Variable rate debt to insure the government budget against macroeconomic shocks

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Abstract

Inspired by the fiscal insurance theory of public debt management we focus on the role of debt management in insuring the government budget against business cycle fluctuations. In particular we analyze the potential of inflation-indexed and short-term interest-rate-linked debt to hedge the Austrian government budget against macroeconomic demand, supply and monetary policy shocks. By employing a multi-country BVAR model for the Austrian and euro area economy over the period 1999 to 2016 we find that both instruments are able to hedge a substantial part of cyclical budget balance dynamics. The hedging potential of both instruments differs considerably when specific drivers of business cycle fluctuations are analyzed. In case of demand shocks both instruments have the potential to insure the government budget, while in case of supply shocks and monetary policy shocks this is only true for interest-rate-linked debt and inflation-indexed debt, respectively.

Keywords: Public finance, debt management, variable rate debt

JEL Classification: H63, E62, E44

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1 Introduction

Over the last decades, sovereign debt management in OECD countries has shifted from operational bodies within finance ministries or central banks to partly or fully independent entities. This operational transformation has been accompanied by a change of debt management objectives from macroeconomic stabilization to expected cost minimization (Hoogduin et al., 2011). Our work tries to counteract this development by raising awareness about the potential of debt management as a vital tool of fiscal stabilization policy. Inspired by the fiscal insurance theory of public debt management (Faraglia et al., 2008) we focus on the role of debt management in insuring government finances against macroeconomic shocks.

In the traditional optimal taxation literature setting (Lucas and Stokey, 1983) fiscal insurance addresses the potential of debt management strategies to smooth taxes over time. Our approach focuses on the potential of debt management to create procyclical interest payment reactions in order to produce fiscal space for automatic stabilizers to move freely. A similar motive of public debt management that stresses the situation of a fiscal rule environment can be found in Giavazzi and Missale (2004), Borensztein et al. (2004), Goldfajn (1998), Lloyd-Ellis and Zhu (2001). In theoretical terms, our setting implies that public debt management tries to minimize the conditional variance of the budget balance ratio, i.e. to minimize the cash flow risk of the budget, which corresponds to a smoothing of the budget balance ratio over time. Alternative risk measures relevant for public debt management like rollover risk, liquidity risk, interest rate risk and reputation risk stay undiscussed.[1] Deviating from the existing debt management literature we do not consider the price of government bonds (market value of debt) to be of specific relevance for the governmental inter-temporal budget constraint (fiscal policy/public debt management). This assumption replicates real-life debt management behavior in many countries, where government debt is to a large extent held to maturity. Debt management only occasionally makes use of buy-backs or equivalent derivative operations.

The first part of the paper presents a theoretical framework for identifying the key elements determining the hedging/insurance properties of debt management instruments. We show that in a simple static framework the optimal debt portfolio hedge against the effect of macroeconomic shocks on the government budget is realized if the reaction of interest payments is equivalent to the reaction of the primary budget balance ratio. In this case the variance of the budget balance becomes completely immune to macroeconomic shocks. By considering stylized textbook monetary policy and macroeconomic demand

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[1]For a thorough discussion of these risk measures in the context of public debt management see Holler (2013).

and supply shocks we analyze the hedging potential of debt instruments with varying coupon payments linked to short-term interest rates (floating rate bonds) and inflation rates (inflation-indexed-bonds). We show that floating rate bonds can be used to insure the government budget against demand shocks while in the case of supply shocks their hedging potential ambiguously depends on the shock reaction of interest rates. Only in the case of monetary policy shocks the theoretical framework clearly identifies an increase of the variance of the budget balance through the use of floating rate instruments. In contrast, inflation-indexed debt reduces budget cash flow risk in the case of demand shocks and monetary policy shocks while it only increases the variance of the budget balance in the case of supply shocks.

