. First, as Figure 16 illustrates, debt by 2030 will not have yet converged to the 30% target, implying a very long consolidation period spanning a generation. Second, there is more than 50% chance that during the consolidation nominal income growth rate will fall below the interest rate, implying a debt divergence and eventually necessitating a more forceful fiscal reaction to bring the ballooning debt under control. One can also see this risk in the skewed confidence bands of interest cost as a ratio of GDP – there is 10% chance that the interest rate cost will reach 3% of GDP compared to 1.5% today.[9]

Figure 16: Baseline: confidence bands of fiscal variables – Czech Republic



Source: Authors' calculations.

In examining these risks in more detail, we run an alternative scenario based on the assumption of falling labour supply growth based on demographic projections of the Czech Statistical Office. According to these projections, labour supply growth is set to fall in the coming decades from about 1% annually in the recent years to about -0.5%. This will, ceteris paribus, reduce potential growth – by about 1pp in our calculations (Table 3) reducing the debt target will be much more difficult than in the baseline. Longer periods of much bigger primary surpluses will be required. In addition to lower nominal income growth, the average interest costs will also likely increase owing to higher debt levels and so the probability of facing the unsustainable situation of the interest rate in excess of nominal growth during this period will

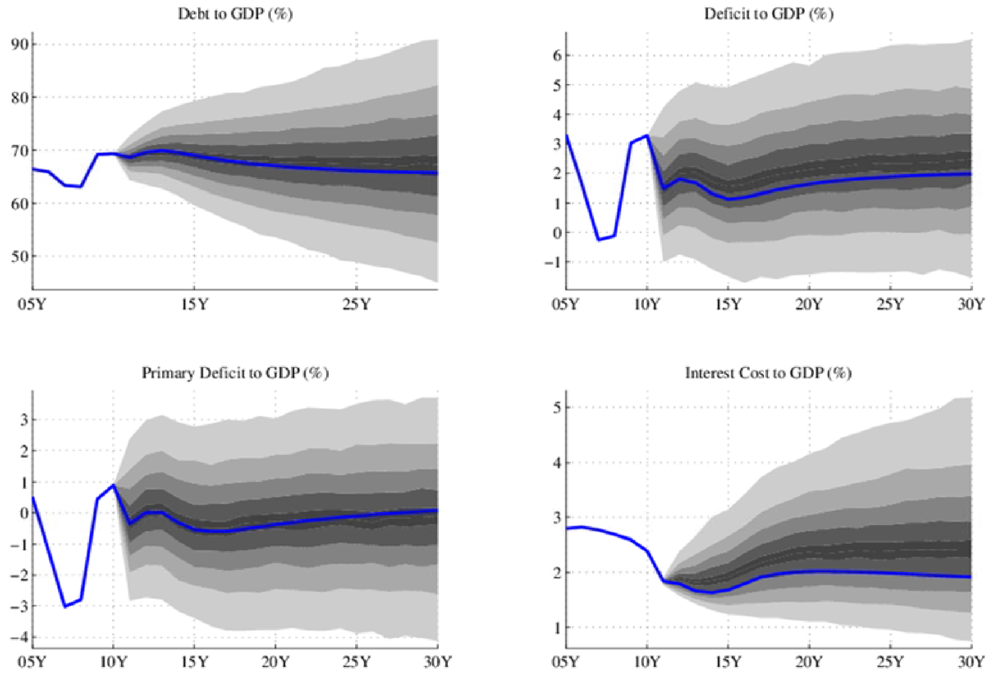
[9] This is a result of the zero interest rate floor and of the fiscal accounting identities which imply that a symmetric change of debt to GDP implies asymmetric costs in terms of primary deficit accommodations.

reach almost 70%. The authorities will therefore have to stand ready to apply additional discretionary austerity in such cases, which might be politically cumbersome.

Germany

Germany's baseline (Figure 17) shows that keeping the current policies and a debt target at 65% will be relatively easy to achieve, although there too are risks. Under the baseline, Germany will have to run primary surplus about 50% of the time, but on average very small ones – about 0.2% of GDP. There will be little output costs in this case. Even if continuing the current policies runs risks that the debt will actually be higher in 2030 than in 2010, it will almost surely not approach 100% – our calibration of the threshold level of debt beyond which the interest premiums will start rising disproportionately. Although such a threshold is impossible to determine *ex ante*, we believe Germany is immune from this risk for the foreseeable future.

Figure 17: Baseline: confidence bands of fiscal variables – Germany



Source: Authors' calculations.

The only serious risk the baseline shows is the 60% probability that nominal income growth will fall below the interest rate on the debt during this period, necessitating a more forceful fiscal contraction.

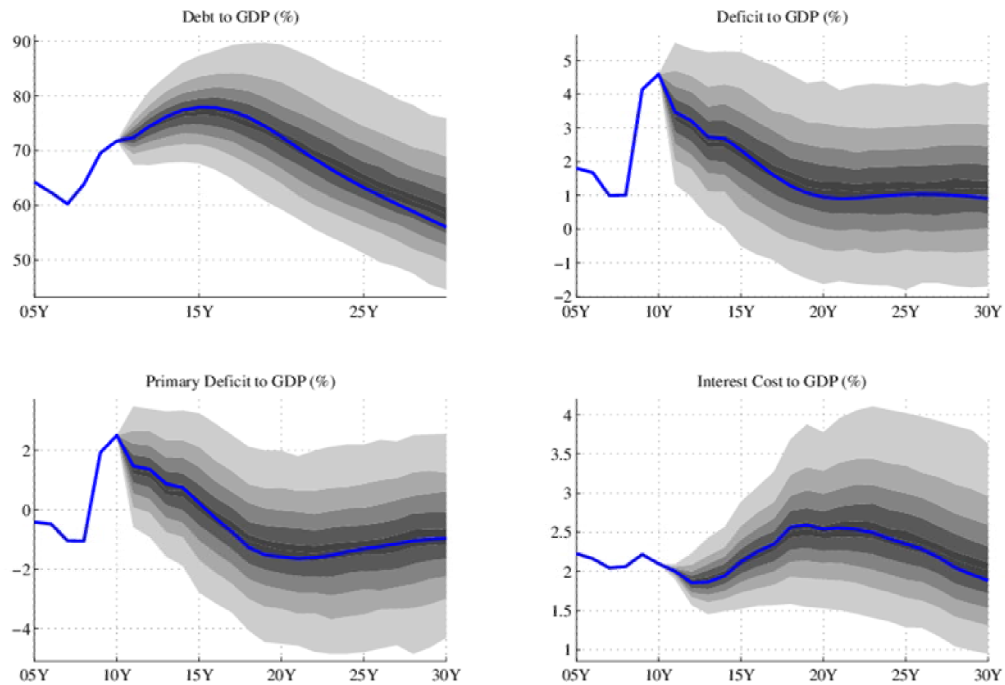
Although Germany is currently paying ultra-low interest premiums, its debt is relatively short-term and hence the current low debt service costs can peter out very quickly.

To examine this risk in more detail, we use an alternative scenario, which – as in the Czech case – evaluates the impacts of a permanent drop in labour supply growth. As in the Czech case, the German Statistical office predicts a drop in the growth rate of the working age population, albeit somewhat lower – from about -0.5% recently to about -1% in the next two decades. The alternative forecast (also Table 2) shows that Germany should be able to cope with such a scenario comfortably, while preserving the current policies and debt targets. The number of years and the average size of the required primary surpluses are very close to those in the baseline, and the output loss is not substantial (after considering the fall in potential output growth owing to the lower labour supply growth).

Austria

Austria's baseline (Figure 18) preserves the current policies and the debt target of 65% (Table 1). This should be easy to achieve. The required primary surpluses should be very low on average. Although the debt service costs are the highest among the three countries, the economy should be able to cope. Although in the mean this strategy seems as comfortable as in Germany, there are two main differences between Austria and Germany. First, there is the sharp increase in the debt in the first ten years of the simulation from the current 70% to close to 80% of GDP. This could bring Austria close to a threshold of rapidly rising risk premiums. In the simulation, this risk does not materialize, because we kept the threshold at 100% of debt-to-GDP (the same as Germany's). The second difference is in the size of the economy – Austria is a much smaller economy and the crisis has shown that the thresholds for smaller countries can be much lower than for larger economies. Continuing current policies, Austria also has the highest probability of the three economies that the end-level of debt will be higher than today – even higher than the Czech economy whose baseline is based on a debt reduction rather than preservation as in Austria's case.

Figure 18: Baseline: confidence bands of fiscal variables – Austria



Source: Authors' calculations.

To mitigate these risks Austria could think about a more ambitious fiscal consolidation plan. For instance, we evaluate an alternative scenario in which the debt target is reduced from 65% of GDP to 40% (Table1). Such scenario would bring longer periods of more fiscal austerity, but at the same time output loss would not be substantial. Moreover, the probability of success in reducing the debt permanently is close to 90%, vindicating such temporary output sacrifices. An additional benefit comes from lower interest costs of servicing the debt and, eventually in the long-term, higher growth.

Pro-cyclical and counter-cyclical fiscal rules

Our model framework can be used in an evaluation of alternative fiscal policies and rules. To illustrate this, this section examines the baseline scenarios for the three economies with modified fiscal rules accounting for pro- and counter-cyclicality of structural deficits. A pro-cyclical rule adjusts structural deficits upwards during booms relative to the baseline. This reflects the assumption that extra growth is "spent". A counter-cyclical rule, by contrast, adjusts structural deficits downward during boom years relative to the baseline, which reflects the assumption that a fiscal authority uses such opportunity of good growth to decrease public debt.