The theoretical analysis is followed by an empirical evaluation of the potential historical performance of variable rate debt instruments to insure the Austrian government budget against national and international macroeconomic shocks over the period 2006 to 2016. Specifically we use a multi-country structural Bayesian VAR model to identify the joint reaction of macroeconomic variables to Austrian and euro area supply, demand and monetary policy shocks. This analysis supports the results drawn from the simple theoretical framework and further highlights that the theoretically ambiguous hedging potential of floating rate bonds against supply shocks is clearly positive. We further identify a substantial potential of both types of variable rate instruments to insure the government budget against aggregate macroeconomic shocks observed over the period 2016 to 2016. In addition, we further calculate the potential historical interest payments connected to the use of variable rate debt instruments. We find that the use of both variable rate debt instruments considered in the analysis would have reduced the overall interest payments of the government. The calculated interest payment reduction crucially depends on the observed path of benchmark rate movements. A period of increasing interest or inflation rates would clearly correspond to higher interest payments connected to the use of variable debt instruments while the use of these instruments would still reduce the variance of the budget balance. Expectations about the type of economic shocks and the path of interest rates therefore have to guide the potential implementation of variable rate debt instruments.

2 Analytical framework

In our framework the objective of debt management solely lies in smoothing the budget balance in terms of GDP over time. Mathematically this implies that debt management is trying to minimize the conditional variance of the budget balance ratio $Min\mathbb{E}_t(BB_{t+1} - \mathbb{E}_t BB_{t+1})^2$, where BB_t is the budget balance ratio in period t. The contemporaneous

government budget constraint is given by:

$$BB_{t+1} = PB_{t+1} - i^a_{t+1}D_t \qquad (2.1)$$

where PB_{t+1} is the primary balance ratio and i^a_{t+1} is the average growth-adjusted benchmark interest rate in period $t+1$ ($i^{\tilde{a}}_{t+1}\frac{Y_t}{Y_{t+1}}$) and D_t is the debt ratio in period t. The impact of an unexpected macroeconomic shock ϵ_{t+1} on the balance budget ratio is given by [2]:

$$\frac{\partial BB_{t+1}}{\partial \varepsilon_{t+1}} = \frac{\partial PB_{t+1}}{\partial \varepsilon_{t+1}} - \frac{\partial i^a_{t+1}}{\partial \varepsilon_{t+1}}D_t \qquad (2.2)$$

A perfect budget balance hedge against the macroeconomic shock implies that the reaction of the primary balance ratio is offset by the reaction of interest payments ($i^a_{t+1}D_t$):

$$\frac{\partial PB_{t+1}}{\partial \varepsilon_{t+1}} = \frac{\partial i^a_{t+1}}{\partial \varepsilon_{t+1}}D_t \qquad (2.3)$$

The reaction of the primary balance to a macroeconomic shock (left-hand side of equation 2.3) is crucially dependent on the fiscal policy (transfer and taxation system) of a country that determines the size of automatic stabilizers. To understand the reaction of interest payments (right-hand side of equation 2.3) we consider a simple two-period framework with fixed and variable interest rate debt to split the average growth-adjusted interest rate into its components:

$$i^a_{t+1}D_t = i_t D_t(1 - \Psi) + i_{t+1}D_t\Psi \qquad (2.4)$$

where $\Psi \in 0, 1$ is the share of variable rate debt and $(1 - \Psi)$ is the share of fixed rate debt.

$$\frac{\partial i^a_{t+1}}{\partial \varepsilon_{t+1}}D_t = \frac{\partial i_{t+1}}{\partial \varepsilon_{t+1}}D_t\Psi \qquad (2.5)$$

Equation 2.5 highlights that the reaction of interest payments is determined by the reaction of the benchmark interest rate to the macroeconomic shock, the size of public debt and the debt portfolio structure chosen by the public debt management authority. In a traditional set of public debt management instruments, the variable-rate-ratio[3] represented by Ψ, steers the influence of benchmark interest rate changes on overall interest payments.

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[2]For the sake of clarity we assume that the second order effect of macroeconomic shocks on the growth-adjustment factor Y_t/Y_{t+1} in equation 2.2 is negligible, i.e. $i^a_t = i^{\tilde{a}}_t$

[3]Variable rate debt as a percentage of total debt

The general question of our analysis is whether Ψ can be used to smooth the government budget against the budget balance effect of macroeconomic shocks. Specifically we try to identify the variable-rate-ratio that minimizes the variance of the budget balance by considering two types of variable rate instruments, namely inflation-indexed debt and floating rate debt linked to the 3-month Euribor. With respect to the macroeconomic shocks (ε) we differentiate between macroeconomic supply, demand and monetary policy shocks. We draw from textbook economic theory that inflation-indexed debt has the potential to smooth the government budget in the case of demand and monetary policy shocks while the opposite is true in the case of macroeconomic supply shocks. The smoothing potential of floating rate debt is less clearcut. While floating rate debt smooths the budget balance in the case of demand shocks, it increases the variance of the budget deficit in case of monetary policy shocks. Its reaction to supply shocks is ambiguous. A Taylor-rule-like monetary policy weights the effect of the inflation reaction against the output reaction. If the influence and reaction of GDP in the monetary policy rule is strong enough, floating rate debt offers a budget hedge against supply shocks. The opposite is true for a strong reaction and influence of inflation in the monetary policy rule. This highlights that the size and type of observed economic shocks determines the hedging or smoothing potential of the considered variable debt instruments. In order to draw general conclusions about the hedging potential of variable rate instruments the next section of the paper empirically evaluates their potential historical performance over the period 1999 to 2016 for the case of Austria.

3   Identification of macroeconomic shocks driving the Austrian economy

This part focuses on the identification and quantification of structural economic shocks hitting the Austrian economy between 2000 and 2016. With respect to our theoretical framework we try to identify the macroeconomic shock variable ε and its impact on economic output, inflation and interest rates. Economic shocks driving business cycle fluctuations in Austria are analyzed within a Bayesian VAR model using sign and zero restrictions. The Austrian economy is modeled as part of the euro area. As a small open economy, the business cycle in Austria is strongly determined by global developments. Since the majority of Austrian trade flows are within the euro area we make the simplifying assumption that the euro area captures all important global developments. Thus the identification of euro area (global) and domestic shocks is analyzed in a two-country/region VAR model including the euro area and Austria (see Canova (2005), Fenz and Schneider (2006) and Fenz and Schneider (2007)).

3.1 The BVAR model

The BVAR model consists of three variables for the euro area: real GDP as a measure of real activity, the CPI as a measure of inflation, and short term interest rate (3-month Euribor). Since Austria is part of the European monetary union (EMU) the Austrian block reduces to two variables only: real GDP and the CPI. Given the small size of the Austrian economy relative to the euro area as a whole, we assume that there are no feedbacks from Austrian variables to euro area variables. Since the focus of the paper is on short- to medium-term effects of idiosyncratic economic shocks only stationary variables enter the BVAR. The possible loss of information concerning long-run relations by not using levels in the BVAR is more than offset by the reduced risk of spurious regressions. Since statistical tests indicate that most variables are I(1) we decided to use annual growth rates for output and price index and levels for short-term nominal interest rates.[4] The corresponding reduced form two-country model is given by:

$$\begin{pmatrix} x_t^{EA} \\ x_t^{AT} \end{pmatrix} = \begin{pmatrix} A_{11}(L) & 0 \\ A_{21}(L) & A_{22}(L) \end{pmatrix} \begin{pmatrix} x_{t-1}^{EA} \\ x_{t-1}^{AT} \end{pmatrix} + \begin{pmatrix} \varepsilon_t^{EA} \\ \varepsilon_t^{AT} \end{pmatrix} \tag{3.1}$$

where $(\varepsilon_t^{EA}, \varepsilon_t^{AT})' \sim (0, \Sigma)$, $\Sigma = blockdiag(\Sigma_{\varepsilon^{EA}, \varepsilon^{AT}})$. x_t^{EA} represents the set of euro area variables, x_t^{AT} the set of Austrian variables. According to the Akaike information criteria, a lag length of two was selected.

3.2 Identification scheme

We use the identification scheme of Canova (2005) to derive structural shocks from the BVAR innovations. The basic idea behind that approach is to use sign restrictions on the cross-correlation of the impulse responses to identify economically interpretable shocks. Instead of imposing restrictions on the contemporaneous relations between the innovations, we search randomly among all possible decompositions of the BVAR innovations and choose those which are in line with our restrictions on the impulse responses.[5] The search is continued until 10,000 admissible decompositions are found. Among all admissible decompositions, we choose the one that according to the historical decomposition has

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[4]To render the interest rate series stationary in levels we corrected for the negative trend over the observation period.

[5]Compared to alternative identification schemes (Cholesky decomposition, short-run restrictions (Sims (1980)), long-rung restrictions (Blanchard and Quah (1988)) and the generalized impulse response function (Pesaran and Shin (1998)) the one proposed by Canova (2005) has two main advantages. First, the statistical problem of orthogonalization is strictly separated from identification, which helps to make all assumptions needed for identification very explicit. Second, no zero restrictions on either the short-run or the long-run impulse responses are needed. These are often inconsistent with a large class of theoretical models (Canova and Pina (1999)).

the minimal distance over all shocks to the median historical decomposition.