The parameters of the structural deficit rule in (1) are modified for this purpose. In the baseline scenario, f_4 is set to zero. A positive value implies pro-cyclical policy, as the structural deficit tends to grow in boom years, and a negative value implies counter-cyclical policy, as structural deficits fall in the boom years. We simulate the model with $f_4 = 0.4$ (the pro-cyclical case) and with $f_4 = -0.4$ (the counter-cyclical case). In all other respects the simulations are the same as the baseline.

The scenarios are designed so that the structural deficits consistent with the baseline scenario are the same for the pro-cyclical and counter-cyclical cases. This is to allow for a direct comparison of the fiscal policies. It is implemented by taking the path of the structural deficit from the baseline and imposing it on the forecast of the both versions of the model. Such forecasts paths will be almost identical to the baseline scenario (deficit and debt will be the same). However, when these two models are simulated, they will imply different distributions of the variables, namely interest costs and primary deficits.

The distribution of expected primary surplus highlights the main difference between the pro- and counter-cyclical rules. Figures 19 and 20 illustrate — using the Czech economy simulations— that pro-cyclical rules lead to more volatile primary surpluses than counter-cyclical rules, which make positive surpluses more certain. This relative certainty of primary surplus is what makes the counter-cyclical rules deliver consolidation with more certainty, but also increases the political costs of doing so, because of the protracted periods of fiscal austerity.

Figure 19: Counter-cyclical version: histogram of average primary surplus as percent of GDP

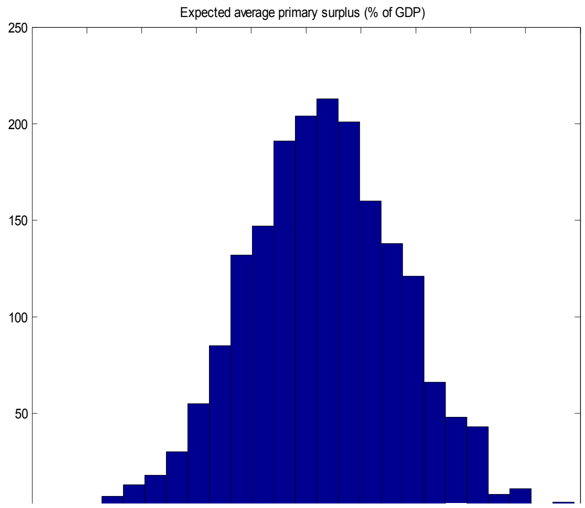
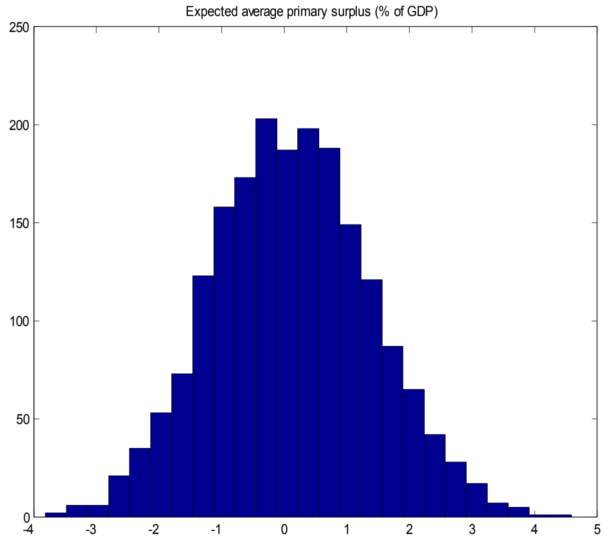


Figure 20: Pro-cyclical version: histogram of average primary surplus as percent of GDP



Source: Authors' calculations.

Table 4 summarizes the statistics for the Czech baseline (note that this assumes a decline of the debt target to 30% of GDP), counter-cyclical and pro-cyclical cases. As expected, the counter-cyclical case has larger primary surpluses and a greater number of years of a primary surplus than the other two scenarios. The benefits of the counter-cyclical policies are in lower debt levels and a lower probability of a fiscal consolidation failure: the probability that the debt will increase by 2020 is only half of that the pro-cyclical case (31% versus 57%). However, this greater certainty of success and lower debt do not transform to other benefits like a smaller output loss, or smaller probability of operating in an environment of higher interest than growth. It is because the consolidation in the period of 2011–2030 is dominated by output costs and the benefits of a lower debt translating into a higher potential and lower interest costs only transpire after 2030.

Table 4. Summary of statistics for baseline, counter-cyclical and pro-cyclical models

Statistics	2011-2030		
	Baseline	Counter-cyc.	Pro-cyc.
Average growth (%)	1.5	1.5	1.5
Cumulative output loss from 2 % trend (%)	9.8	10.2	10.1
Average interest cost (% if GDP)	1.9	1.9	2.2
Number of years of primary surplus	11.4	12.2	9.7
Average primary surplus (% of GDP)	0.3	0.7	0.1
Probability of eff. interest rate being larger than growth	0.54	0.56	0.54
Probability of end point debt increase	0.37	0.31	0.57

Source: Authors' calculations.

Similar results hold for the other two economies. Counter-cyclical rules in general bring about a faster and a much more certain consolidation than pro-cyclical rules, which actually have a large probability that the debt will increase rather than fall by 2030. However, they come at costs of longer periods of larger primary surpluses than the baseline. As in the Czech case, the benefits of a faster consolidation and lower debt in terms of lower interest rates and higher growth only accrue beyond the forecast horizon.

Pro-cyclical rules, on the other hand, require much less political resolve, as they entail periods of both primary surpluses and deficits. The debt declines to the new target almost solely thanks to nominal GDP growth exceeding the interest rate paid on the debt. As such, the pro-cyclical rules are very vulnerable to shocks increasing the risk premiums or decreasing nominal GDP growth (such as a fall in potential GDP growth or an increase in the yield curve), which makes consolidation all the less likely to succeed overall.

Conclusions and policy implications

In this paper we have developed a simple model-based framework for stress-testing fiscal scenarios in deterministic and stochastic modes. The model allows us to analyse fiscal behaviour, express it in well-defined categories of debt/deficit targets and behavioural rules, evaluate the implications for the real economy and test the robustness with respect to shocks.

The semi-structural form of the model allows for a wide range of policy experiments, consistency checks, and risk analyses. It can be used for assessing the stochastic performance of deficit-debt fiscal rules, the optimal currency and maturity composition of the debt, the effects of non-linear thresholds (such as the zero interest rate bound or risk premium formation) on fiscal consolidation, the effects of changing macroeconomic fundamentals, interactions with monetary policy, and much more. This makes it potentially a very useful advisory tool for policy makers and fiscal councils and boards.

Applying the model to the data of Austria, the Czech Republic and Germany, we have made the following observations:

- The absence of long-term debt-anchoring fiscal policies is the most visible in the Czech Republic, despite having the lowest debt levels. The model-estimated debt targets for Austria and Germany have been stable (and decreasing in the case of Germany) and close to the actual debt levels. On the other hand, the Czech fiscal behaviour in the last decade has corresponded to a much higher debt target (not far from that of Austria and Germany) than the observed low debt levels would suggest.

- All three economies responded to the financial crisis by a mix of short-term fiscal expansion and medium-term austerity. The estimates of medium-term debt targets declined during the crisis, reflecting the drive for a medium-term fiscal consolidation. Austria and the Czech Republic applied short-term discretionary stimuli on the top of automatic stabilizers, which helped in smoothing the impact of the crisis on the real economy. On the other hand, Germany applied a short-term discretionary restriction to reduce the deficits that were being driven up by the impact of automatic stabilizers.

- Among the three economies, Germany is the most exposed one to the roll-over risk on its short-term debt and has also a sizeable share of non-securitized debt (NSD). Austria and the Czech Republic have been increasing the maturity of the debt, and Austria has also reduced the share of its NSD. The Czech Republic is becoming more vulnerable to the exchange rate risk due to the increasing foreign exchange component of its debt.

- Austria and the Czech Republic face a serious risk of debt interest rates exceeding nominal income growth in the future, which could adversely affect their fiscal consolidation efforts. While all three economies expect a slow-down in nominal income growth (also owing to low labour supply growth), Austria and the Czech Republic are also likely to see an increase in risk premiums owing to rising debt levels (Czech Republic) or the evaporating EMU effect (Austria). On the other hand, Germany is reaping the benefits of very low risk premiums related to the Eurozone fiscal challenges.

The economies can address these risks and their fiscal situation by adjusting their fiscal behaviour in a number of ways. These involve a decrease in the long-term debt-to-GDP target ratios, changing the maturity and currency composition of the debt and applying various fiscal rules for its structural deficits (alongside discretionary changes in primary deficits). We have evaluated some of the possible responses using a set of indicators that in our view comprehensively characterize a fiscal consolidation program: the cost and benefits in terms of cumulated output loss, political feasibility in terms of a number of years, the average size of primary surpluses required to reach the debt target and the risk of a failed consolidation (the probability of end-point debt being higher than initial debt).

Our experiments with the possible future policies have yielded the following insights:

- Among the three countries, Germany has the least need for a change in its fiscal behaviour and a reduction of debt levels. In our simulations, continuing with the current policies remains sustainable at least until the end of this decade. Germany is also best positioned to withstand a likely drop in nominal income growth related to lower labour supply growth.