To be more specific, we start with the BVAR innovations $\varepsilon_t \sim (0, \Sigma_\varepsilon)$. To identify uncorrelated structural shocks from the correlated innovations, we begin by orthogonalizing the variance covariance matrix of the innovations of the BVAR (Σ_ε) by means of static principal components. Using a standard eigenvalue-eigenvector decomposition gives $\Sigma_\varepsilon = VDV'$, where V is the matrix of eigenvectors and D a diagonal matrix of eigenvalues. Setting $P = VD^{1/2}$ we can rewrite $\Sigma_\varepsilon = VDV'$ and transform the BVAR in equation 3.1 to

$$\tilde{x}_t = A(L)\tilde{x}_{t-1} + \tilde{\varepsilon}_t \tag{3.2}$$

where $\tilde{x}_t = P^{-1}x_t$, $\tilde{\varepsilon}_t = P^{-1}\varepsilon_t$, $\tilde{\varepsilon}_t = (0, I)$. This transformation guarantees that the transformed residuals are orthonormal. However, the orthogonalization is by no means unique. To see this, notice that for any orthonormal matrix $Q : QQ' = I$, $\Sigma_\varepsilon = \tilde{P}\tilde{P}' = PQQ'P'$, is an admissible decomposition. Thus, we can construct a set of admissible decompositions by using different orthonormal matrices Q. Within the class of orthonormal matrices, rotation matrices are a reasonable candidate to consider. They allow us to cover the whole space of Q matrices in a straightforward way. Rotation matrices use sine and cosine functions to rotate the orthogonalized residuals (Schneider and Fenz (2011)). We search randomly in the set of rotation matrices for decompositions with a meaningful economic interpretation, i.e. decompositions that fulfill the set of sign restrictions which is imposed on the cross-correlation. These sign restrictions are derived from standard economic theory. We aim to identify three different structural shocks - a demand shock, a supply shock and a monetary policy shock - for the euro area and two different structural shocks - a demand shock and a supply shock - for Austria. Standard macroeconomic theory provides us signs for the theoretical co-movement of the variables of the euro area and the Austrian block in the BVAR in response to the structural shocks. A positive demand shock will generate a positive response of output and a rise in inflation. Monetary authorities will increase interest rates, thereby generating a positive co-movement between all three variables. In contrast, a positive supply shock will increase output but decrease prices, while the effect on short-term interest rates remains ambiguous. Finally, a positive monetary policy shock is associated with lower short-term interest rates. The expansionary impulse will cause output and inflation to increase simultaneously. Thus, the three structural shocks are characterized by co-movements between output, inflation and short-term interest rates with different signs. These sign restrictions can be derived from a large set of theoretical models. They are consistent with the standard textbook aggregate-demand aggregate-supply framework as well as with more advanced models like DSGE models in the line of Smets and Wouters (2003).

Table 3.1: Sign restrictions

	GDP^{EA}	π^{EA}	i^{EA}	GDP^{AT}	π^{AT}
EA demand shock	1	1	1	?	?
EA supply shock	1	−1	?	?	?
EA monetary policy shock	1	1	−1	?	?
AT demand shock	0	0	0	1	1
AT supply shock	0	0	0	1	−1

GDP^j indicates the year on year growth rate of real GDP of country j, π^j the year on year inflation rate of country j and i^{EA} the short-term interest rate of the euro area.

For each admissible decomposition, the impulse responses for the euro area and Austrian variables must fulfill the theoretical restrictions outlined in table 3.1. A positive co movement is indicated by (1) in table 3.1, a negative co-movement by (-1), a zero restriction by (0) and no restriction by (?). For Austria, a distinct monetary policy shock can not be identified; thus the Austrian block consists of only two variables, GDP growth and inflation, respectively. The estimation method used follows Rubio-Ramirez et al. (2014). It allows simultaneously for sign restrictions and zero restrictions in a time varying VAR model with stochastic volatility. As can be seen from table 3.1 the response of output growth and inflation in Austria to euro area shocks has not been restricted a priori. Nevertheless given the tight economic linkages between both regions one would expect the Austrian variables to move in the same direction as the euro area variables. All data are taken from Eurostat's New Cronos database. The estimation period starts in the first quarter of 1999 (start of EMU) and ends with the fourth quarter of 2016.