- Both the Czech Republic and Austria could respond to the current situation by reducing its future debt-to-GDP ratios. Austria, because its initial debt level is very high, the Czech Republic, because continuing the trend of past policies would lead to high debt levels in the future.

- The Czech economy faces the most acute need to change its fiscal policies, despite the current relatively low debt levels. However, trying to stabilize the future debt at around the current levels will involve long periods of primary deficits and low growth, which might be difficult to achieve politically. Moreover, despite such sacrifices, there is still a large probability that the relative debt levels in around 2030 will be higher than today. On top of this, the consolidation becomes near-impossible, should nominal income growth fall permanently (say, owing to the expected lower labour supply growth).

- A permanent reduction of debt levels in Austria would also involve long periods of politically difficult primary deficits. Austria may, therefore, prefer to continue with the current policies that are consistent with keeping current high debt levels even if this means facing the risk of possible sudden increases in the debt and risk premiums jeopardizing the fiscal sustainability in the future.

Our experiments also evaluate the contribution of different fiscal rules to the success of consolidation efforts (reducing relative debt levels). For instance, we show that, as expected, counter-cyclical rules (adjusting structural deficits downwards during booms and *vice versa*) bring about a faster and more certain consolidation than pro-cyclical rules, which actually have a large probability that the debt will increase rather than fall by 2030. As such, the counter-cyclical rules will bring benefits of lower interest rates and higher growth. However, in our simulations these benefits accrue only in the long-term – after 2030 – perhaps too late to politically justify the higher primary surpluses implied by the counter-cyclical rules.

Pro-cyclical rules, on the other hand, require much less political resolve, as they entail periods of both primary surpluses and deficits. The debt declines to the new target almost solely thanks to nominal GDP growth exceeding interest rate costs. As such, the pro-cyclical rules are very vulnerable to shocks increasing the interest rate costs or decreasing nominal GDP growth (such as a fall in potential GDP growth or an increase in the yield curve), which makes consolidation all the less likely to succeed overall.

BIBLIOGRAPHY

Alesina, A. (2010), Fiscal Adjustments: Lessons from Recent History. *Mimeo, Department of Economics, Harvard University*.

Barrell, R., D. Holland, I. Hurst. (2012), Fiscal Consolidation: Part 2.Fiscal Multipliers and Fiscal Consolidations. *OECD Economics Department Working Papers*, No. 933

Bos, F. (2007). The Dutch Fiscal Framework: History, Current Practice and the Role of the Central Planning Bureau. *OECD Journal on Budgeting*, No. 8(1).

Calmfors L. (2010) The Role of Independent Fiscal Policy Institutions. *Finanspolitiska radet background report 2010/9.* <http://www.finanspolitiskaradet.se/download/18.64075cf012c96962a7d800012034/Underlagsrapport+9+2010+Calmfors.pdf>.

Coenen, G., Ch. Erceg, Ch. Freedman, D. Furceri, M. Kumhof, R. Lalonde, D. Laxton, J. Lindé, A. Mourougane, D. Muir, S. Mursula, C. Resende, J. Roberts, W. Roeger, S. Snudden, M. Trabandt and J. Veld (2010) Effects of Fiscal Stimulus in Structural Models. *IMF Working Paper*, 10/73, March

Corbacho, A., Medina, L. and Caceres, C. November (2010), Structural Breaks in Fiscal Performance: Did Fiscal Responsibility Laws Have Anything to Do with Them? *International Monetary Fund Working Paper,* No. 10/248.< http://ideas.repec.org/p/imf/imfwpa/10-248.html>.

Hagemann, R. (2010) Improving Fiscal Performance Through Fiscal Councils. *OECD Economics Department Working Paper,* No. 829. <http://www.oecd-ilibrary.org/docserver/download/fulltext/5km33sqsqq9v.pdf?expires=1301484507&id=0000&accname=guest&checksum=150F89AB97DB09087604DDFE07652FBCl>.

Herndon, T., M. Ash and R. Pollin (2013). Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff. *Political Economy Research Institute Publication,* April, University of Massachusetts Amherst

International Monetary Fund. (October 2010). World Economic Outlook (WEO). <http://www.imf.org/external/pubs/ft/weo/2010/02/pdf/text.pdf>.

Kopits, G. and Symansky, S.A. (1998) Fiscal Policy Rules. *International Monetary Fund Occasional Paper*.

Leeper, E. (2010) Monetary Science, Fiscal Alchemy. *NBER WP no 16510*, October

Merola, R. and D. Sutherland. (2012) Fiscal Consolidation: Part 3. Long-run Projections and Fiscal Gap Calculations. *OECD Economics Department Working Papers*.

OECD (2012), *Economic Surveys: Hungary*, OECD, Paris.

Reinhart, C., M, K. Rogoff (2010) Growth in a Time of Debt. *American Economic Review* 100, No. 2: 573-578.

Sutherland, D., Hoeller P., Merola R. (2012) Fiscal consolidation: How much, how fast and by what means? *OECD Economic Outlook Report*, April

Wyplosz, C. (2005) Fiscal Policy: Institutions versus Rules. *National Institute Economic Review,* No. 191(1): 64–78. doi: 10.1177/0027950105052661. <http://ner.sagepub.com/content/191/1/64.abstract>.

Wyplosz,C. (2008) Fiscal Policy Councils: Unlovable or Just Unloved? *Swedish Economic Policy Review*, No.15: 173–192.

ANNEX 1: LIST OF STRUCTURAL MODEL EQUATIONS

Total Deficit Identity :

$$d_t = pd_t = id_t \tag{2}$$

Interest Cost Identity :

$$id_t = id_t^{1Y} + id_t^{3Y} + id_t^{10Y} + id_t^{f\,cy} + \sigma_{id} \times \varepsilon_t^{id} \tag{3}$$

FCY Interest Cost Identity :

$$\begin{aligned} id_t^{f\,cy} = {} & \exp((s_t - s_{t-1})/100) \cdot b_{t-1}^{f\,cy} \cdot (\exp\left(i_{t-1}^{f\,cy}/100\right) - 1)/\exp((ny_t - ny_{t-1})/100) \\ & + \exp((s_t - s_{t-2})/100) \cdot b_{t-2}^{f\,cy} \\ & \cdot (\exp\left(i_{t-2}^{f\,cy}/100\right) - 1)/\exp((ny_t - ny_{t-2})/100) + \exp((s_t - s_{t-3})/100) \\ & \cdot b_{t-3}^{f\,cy} \cdot (\exp\left(i_{t-3}^{f\,cy}/100\right) - 1)/\exp((ny_t - ny_{t-3})/100) \\ & + \exp((s_t - s_{t-4})/100) \cdot b_{t-4}^{f\,cy} \\ & \cdot (\exp\left(i_{t-4}^{f\,cy}/100\right) - 1)/\exp((ny_t - ny_{t-4})/100) + \exp((s_t - s_{t-5})/100) \\ & \cdot b_{t-5}^{f\,cy} \cdot (\exp\left(i_{t-5}^{f\,cy}/100\right) - 1)/\exp((ny_t - ny_{t-5})/100) \end{aligned} \tag{4}$$

1Y Interest Cost Identity :

$$id_t^{1Y} = (\exp(i_{t-1}/100) - 1) \cdot b_{t-1}^{1Y}/\exp((ny_t - ny_{t-1})/100) \tag{5}$$

3Y Interest Cost Identity :

$$\begin{aligned} id_t^{3Y} = {} & (\exp(i3_{t-1}/100) - 1) \cdot b_{t-1}^{3Y}/\exp((ny_t - ny_{t-1})/100) + (\exp(i3_{t-2}/100) - 1) \\ & \cdot b_{t-2}^{3Y}/\exp((ny_t - ny_{t-2})/100) + (\exp(i3_{t-3}/100) - 1) \\ & \cdot b_{t-3}^{3Y}/\exp((ny_t - ny_{t-3})/100) \end{aligned} \tag{6}$$

10Y Interest Cost Identity :

$$\begin{aligned} id_t^{10Y} = {} & (\exp(i10_{t-1}/100) - 1) \cdot b_{t-1}^{10Y}/\exp((ny_t - ny_{t-1})/100) + (\exp(i10_{t-2}/100) - 1) \\ & \cdot b_{t-2}^{10Y}/\exp((ny_t - ny_{t-2})/100) + (\exp(i10_{t-3}/100) - 1) \\ & \cdot b_{t-3}^{10Y}/\exp((ny_t - ny_{t-3})/100) + (\exp(i10_{t-4}/100) - 1) \\ & \cdot b_{t-4}^{10Y}/\exp((ny_t - ny_{t-4})/100) + (\exp(i10_{t-5}/100) - 1) \\ & \cdot b_{t-5}^{10Y}/\exp((ny_t - ny_{t-5})/100) + (\exp(i10_{t-6}/100) - 1) \\ & \cdot b_{t-6}^{10Y}/\exp((ny_t - ny_{t-6})/100) + (\exp(i10_{t-7}/100) - 1) \\ & \cdot b_{t-7}^{10Y}/\exp((ny_t - ny_{t-7})/100) + (\exp(i10_{t-8}/100) - 1) \\ & \cdot b_{t-8}^{10Y}/\exp((ny_t - ny_{t-9})/100) + (\exp(i10_{t-9}/100) - 1) \\ & \cdot b_{t-9}^{10Y}/\exp((ny_t - ny_{t-9})/100) + (\exp(i10_{t-10}/100) - 1) \\ & \cdot b_{t-10}^{10Y}/\exp((ny_t - ny_{t-10})/100) \end{aligned} \tag{7}$$

Debt Accumulation Identity :

$$b_t = d_t + b_{t-1}/\exp((ny_t - ny_{t-1})/100) + \sigma_b \cdot \varepsilon_t^b \tag{8}$$

1Y Debt Accumulation Identity :

$$b_t^{1Y} = h_t^{1Y} \cdot d_t + b_{t-1}^{1Y}/\exp((ny_t - ny_{t-1})/100) \tag{9}$$

3Y Debt Accumulation Identity :

$$b_t^{3Y} = h_t^{3Y} \cdot d_t + b_{t-3}^{3Y} / \exp((ny_t - ny_{t-3})/100) \tag{10}$$

10Y Debt Accumulation Identity :

$$b_t^{10Y} = h_t^{10Y} \cdot d_t + b_{t-10}^{10Y} / \exp((ny_t - ny_{t-10})/100) \tag{11}$$

FCY Debt Accumulation Identity :

$$b_t^{fcy} = h_t^{fcy} \cdot d_t + \exp((s_t - s_{t-5})/100) \cdot b_{t-5}^{f\,cy} / \exp((ny_t - ny_{t-5})/100) \tag{12}$$

Outstanding 1Y Debt :

$$b_t^{tot1Y} = b_t^{f\;1Y} \tag{13}$$

Outstanding 3Y Debt :

$$b_t^{tot3Y} = b_t^{3Y} + b_{t-1}^{3Y} / \exp((ny_t - ny_{t-1})/100) + b_{t-2}^{3Y} / \exp((ny_t - ny_{t-2})/100) \tag{14}$$

Outstanding 10Y Debt :

$$\begin{aligned} b_t^{tot10Y} = b_t^{10Y} &+ b_{t-1}^{10Y} / \exp((ny_t - ny_{t-1})/100) + b_{t-2}^{10Y} / \exp((ny_t - ny_{t-2})/100) \\ &+ b_{t-3}^{10Y} / \exp((ny_t - ny_{t-3})/100) + b_{t-4}^{10Y} / \exp((ny_t - ny_{t-4})/100) \\ &+ b_{t-5}^{10Y} / \exp((ny_t - ny_{t-5})/100) + b_{t-6}^{10Y} / \exp((ny_t - ny_{t-6})/100) \\ &+ b_{t-7}^{10Y} / \exp((ny_t - ny_{t-7})/100) + b_{t-8}^{10Y} / \exp((ny_t - ny_{t-8})/100) \\ &+ b_{t-9}^{10Y} / \exp((ny_t - ny_{t-9})/100) \end{aligned} \tag{15}$$

Debt to GDP Target :

$$b_t^{tar} = b_{t-1}^{tar} + \sigma_{b^{tar}} \cdot \varepsilon_t^{b^{tar}} \tag{16}$$

Expected Deviation from Debt Target :

$$b_t^{dev} = 0.2 \cdot (b_t - b_t^{tar}) + 0.8 \cdot E_t[b_{t+1}^{dev}] \tag{17}$$

Expected Nominal Income Growth :

$$\Delta^e ny_t = 0.2 \cdot (ny_t - ny_{t-1}) + 0.8 \cdot E_t[\Delta^e ny_{t+1}] \tag{18}$$

Structural Deficit Consistent with Debt Target :

$$sd_t^{tar} = \; b_t^{tar} \cdot (1 - 1/exp\,(\Delta^e ny_t/100)) \tag{19}$$

Business Cycle Gap :

$$\begin{aligned} \widehat{NY}_t = ny_t - (&ny_{t-6} + ny_{t-5} + ny_{t-4} + ny_{t-3} + ny_{t-2} + ny_{t-1} + ny_t + E_t[ny_{t+6}] \\ &+ E_t[ny_{t+5}] + E_t[ny_{t+4}] + E_t[ny_{t+3}] + E_t[ny_{t+2}] + E_t[ny_{t+1}])/13 \end{aligned} \tag{20}$$

Stiffness of Structural Deficit Accommodation :

$$a_t^{sd} = \; a_{ss}^{sd} \tag{21}$$

Structural Deficit :

$$sd_t = a_t^{sd} \cdot (sd_{t-1} + f_4 \cdot \widehat{NY}_t) + (1 - a_t^{sd}) \cdot sd_t^{tar} + \sigma_{sd} \cdot \varepsilon_t^{sd} \tag{22}$$

Fiscal Rule :

$$d_t = sd_t - f_1 \cdot \hat{y}_t - f_2 \cdot b_t^{dev} + \sigma_d \cdot \varepsilon_t^d \tag{23}$$

Fiscal Impulse :

$$d_t^{imp} = \sigma_d \cdot \varepsilon_t^d + \sigma_{sd} \cdot \varepsilon_t^{sd} + 0.4 \cdot \sigma_{b^{tar}} \cdot \varepsilon_t^{b^{tar}} \tag{24}$$

Share of Deficit Financed by Newly Issued 1Y Paper :

$$h_t^{1Y} = h_{t-1}^{1Y} + \sigma_{h_1} \cdot \varepsilon_t^{\mathrm{h1}} \tag{25}$$

Share of Deficit Financed by Newly Issued 3Y Paper :

$$h_t^{3Y} = h_{t-1}^{3Y} + \sigma_{h_3} \cdot \varepsilon_t^{h3} \tag{26}$$

Share of Deficit Financed by Newly Issued 10Y Paper :

$$h_t^{10Y} = h_{t-1}^{10Y} + \sigma_{h_{10}} \cdot \varepsilon_t^{h10} \tag{27}$$

Share of Deficit Financed by Newly Issued FCY Paper :

$$h_t^{fcy} = 1 - h_t^{1Y} - h_t^{3Y} - h_t^{10Y} \tag{28}$$

3Y Rates :

$$i3_t = 1/3 \cdot (i_t + E_t[i_{t+1}] + E_t[i_{t+2}]) + tprem3_t \tag{29}$$

Real 3Y Rates :

$$r3_t = 1/3 \cdot (r_t + E_t[r_{t+1}] + E_t[r_{t+2}]) + tprem3_t \tag{30}$$

Eq. Real 3Y Rates :

$$\overline{r3_t} = 1/3 \cdot (\bar{r}_t + E_t[\bar{r}_{t+1}] + E_t[\bar{r}_{t+2}]) + tprem3_t \tag{31}$$

10Y Rates :

$$\begin{aligned}\mathrm{i}10_t = 1/10 \cdot (\mathrm{i}_t &+ E_t[i_{t+1}] + E_t[i_{t+2}] + E_t[i_{t+3}] + E_t[i_{t+4}] + E_t[i_{t+5}] + E_t[i_{t+6}] + E_t[i_{t+7}] \\ &+ E_t[i_{t+8}] + E_t[i_{t+9}] + tprem10_t\end{aligned} \tag{32}$$

Real 10Y Rates :

$$\begin{aligned}\mathrm{r}10_t = 1/10 \cdot (\mathrm{r}_t &+ E_t[r_{t+1}] + E_t[r_{t+2}] + E_t[r_{t+3}] + E_t[r_{t+4}] + E_t[r_{t+5}] + E_t[r_{t+6}] + E_t[r_{t+7}] \\ &+ E_t[r_{t+8}] + E_t[r_{t+9}] + tprem10_\mathrm{t}\end{aligned} \tag{33}$$

Eq. Real 10Y Rates :

$$\begin{aligned}\overline{\mathrm{r}10_t} = 1/10 \cdot (\bar{r}_t &+ E_t[\bar{r}_{t+1}] + E_t[\bar{r}_{t+2}] + E_t[\bar{r}_{t+3}] + E_t[\bar{r}_{t+4}] + E_t[\bar{r}_{t+5}] + E_t[\bar{r}_{t+6}] + E_t[\bar{r}_{t+7}] \\ &+ E_t[\bar{r}_{t+8}] + E_t[\bar{r}_{t+9}] + tprem10_t\end{aligned} \tag{34}$$

FCY Rates :

$$\begin{aligned}\mathrm{i}_\mathrm{t}^\mathrm{fcy} = 1/5 \cdot (\mathrm{i}_\mathrm{t}^* &+ prem_t^{FCY} + E_t[\mathrm{i}_{\mathrm{t+1}}^*] + E_t[prem_{t+1}^{FCY}] + E_t[\mathrm{i}_{\mathrm{t+2}}^*] + E_t[prem_{t+2}^{FCY}] + E_t[\mathrm{i}_{\mathrm{t+3}}^*] \\ &+ E_t[prem_{t+3}^{FCY}] + E_t[\mathrm{i}_{\mathrm{t+4}}^*] + E_t[prem_{t+4}^{FCY}] + 5/7 \cdot tprem3_t + 2/7 \\ &\cdot tprem10_t\end{aligned} \tag{35}$$

FCY Rate Premium :

$$prem_t^{FCY} = prem_{t-1}^{FCY} + prem^{FCY} \cdot \varepsilon_t^{prem^{FCY}} \tag{36}$$