The analysis of the structural shocks that hit the Austrian economy draws on results for impulse response functions and historical decompositions.

3.3 Impulse response functions

The first step in the analysis of business cycle shocks in the euro area and Austria is to consider the impulse response functions of the BVAR model (see figure 3.1). All shocks show the expected signs. While this holds per definition for euro area and Austrian shocks within each region also the transmission pattern of euro area shocks to the Austrian economy - a case where no restrictions have been imposed - is in line with expectations. All three structural euro area shocks - supply, demand and monetary policy shocks - cause GDP and prices in Austria to move in the same direction as in the euro area. Moreover, a euro area supply shock triggers a positive co-movement between the short-term interest rate and GDP. Thus in the implicitly estimated Taylor-rule of the BVAR model, changes in output dominate changes in inflation in case of a standard supply shock. Therefore

the conditions for short-term interest-rate-linked hedging that potentially reduces the variance of the Austrian budget balance are fulfilled in the case of a euro area demand and a euro area supply shock. Only monetary policy shocks cause short-term interest rates and GDP growth to move in opposite directions.

Concerning the size of the transmission, euro area demand shocks cause Austrian GDP to change by almost the same amount while monetary policy and supply shocks show a weaker transmission. Price reactions in Austria and the euro area are almost identical in case of euro area demand and supply shocks but somewhat smaller in case of monetary policy shocks. A comparison of euro area and Austrian demand shocks shows that both trigger very similar reactions of Austrian variables. With the exception of Austrian GDP, which reacts slightly more delayed in case of euro area supply shocks, this also holds for supply shocks. To summarize, the estimated impulse response functions clearly identify a hedging potential for short-term interest-rate-linked debt in case of euro area demand and supply shocks and for inflation-linked debt in case of demand and monetary policy shocks.

**Figure 3.1:** Impulse response functions
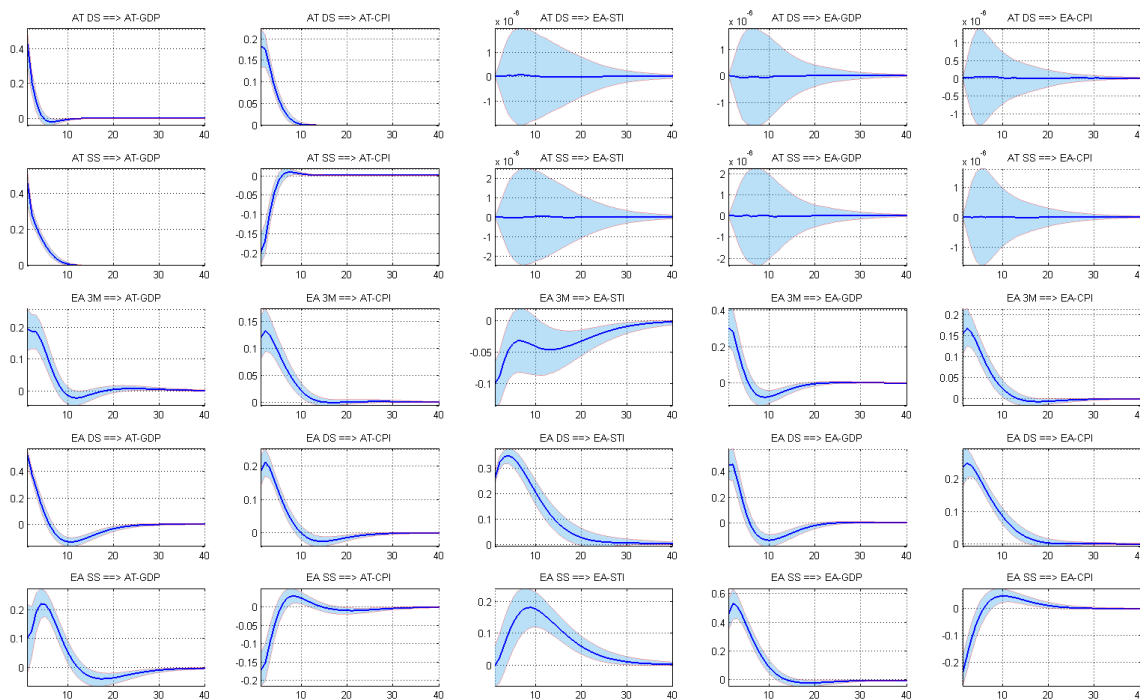
AT=Austria; EA=euro area; SS=supply shock; DS=demand shock; 3M=monetary policy shock; GDP=gross domestic product, CPI=consumer price index, STI=short-term interest rate (3-month Euribor); source: own calculations.