3Y-1Y Term Premium :

$$\begin{aligned}tprem3_t = \rho_{tprem3} \cdot tprem3_{t-1} + (1 - \rho_{tprem3}) \cdot (tprem3_{ss} + \mathrm{p}_1 \cdot (\mathrm{b_t} - \mathrm{b_{ss}^{tar}})) + \ \sigma_{tprem3} \\ \cdot \varepsilon_t^{tprem3}\end{aligned} \tag{37}$$

10Y-1Y Term Premium :

$$tprem10_t = \rho_{tprem10} \cdot tprem10_{t-1} + (1-\rho_{tprem10}) \cdot (tprem10_{ss} + \mathrm{p}_2 \cdot (\mathrm{b_t} - \mathrm{b_{ss}^{tar}})) + \sigma_{tprem10} \cdot \varepsilon_t^{tprem10} \quad (38)$$

Foreign Nominal Rates :

$$\mathrm{i_t^*} = \mathrm{r_t^*} + E_t[\pi_{t+1}^*] \quad (39)$$

Foreign Real Rates :

$$\mathrm{r_t^*} = \mathrm{\hat{r}_t^*} + \mathrm{\bar{r}_t^*} \quad (40)$$

Foreign Real Rate Gap :

$$\mathrm{\hat{r}_t^*} = \rho_{\mathrm{i^*}} \cdot \mathrm{\hat{r}_{t-1}^*} + \sigma_{\mathrm{\hat{r}_t^*}} \cdot \varepsilon_t^{\mathrm{\hat{r}_t^*}} \quad (41)$$

Foreign Output Gap :

$$\mathrm{\hat{y}_t^*} = \rho_{\widehat{\mathrm{y^*}}} \cdot \mathrm{\hat{y}_t^*} + \sigma_{\widehat{\mathrm{y^*}}} \cdot \varepsilon_t^{\widehat{\mathrm{y^*}}} \quad (42)$$

Foreign Inflation :

$$\pi_t^* = \rho_{\pi^*} \cdot \pi_t^* + (1-\rho_{\pi^*}) \cdot \pi_{ss}^* + \sigma_{\pi^*} \cdot \varepsilon_t^{\pi^*} \quad (43)$$

Foreign Price Level :

$$\pi_t^* = \rho_t^* - \rho_{t-1}^* \quad (44)$$

Foreign Equilibrium Real Interest Rate :

$$\mathrm{\bar{r}_t^*} = \rho_{\pi^*} \cdot \mathrm{\bar{r}_{t-1}^*} + (1-\rho_{\mathrm{r^*}}) \cdot \mathrm{r_{ss}^*} + \sigma_{\mathrm{\bar{r}^*}} \cdot \varepsilon_t^{\mathrm{\bar{r}^*}} \quad (45)$$

Country Risk and Currency Premium :

$$prem_t = \rho_{prem} \cdot prem_{t-1} + (1-\rho_{prem}) \cdot (prem_{ss} + \mathrm{p}_4 \cdot (\mathrm{b_t} - \mathrm{b_{ss}^{tar}})) + \sigma_{prem} \cdot \varepsilon_t^{prem} \quad (46)$$

Transitory UIP Condition :

$$\mathrm{i_t} = E_t[\Delta \mathrm{s_{t+1}}] + \mathrm{i_t^*} + prem_t + \sigma_s \cdot \varepsilon_t^s \quad (47)$$

Long Term UIP Condition :

$$\mathrm{\bar{r}_t} = E_t[\mathrm{\bar{z}_{t+1}}] - \mathrm{\bar{z}_t} + \overline{\mathrm{r_t^*}} + prem_t \quad (48)$$

Eq. Real Exchange Rate Level :

$$\mathrm{\bar{z}_t} = \mathrm{\bar{z}_{t-1}} + \mathrm{g_t^z} + \mathrm{p}_3 \cdot (\mathrm{b_t} - \mathrm{b_{t-1}}) \quad (49)$$

Eq. Real Exchange Rate Depreciation :

$$\mathrm{g_t^z} = \rho_{\mathrm{g^z}} \cdot \mathrm{g}_{t-1}^{z} + (1-\rho_{\mathrm{g^z}}) \cdot \mathrm{g_{ss}^z} + \sigma_{\mathrm{g^z}} \cdot \varepsilon_t^{\mathrm{g^z}} \quad (50)$$

Real Exchange Rate Identity :

$$\mathrm{z_t} = \mathrm{s_t} - \mathrm{p_t^{cpi}} + \mathrm{p_t^*} \quad (51)$$

Nominal Exchange Rate Depreciation :

$$\Delta \mathrm{s_t} = \mathrm{s_t} - \mathrm{s_{t-1}} \quad (52)$$

Change of Eq. Long Rates :

$$\Delta \mathrm{\overline{lr}_t} = (E_t[\mathrm{\overline{lr}_{t+1}}] + \mathrm{\overline{lr}_t} + \mathrm{\overline{lr}_{t-1}})/3 - (\mathrm{\overline{lr}_{t-7}} + \mathrm{\overline{lr}_{t-8}} + \mathrm{\overline{lr}_{t-9}})/3 \quad (53)$$

Potential Output :
$$\bar{\mathrm{y}}_{\mathrm{t}} = \bar{\mathrm{y}}_{\mathrm{t}-1} + \mathrm{g}_{\mathrm{t}} - \mathrm{p}_5 \cdot \Delta\overline{\mathrm{lr}}_{\mathrm{t}}/8 + \sigma_{\bar{y}} \cdot \varepsilon_t^{y} \tag{54}$$

Potential Output Growth :
$$\mathrm{g}_{\mathrm{t}} = \rho_{\mathrm{g}} \cdot \mathrm{g}_{\mathrm{t}-1} + (1 - \rho_{\mathrm{g}}) \cdot \mathrm{g}_{\mathrm{ss}} + \sigma_{\mathrm{g}} \cdot \varepsilon_t^{g} \tag{55}$$

Eq. Long Rates :
$$\overline{\mathrm{lr}}_{\mathrm{t}} = 0.4 \cdot \bar{\mathrm{r}}_{\mathrm{t}} + 0.4 \cdot \overline{\mathrm{r3}}_{\mathrm{t}} + 0.2 \cdot \overline{\mathrm{r10}}_{\mathrm{t}} \tag{56}$$

Imported Inflation :
$$\pi_t^{imp} = \pi_t^{*} + \Delta s_t - (\overline{z_t} - \overline{z_{t-1}}) \tag{57}$$

Inflation Expectations :
$$\pi_t^{e,cpi} = E_t[\pi_{t+1}^{cpi}] \tag{58}$$

Phillips Curve :
$$\pi_t^{cpi} = e_1 \cdot \pi_t^{e,cpi} + (1 - e_1 - e_2) \cdot \pi_{t-1}^{cpi} + e_2 \cdot \pi_t^{imp} + e_3 \cdot \widehat{y_t} + \sigma_\pi \cdot (\varepsilon_t^{\pi} - \gamma_{\bar{y},\pi} \cdot \varepsilon_t^{y}) \tag{59}$$

Fisher Identity :
$$\mathrm{r}_{\mathrm{t}} = \mathrm{i}_{\mathrm{t}} - E_t[\pi_{t+1}^{cpi}] \tag{60}$$

IS Curve :
$$\widehat{y_t} = k_1 \cdot E_t[\hat{y}_{t+1}] + k_2 \cdot \hat{y}_{t-1} - k_3 \cdot (lr_t - \overline{lr_t}) + k_4 \cdot \hat{z}_t + k_5 \cdot \widehat{y_t^{*}} + k_6 \cdot d_t^{imp} + \sigma_{\hat{y}} \cdot (\varepsilon_t^{\hat{y}} + \gamma_{g,\hat{y}} \cdot \varepsilon_t^{g}) \tag{61}$$

Long Real Rates :
$$lr_t = 0.4 \cdot r_t + 0.4 \cdot r3_t + 0.2 \cdot r10_t \tag{62}$$

Real Exchange Rate Gap :
$$\widehat{z_t} = z_t - \overline{z_t} \tag{63}$$

Inflation Target :
$$\pi_t^{tar} = \pi_{t-1}^{tar} + \sigma_{\pi^{tar}} \cdot \varepsilon_t^{\pi^{tar}} \tag{64}$$

Monetary Policy Rule :
$$i_t^{des} = u_1 \cdot i_{t-1} + (1 - u_1) \cdot (\overline{r_t} + \pi_t^{tar} + u_2 \cdot (E_t[\pi_{t+1}^{cpi}] - E_t[\pi_{t+1}^{tar}])) + \sigma_i \cdot \varepsilon_t^{i} \tag{65}$$

$$i_t = i_t^{des} \tag{66}$$

Nominal GDP Level :
$$ny_t = y_t + p_t \tag{67}$$

GDP Deflator :
$$\pi_t = p_t - p_{t-1} \tag{68}$$

Headline CPI :
$$\pi_t^{cpi} = p_t^{cpi} - p_{t-1}^{cpi} \tag{69}$$

Wedge Between Deflator and Headline Inflation :

$$\pi_t - \pi_t^{cpi} = \rho_{dlpw} \cdot (\pi_{t-1} - \pi_{t-1}^{cpi}) + \sigma_{dlpw} \cdot \varepsilon_t^{dlpw} \tag{70}$$

Aggregate Demand :

$$y_t = \bar{y}_t + \widehat{y_t} \tag{71}$$

Nominal GDP Growth:

$$\Delta n y_t = n y_t - n y_{t-1} \tag{72}$$

Real GDP Growth:

$$\Delta y_t = y_t - y_{t-1} \tag{73}$$

ANNEX 2: STRUCTURAL MODEL VARIABLES AND PARAMETERS

Transition Variables (linear)