3.4 Historical decomposition

Figure 3.2 shows the historical decomposition of Austrian GDP growth into euro area and Austrian structural shocks. The contribution of a shock at time t comprises the contemporaneous influence at time t as well as the delayed influence of the shock in all previous periods. Thus although the model was estimated over the full sample it takes some time at the beginning of the sample period until past shocks can explain business cycle fluctuations completely. The length of this phase-in period depends crucially on the persistence of shocks as shown in the impulse response functions. The unexplained part of business cycle fluctuations at the beginning of the sample is captured by the grey bars called "initial conditions" in figure 3.2. After 5 years the unexplained part of business cycle fluctuations becomes negligible.

Figure 3.2: Historical decomposition of Austrian GDP growth (real, year-on-year growth rates)
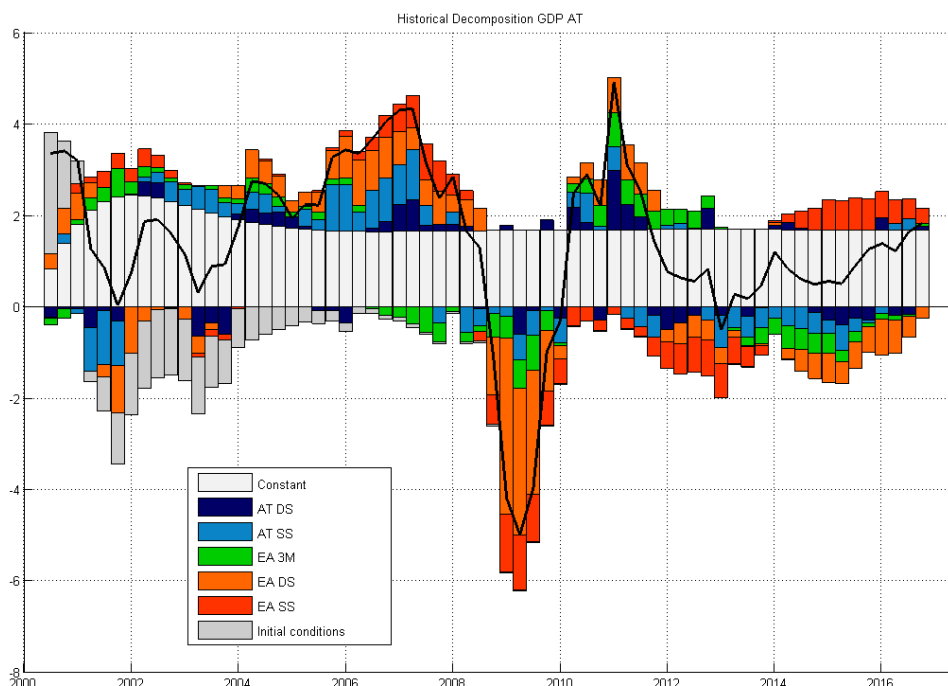
Source: own calculations.

After the recession in 2001 the Austrian economy needed several years to recover. From 2005 onwards euro area and domestic supply and demand shocks contributed significantly to growth in Austria. The global character of the financial and economic crisis with its climax in 2009 is reflected in the historical decomposition by large negative contributions from international (euro area) shocks - mainly demand shocks - to output growth in

Austria. But the downturn was also reinforced by domestic shocks. The economic rebound in 2010/11 was triggered partly by euro area shocks reflecting the recovery of the world economy. The comparatively strong effect of domestic shocks to the rebound of the Austrian economy may be explained by confidence effects. Moreover growth contributions of monetary policy shocks turned positive. After 2011 the Austrian economy entered into a period of low growth until 2015. Initially the European debt crises had a dampening effect on output in Austria. But from 2014 onwards the upswing of the German economy caused growth contributions of euro area shocks to slowly turn positive. In contrast, domestic shocks had a persistent dampening effect indicating that the Austrian economy is potentially facing structural problems. Only very recently domestic shocks have turned neutral.