Variable	Model name	Description
y	*l_y*	Real GDP (100*log)
Δy	*dl_y*	Real GDP Growth (in percent)
$\bar{y}$	*l_y_tnd*	Potential Real GDP (100*log)
$\hat{y}$	*l_y_gap*	Real GDP Gap (in percent)
g	*g_y_tnd*	Potential real GDP Growth (in percent)
p	*l_p*	GDP Deflator (100*log)
π	*dl_p*	GDP Deflator Inflation (in percent)
p^{cpi}	*l_cpi*	Headline CPI (100*log)
π^{cpi}	*dl_cpi*	Headline CPI Inflation (in percent)
$\pi^{e,cpi}$	*e_dl_cpi*	Headline CPI Inflation Expectation (in percent)
π^{tar}	*dl_cpi_tar*	Inflation Target (in percent)
π^{imp}	*dl_cpi_im*	Imported Inflation in Local Currency (in percent)
ny	*l_ny*	Nominal GDP Level (100*log)
Δny	*dl_ny*	Nominal GDP Growth (in percent)
$\Delta^{e} ny$	*e_dl_ny*	Expected Nominal GDP Growth (in percent)
i	$rsg1$	Government Bond Yields (1Y) (in percent, p.a.)
$i3$	$rsg3$	Government Bond Yields (3Y) (in percent, p.a.)
$i10$	$rsg10$	Government Bond Yields (10Y) (in percent, p.a.)
$tprem3$	$tprem3$	Term Premium (3Y over 1Y) (percentage points)
$tprem10$	$tprem10$	Term Premium (10Y over 1Y) (percentage points)
r	$rr1$	Real Government Bond Yields (1Y) (in percent, p.a.)
$\bar{r}$	$rr1\_tnd$	Equilibrium Real Government Bond Yields (1Y) (in percent, p.a.)
lr	lrr	Average Real Government Bond Yields (in percent, p.a.)
$\overline{lr}$	lrr_tnd	Average Long Equilibrium Real Government Bond Yields (in percent, p.a.)
$\Delta\overline{lr}$	d_lrr_tnd	Change of Average Long Equilibrium Real Government Bond Yields (pp)
$r3$	$rr3$	Real Government Bond Yields (3Y) (in percent, p.a.)
$r10$	$rr10$	Real Government Bond Yields (10Y) (in percent, p.a.)
$\overline{r3}$	$rr3\_tnd$	Equilibrium Real Government Bond Yields (3Y) (in percent, p.a.)
$\overline{r10}$	$rr10\_tnd$	Equilibrium Real Government Bond Yields (10Y) (in percent, p.a.)
i^{fcy}	rsg_fcy	Foreign Currency Government Debt Interest Rate (in percent, p.a.)
Δs	dl_czk_eur	Nominal Exchange Rate Depreciation CZK/EUR (in percent)
s	l_czk_eur	Nominal Exchange Rate Level CZK/EUR (100*log)

b	*debt_rat*	Government Debt to GDP (in percent)
b^{tar}	*debt_tar_rat*	Government Debt Target to GDP (in percent)
b^{dev}	*e_debt_dev*	Expected Government Debt Deviation From Target to GDP (pp)
d	*def_rat*	Total Government Deficit to GDP (in percent)
pd	*primdef_rat*	Primary Government Deficit to GDP (in percent)
sd	*def_struct_rat*	Structural Government Deficit to GDP (in percent)
sd^{tar}	*def_struct_tar_rat*	Structural Government Deficit Consistent with Debt Target to GDP (in percent)
$\widehat{NY}$	*cycle_gap*	Business Cycle Gap (in percent)
a^{sd}	*stiff_def_struct_rat*	Stiffness of Structural Deficit Accommodation (unitless)
d^{imp}	*fiscimp_rat*	Fiscal Impulse to GDP (in percent)
id	*intcost_rat*	Interest Cost to GDP (in percent)
id^{1Y}	*intcost*1*_rat*	Interest Cost on 1Y LCY Government Debt to GDP (in percent)
id^{3Y}	*intcost*3*_rat*	Interest Cost on 3Y LCY Government Debt to GDP (in percent)
id^{10Y}	*intcost*10*_rat*	Interest Cost on 10Y LCY Government Debt to GDP (in percent)
id^{fcy}	*intcost_fcy_rat*	Interest Cost on FCY Government Debt to GDP (in percent)
b^{1Y}	*debt*1*_rat*	Newly Issued 1Y LCY Government Debt to GDP (in percent)
b^{3Y}	*debt*3*_rat*	Newly Issued 3Y LCY Government Debt to GDP (in percent)
b^{10Y}	*debt*10*_rat*	Newly Issued 10Y LCY Government Debt to GDP (in percent)
b^{fcy}	*debt_fcy_rat*	Newly Issued FCY Government Debt to GDP (in percent)
b^{tot1Y}	*totdebt*1*_rat*	Total Outstanding 1Y LCY Government Debt to GDP (in percent)
b^{tot3Y}	*totdebt*3*_rat*	Total Outstanding 3Y LCY Government Debt to GDP (in percent)
b^{tot10Y}	*totdebt*10*_rat*	Total Outstanding 10Y LCY Government Debt to GDP (in percent)
h^{1Y}	*share*1*_def*	Ratio of Deficit Allocated to 1Y Debt (ratio)
h^{3Y}	*share*3*_def*	Ratio of Deficit Allocated to 3Y Debt (ratio)
h^{10Y}	*share*10*_def*	Ratio of Deficit Allocated to 10Y Debt (ratio)
h^{fcy}	*share_fcy*	Ratio of Deficit Allocated to FCY Debt (ratio)
i^{*}	*rsf*	Foreign Nominal 1Y Interest Rate (in percent, p.a.)
r^{*}	*rrf*	Foreign Real 1Y Interest Rate (in percent, p.a.)
$\widehat{r^{*}}$	*rrf_gap*	Foreign Real 1Y Interest Rate Gap (in percent, p.a.)
$\widehat{y^{*}}$	*l_y_eu_gap*	Foreign Output Gap (in percent)
π^{*}	*dl_p_eu*	Foreign Inflation Rate (in percent)
p^{*}	*l_p_eu*	Foreign Price Level (100*log FCY)
p^{*}	*rrf_tnd*	Equilibrium Foreign Real Interest Rate (in percent, p.a.)
p^{*}	*prem*	Country and Currency Risk Premium (pp)

p^*	l_z	Real Exchange Rate Level (100*log)
p^*	l_z_tnd	Equilibrium Real Exchange Rate Level (100*log)
g^z	g_z_tnd	Trend Depreciation of Equilibrium Real Exchange Rate (in percent)
$\hat{z}$	l_z_gap	Real Exchange Rate Gap (in percent)
$prem^{FCY}$	prem_rsg_fcy	Foreign Currency Rate Premium (in percent, p.a.)
i^{des}	rsg1des	Government Bond Yields (1Y) (wanted by monetary policy) (in percent, p.a.)

Transition Shocks

Variable	Model name	Description
ε^{id}	shock_intcost_rat	Interest Cost Discrepancy Shock (pp)
ε^{b}	shock_debt_rat	Government Debt Discrepancy Shock (pp)
$\varepsilon^{\widehat{r^*}}$	shock_rrf_gap	Innovation to Foreign Real Rate Gap Process (pp)
$\varepsilon^{\widehat{y^*}}$	shock_l_y_eu_gap	Innovation to Foreign Output Gap Process (pp)
ε^{π^*}	shock_dl_p_eu	Innovation to Foreign Inflation Process (pp)
$\varepsilon^{\overline{r^*}}$	shock_rrf_tnd	Innovation to Foreign Eq. Real Interest Process (pp)
ε^{s}	shock_uip	UIP Condition Shock (pp)
$\varepsilon^{b^{tar}}$	shock_debt_tar	Shock to Target Government Debt to GDP Ratio (pp)
ε^{sd}	shock_def_struct_rat	Shock to Structural Deficit to GDP Ratio (pp)
ε^{d}	shock_def_rat	Shock to Deficit Fiscal Rule (pp)
ε^{h1}	shock_share1_def	Shock to Share of Deficit Allocated to 1Y Debt (fraction)
ε^{h3}	shock_share3_def	Shock to Share of Deficit Allocated to 3Y Debt (pp)
ε^{h10}	shock_share10_def	Shock to Share of Deficit Allocated to 10Y Debt (pp)
ε^{tprem3}	shock_tprem3	Shock to Term Premium 3Y-1Y (pp)
$\varepsilon^{tprem10}$	shock_tprem10	Shock to Term Premium 10Y-1Y (pp)
ε^{g^z}	shock_g_z_tnd	Shock to Eq. Real Exchange Rate Depretiation Rate (pp)
ε^{y}	shock_l_y_tnd	Permanent Level Shock to Potential GDP (pp)
ε^{g}	shock_g_y_tnd	Shock to Potential GDP Growth Rate (pp)
$\varepsilon^{\hat{y}}$	shock_l_y_gap	Demand Shock (pp)
ε^{π}	shock_dl_cpi	Cost Push Shock (pp)
$\varepsilon^{\pi^{tar}}$	shock_dl_cpi_tar	Innovation to Inflation Target (pp)
ε^{i}	shock_rsg1	Monetary Policy Shock (pp)
ε^{prem}	shock_prem	Shock to Country Risk Premium (pp)
ε^{dlpw}	shock_dlp_wedge	Shock to Defl. and Headl. CPI Inflation Wedge (pp)
$\varepsilon^{prem^{FCY}}$	shock_prem_rsg_fcy	Shock to Foreign Currency Rate Premium(pp)

Steady-State Parameters

variable	code name	Austria	Czech Republic	Germany
π_{ss}^{*}	ss_dl_p_eu	1.9	1.9	2.5
r_{ss}^{*}	ss_rrf_tnd	0.7691	0.7691	1
$tprem3_{ss}$	ss_tprem3	0.6	0.7	0.2
$tprem10_{ss}$	ss_tprem10	1.20	1.2	0.4
b_{ss}^{tar}	ss_debt_rat	60	30	70
g_{ss}	ss_g_y_tnd	2	2	2
g_{ss}^{z}	ss_g_z_tnd	0	-2.5	0
$prem_{ss}$	ss_prem	0	2.5	0
a_{ss}^{sd}	ss_stiff_def_struct_rat		0.8	
$dlpw_{ss}^{*}$	ss_dlp_wedge			-0.5822

Transition Parameters

variable	code name	Austria	Czech Republic	Germany
f_4	c_cycle_struct	0	0	0
f_1	c_def_l_y_gap	0.63	0.5	0.63
f_2	c_def_debt_dev	0.08	0.1	0.1
p_1	c_debt_in_tprem3	0.05	0.05	0.025
p_2	c_debt_in_tprem10	0.08	0.08	0.04
p_3	c_debt_z_tnd	0.15	0.15	0.05/0.15
p_4	c_debt_in_prem	0.05	0.05	0.025
p_5	c_pot_rr_tnd	1	1	1
e_1	c1_dl_p	0.4	0.4	0.4
e_2	c2_dl_p	0.1	0.1	0.02
e_3	c3_dl_p	0.4	0.4	0.2/0.4/0.5
k_1	c1_l_y_gap	0.15	0.15	0.15
k_2	c2_l_y_gap	0.4	0.4	0.4
k_3	c3_l_y_gap	0.2	0.2	0.4/0.2
k_4	c4_l_y_gap	0.15	0.15	0.02
k_5	c5_l_y_gap	0.55	0.5	0.55
k_6	c6_l_y_gap	0.38	0.4	0.5
u_1	c1_rsg1	0.35	0.35	0.4
u_2	c2_rsg1	2.6	1.5/2.6	2.5
u_3	c3_rsg1			0.5
f_3	c_def_struct_rat	0.7		0.8
ρ_{trem3}	p.rho_tprem3	0.7	0.65	0.6
ρ_{trem10}	p.rho_tprem10	0.65	0.75	0.6
$\rho_{\widehat{r^*}}$	rho_rrf_gap	0.6252		
$\rho_{\widehat{y^*}}$	rho_y_eu_gap	0.5329	0.5329	0.4998
ρ_{π^*}	rho_dl_p_eu	0.2839	0.2839	0.4999
ρ_{r^*}	rho_rrf_tnd	0.916	0.916	0.9605
ρ_{g^z}	rho_g_z_tnd	0.9	0.9	0.0
ρ_g	rho_g_y_tnd	0.9	0.9	0.92

ρ_{prem}	rho_prem	0.87	0.7	0.8
ρ_{dlpw}	rho_dlp_wedge	0.3	0.3	0.1063
δ_s	delta_smooth	0.01	0.01	0.01
γ_+	cpclim1	6	6	6.0
γ_-	cpclim2	-2	-2	-2.0
σ_{id}	stderr_intcost_rat	0.1	0.06	0.1
σ_b	stderr_debt_rat	0.01	2	1
$\sigma_{\widehat{r^*}}$	stderr_rrf_gap	0.8504	0.8504	1.0428
$\sigma_{\widehat{y^*}}$	stderr_l_y_eu_gap	0.7559	0.7559	0.6151
σ_{π^*}	stderr_dl_p_eu	0.7246	0.7246	0.4717
$\sigma_{\bar{r}^*}$	stderr_rrf_tnd	0.2686	0.2686	0.5863
σ_s	stderr_uip	1.2	2	2
$\sigma_{b^{tar}}$	stderr_debt_tar	1	5	5
σ_{sd}	stderr_def_struct_rat	0.33	0.8	0.8
σ_d	stderr_def_rat	0.8	1.5	1.5
σ_{h_1}	stderr_share1_def	0.03	0.03	0.1
σ_{h_3}	stderr_share3_def	0.03	0.03	0.1
$\sigma_{h_{10}}$	stderr_share10_def	0.03	0.03	0.01
σ_{tprem3}	stderr_tprem3	0.15	0.3	0.3
$\sigma_{tprem10}$	stderr_tprem10	0.22	0.3	0.3
σ_{g^z}	stderr_g_z_tnd	0.22	0.4	0.4
$\sigma_{\bar{y}}$	stderr_l_y_tnd	0.2	0.5	0.5
σ_g	stderr_g_y_tnd	0.5	0.7	0.7
σ_π	stderr_dl_cpi	0.5	0.5	0.5
$\sigma_{ATS/EUR}$	stderr_dl_ats_eur	0.5		
$\sigma_{\hat{y}}$	stderr_l_y_gap	0.54	0.8	0.8
$\sigma_{\pi^{tar}}$	stderr_dl_cpi_tar		0.25	0.25
σ_{prem}	stderr_prem	0.44	0.5	0.5
σ_{dlpw}	stderr_dlp_wedge	0.7	2.25	0.7114
$\sigma_{prem^{FCY}}$	stderr_prem_rsg_fcy		0.2	
$\sigma_{i^{nsc}}$	stderr_rsg_nsc	0.5		0.0875
σ_i	stderr_rsg1		0.5	0.5
$\gamma_{\bar{y},\pi}$	corr_p_y	0.2	0.2	0.2
$\gamma_{g,\hat{y}}$	corr_y_g	0.5	0.5	0.5

ANNEX 3: OBSERVABLE VARIABLES IN THE COUNTRY MODELS

Observed data series for the Czech Republic

Variable	Name	Note
y_t	Real gross domestic product	Yearly GDP of Czech Republic in previous year average purchaser prices in national currency Czech Koruna (CZK). Time series is published by Czech Statistical Office (CZSO).
ny_t	Nominal gross domestic product	Quarterly GDP of Czech Republic. Time series is published by Czech Statistical Office (CZSO).
π_t^{tar}	Inflation target of the Czech National Bank	Official inflation target is published by Czech National Bank (CNB) on yearly basis.
i_t	1Y T-bond yields	Yearly average of generic bid yield of government bonds (t-bonds) with residual maturity one year. Daily time series is published by Bloomberg.
$i3_t$	3Y T-bond yields	Yearly average of generic bid yield of t-bonds with residual maturity three years. Daily time series is published by Bloomberg.
$i10_t$	10Y T-bond yields	Yearly average of generic bid yield of t-bonds with residual maturity ten years. Daily time series is obtained from Bloomberg database.
s_t	Spot exchange rate CZK/EUR	The yearly average of the spot exchange rate of the Koruna against the Euro. The time series is obtained from the Bloomberg database.
b_t	Total government debt	Overall stock of general government debt at the end of the year in CZK. Data are published by Czech Ministry of Finance on yearly basis.
d_t	Government deficit	Deficit of general government in CZK is published by CZSO on yearly basis.
pd_t	Primary deficit	Primary deficit is published by EUROSTAT in CZK on yearly basis.
b_t^{tot1Y}	Debt in form of t-bonds with residual maturity up to 1 year	Total volume of outstanding t-bonds with residual maturity at most one year on 31st December of each year. Starting by year 2000 time series is reconstructed by OGResearch from Czech Ministry of Finance reports of central government debt by maturity. Observations prior to 2000 are estimated by OGResearch from results of primary auctions on t-bonds. Historical results of primary auctions on t-bonds are published by Czech Ministry of Finance.
b_t^{tot3Y}	Debt in form of t-bonds with residual maturity between 1 and 5 years	Total volume of outstanding t-bonds with residual maturity longer than 1 year but maximum up to 5 years on 31st December of each year. Series has been constructed analogically to series of total volume of t-bonds with maximum residual maturity one year.
b_t^{tot10Y}	Debt in form of t-bonds with residual maturity longer than 5 years	Total volume of outstanding t-bonds with residual maturity longer than 5 years on 31st December of each year. Series has been constricted analogically to series of total volume of t-bonds with maximum residual maturity one year.
i^*	German government	Yearly average of German 1 year maturity t-bond yields. Daily time series is obtained from Bloomberg database.

	bonds yields (1 year)	
$\hat{y}^*$	Eurozone output gap	OGResearch estimate based on a structural model.
p^*	Eurozone Harmonized Consumer Price Index	The seasonally adjusted data are obtained from the OECD database. The CPI is available on a monthly basis.

Observed data series for Austria

Variable	Name	Note
y_t	Real gross domestic product	Yearly GDP with base year in 2005 obtained from Eurostat. The series is available from 1979.
p	Gross domestic product deflator	Yearly nominal GDP obtained from the Oesterreichische Nationalbank. This GDP is then divided by the real GDP index to obtain the GDP deflator.
p^{cpi}	Austrian consumer price index	The time-series is calculated from monthly values published by the Statistik Austria. The base year of the CPI is an average of 1996.
i	1Y T-bond yields	Yearly average of interest rates on Treasury Bill with a maturity of 1 year, OECD Database.
$i3$	3Y T-bond yields	Yearly values are calculated from monthly averages of Austria 3Y Government Bonds, which are obtained as a generic bid yield from the Bloomberg.
$i10$	10Y T-bond yields	Yearly values are calculated from monthly averages of Austria 10Y Government Bonds (obtained from the same source as the 3Y Government Bonds).
s_t	Spot exchange rate ATS/EUR	The yearly average of the monthly spot exchange rate of the Austrian shilling to ECU before 1998 and a fix conversion rate to EUR is used after (13.76 ATS per EUR). OGR computation.
b_t	Gross government debt as percent to GDP	Total general government debt (all liabilities that require payment or payments of interest and/or principal by the debtor to the creditor at a date or dates in the future) as published by IMF - World Economic Outlook database. The series is divided by nominal GDP.
d_t	Government deficit As percent of GDP	Net lending/borrowing as a difference between total general government revenues and expenditures divided by nominal GDP in EUR. Available in the World Economic Outlook database published by IMF.
pd_t	Primary deficit as percent of GDP	Deficit of general government plus net payable/paid interest costs on government debt in EUR divided by nominal GDP published by IMF (World Economic Outlook database).
b_t^{tot1Y}	Debt in form of t-bonds with residual maturity up to 1 year as percent of GDP	Calculated by OGR using an information on historical issuances of government papers with maturity less than 1 year.

b_t^{tot3Y}	Debt in form of t-bonds with residual maturity between 1 and 5 years as percent of GDP	Calculated by OGR using an information on historical issuances of government papers.
b_t^{tot10Y}	Debt in form of t-bonds with residual Maturity greater than 5 years as percent of GDP	Calculated by OGR using an information on historical issuances of government papers.
i^*	German government bonds yields (1 year)	Yearly average of German 1 year maturity t-bond yields. Daily time series is obtained from Bloomberg database.
b^{fcy}	FCY Government Debt as percent of GDP	Time-series of total outstanding government debt in foreign currencies is obtained from the Oesterreichische Nationalbank. The series is divided by nominal GDP.
$\hat{y}^*$	Eurozone output gap	OGResearch estimate based on a structural model.
p^*	Eurozone Harmonized Consumer Price Index	The seasonally adjusted data are obtained from the OECD database. The CPI is available on a monthly basis.

Observed data series for Germany

Variable	Name	Note
y_t	Real gross domestic product	Yearly GDP obtained by chaining two annual series from DESTATIS, federal Statistical office. The first part has range 1970–1991, second part has a range 1991-2010.
p	Gross domestic product deflator	Yearly nominal GDP obtained from DESTATIS. Until 1991 the time-series is of West Germany. The levels before 1991 obtained from the growth rates from the West Germany and applied on the level in 1991. This nominal GDP is then divided by the real GDP index to obtain GDP deflator.
i_t	1Y T-bond yields	Yearly average of interest rates (calculated by Svensson's method) on papers with a residual maturity of 1.0 year. Bundesbank.
$i3_t$	3Y T-bond yields	Yearly average of interest rates (calculated by Svensson's method) on papers with a residual maturity of 3.0 years. Bundesbank.
$i10_t$	10Y T-bond yields	Yearly average of interest rates (calculated by Svensson's method) on papers with a residual maturity of 10.0 years. Bundesbank.
s_t	Spot exchange rate DEM/EUR	The yearly average of the spot exchange rate of the Deutsch mark to U.S. dollar. Bloomberg.
b_t	Gross government debt as percent to	Total general government debt as published by Bundesbank (Other economic data/ Public finances in Germany/ Development of general

	GDP	government debt/ Creditors). The data before before 1999 are multiplied by DEM/EUR ex- change rate and then the series is divided by nominal GDP in EUR.
d_t	Government deficit As percent of GDP	Net lending/borrowing as a difference between total general government revenues and expenditures divided by nominal GDP in EUR. Published by Eurostat.
pd_t	Primary deficit as percent of GDP	Deficit of general government minus interest costs on government debt in EUR divided by nominal GDP. Eurostat.
b_t^{tot1Y}	Debt in form of t-bonds with residual maturity up to 1 year as percent of GDP	Calculated by OGR using an information on historical issuances of government papers.
b_t^{tot3Y}	Debt in form of t-bonds with residual maturity between 1 and 5 years as percent of GDP	Calculated by OGR using an information on historical issuances of government papers.
b_t^{tot10Y}	Debt in form of t-bonds with residual Maturity greater than 5 years as percent of GDP	Calculated by OGR using an information on historical issuances of government papers.
i^*	1Y U.S. interest rate	Yearly average of the market yields on U.S. Treasury securities at 1-year, constant maturity, quoted on investment basis. FED, economic research and data
$\hat{y}^*$	U.S. output gap	OGResearch estimate based on a structural model.
π^{tar}	Inflation target of ECB	Data observed only since 2001 and set to constant 1.9 %.
p^{cpi}	German consumer price index	Time-series for west Germany (before 1991) and united Germany (after 1991) joined by the growth rates. Both time-series published by DESTATIS.

WORKING PAPERS

The full series of Economics Department Working Papers can be consulted at www.oecd.org/eco/workingpapers/

1073. *Road connectivity and the border effect: Evidence from Europe*
(July 2013) by Henrik Braconier and Mauro Pisu

1072. *Fiscal consolidation across government levels. Part 3: Intergovernmental grants, pro- or counter-cyclical?*
(July 2013) by Hansjörg Blöchliger and Balázs Égert

1071. *Fiscal consolidation across government levels. Part 2: Fiscal rules for sub-central governments, update of the institutional indicator*
(July 2013) by Kaja Fredriksen

1070. *Fiscal consolidation across government levels. Part 1: How much, what policies?*
(July 2013) by Hansjoerg **Blöchliger**

1069. *Restructuring the electricity sector and promoting green growth in Japan*
(June 2013) by Randall S. Jones and Myungkyoo Kim

1068. *Labour market policies to promote growth and social cohesion in Korea*
(June 2013) by Randall S. Jones and Satoshi Urasawa

1067. *Education reform in Korea*
(June 2013) by Randall S. Jones

1066. *Enhancing the cost efficiency and flexibility of the health sector to adjust to population ageing*
(June 2013) by Stéphane Sorbe

1065. *Italy and the euro area crisis: securing fiscal sustainability and financial stability*
(June 2013) by Oliver Denk

1064. *Policy implementation in Italy: legislation, public administration and the rule of law*
(June 2013) by Paul O'Brien

1063. *Greening growth in Luxembourg*
(June 2013) by Nicola Brandt
Vers une croissance plus verte en Luxembourg
(juin 2013) par Nicola Brandt

1062. *The post-crisis narrowing of international imbalances – cyclical or durable?*
(June 2013) by Patrice Ollivaud and Cyrille Schwellnus

1061. *Restructuring welfare spending in Slovenia*
(June 2013) by Rafał Kierzenkowski

1060. *The economics of civil justice: new cross-country data and empirics*
by G. Palumbo; G. Giupponi; L. Nunziata and J. Mora-Sanguinetti (forthcoming)

1059. *Banks' restructuring and smooth deleveraging of the private sector in Slovenia*

(June 2013) by Olena Havrylchyk

1058. *Assessing the efficiency of welfare spending in Slovenia with data envelopment analysis*
(June 2013) by Matevz Hribernik and Rafał Kierzenkowski

1057. *Policy determinants of school outcomes under model uncertainty: evidence from South Africa*
(June 2013) by Thomas Laurent, Fabrice Murtin, Geoff Barnard, Dean Janse van Rensburg, Vijay Reddy, George Frempong and Lolita Winnaar

1056. *Improving education quality in South Africa*
(June 2013) by Fabrice Murtin

1055. *The 90% public debt threshold: the rise and fall of a stylised fact*
(June 2013) by Balázs Égert

1054. *Challenges to sustain Poland's growth model*
(June 2013) by Balázs Égert and Rafał Kierzenkowski

1053. *Reforming agriculture and promoting Japan's integration in the world economy*
(May 2013) by Randall S. Jones and Shingo Kimura

1052. *Inequality and poverty in the United States: public policies for inclusive growth*
(May 2013) by Oliver Denk, Robert Hagemann, Patrick Lenain and Valentin Somma

1051. *Fiscal federalism and its impact on economic activity, public investment and the performance of educational systems*
(May 2013) by Hansjörg Blöchliger, Balázs Égert and Kaja Fredriksen

1050. *Restoring Japan's fiscal sustainability*
(May 2013) by Randall S. Jones and Satoshi Urasawa

1049. *Measuring total factor productivity at the firm level using OECD-ORBIS*
(May 2013) by Peter Gal

1048. *A projection method for public health and long-term care expenditures*
(June 2013) by Christine de la Maisonneuve and Joaquim Oliveira Martins

1047. *R&D, patenting and growth: the role of public policy*
(May 2013) by Ben Westmore

1046. *Knowledge-based capital, innovation and resource allocation*
(May 2013) by Dan Andrews and Chiara Criscuolo

1045. *Reforms for a Cleaner, Healthier Environment in China*
(April 2013) by Sam Hill

1044. *Making the tax system less distortive in Switzerland*
(April 2013) by Andrés Fuentes

1043. *The determinants of informality in Mexico's states*
(April 2013) by Sean M. Dougherty and Octavio Escobar