4 Hedging properties of variable rate debt instruments

After the identification of the reaction of national and international macroeconomic variables to macroeconomic shocks we now focus on the last unexplained element of equation 2.3, the shock-induced reaction of the primary balance. Due to the fact that the primary balance is crucially influenced by a variety of variables outside the scope of the BVAR we did not directly include it in the BVAR analysis. Instead, we simply assume that the shock-induced change of the primary balance is determined by the size of the shock weighted with the semi-elasticity of the budget balance taken from Mourre et al. (2014).[6] Since the semi-elasticity of the budget balance, which measures the reaction of the budget balance as a ratio of GDP to a change in the domestic output gap, considers interest payments to be acyclic, the semi-elasticity of the budget balance is identical to the semi-elasticity of the primary balance. Throughout our analysis we assume that potential output stays constant over time. Therefore the semi-elasticity of the primary balance is equivalent to the reaction of the primary balance to a change in economic growth rates, which corresponds to the measure of economic shocks presented in the previous section. We now have all the necessary tools to evaluate equation 2.3, which corresponds to the hedging potential of variable rate debt instruments. Due to our assumption that Austrian shocks do not influence macroeconomic variables on the euro area level the only instrument which potentially can insure the government budget against national shocks is debt linked to the Austrian HICP. Reflecting the results from the historical shock decomposition (subsection 3.4) we separately analyze the hedging potential of the considered

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[6]This assumption implies that inflation rate dynamics do not influence the budget balance. While this assumption must not hold in reality, the influence of inflation rate changes on the budget balance is not clearcut (see for example Attinasi et al. (2015) or Prammer and Reiss (2015)).

variable rate debt instruments for demand, supply and monetary policy shocks.

4.1   Demand shocks

Figure 4.1 presents the reaction of primary balance ($\partial PB/\partial\varepsilon$), interest payments connected to inflation-indexed debt ($\partial IP^{HICP-linked}/\partial\varepsilon$) and interest payments connected to interest-rate-linked debt ($\partial IP^{3M-Euribor}/\partial\varepsilon$) to Austrian and euro area demand shocks.[7] In the case of Austrian demand shocks over the period 2006 to 2016 interest payments connected to HICP-linked debt and primary balance dynamics generate a pattern that supports the idea of textbook economic theory of positively correlated inflation rates and GDP growth rates. The same is true for the case of euro area demand shocks. Our results underline that HICP-linked interest payments are able to partially insure the government budget against macroeconomic demand shocks. In the case of euro area demand shocks the results further highlight that debt linked to the 3M-Euribor rate can also be used to hedge the government budget. Since European interest rates do not react to domestic Austrian demand shocks, Euribor-linked debt instruments can not be used to insure against domestic shocks. Due to the fact that the correlation between 3M-Euribor-linked interest payments and primary balance changes due to euro area demand shocks appear to be smaller than in the case of HICP-linked interest payments, overall hedging properties are less favorable. In order to derive a metric to measure the smoothing potential of variable rate debt besides eyeball econometrics we calculate the ratio of the variance of the budget balance (σ^{2BB}) and the variance of primary balance (σ^{2PB}) for the whole set of viable variable-rate-ratios (φ). Values below unity represent a positive hedging potential of debt instruments while the opposite is true for values above unity. Figure 4.2 shows that in the case of domestic Austrian demand shocks inflation-indexed debt smooths the budget for all variable debt ratios. The level of smoothing steadily increases in the share of debt linked to the HICP. A debt portfolio consisting of 100% inflation-indexed debt reduces the variance of the budget balance due to domestic demand shocks by more than 50%. A similar result is calculated for the case of euro area demand shocks, where inflation-indexed debt also reduces the variance of the budget balance for the whole set of φ. 3M-Euribor-linked debt on the other hand (see red line in 4.2) also insures the budget balance against euro area demand shocks for the whole set of variable-rate-ratios while the minimum variance of the budget balance corresponds to a variable rate debt ratio of approximately 55%. [8]

[7]In order to ease the visual interpretation of the graphs we assume that $\varphi = 50\%$.

[8]For variable rate debt ratios larger than 55% the variance ratio starts to increase again but remains below 1. This is a consequence of the high persistence of the response of the short-term interest rate to all structural shocks and the important role demand shocks play in explaining fluctuations of the short-term interest rate. Both factors trigger an overshooting in the hedging behavior for variable debt rates above 55% as changes in interest rate payments become larger than changes in the primary balance.

Figure 4.1: Demand shock-induced reaction of primary balance and interest payments
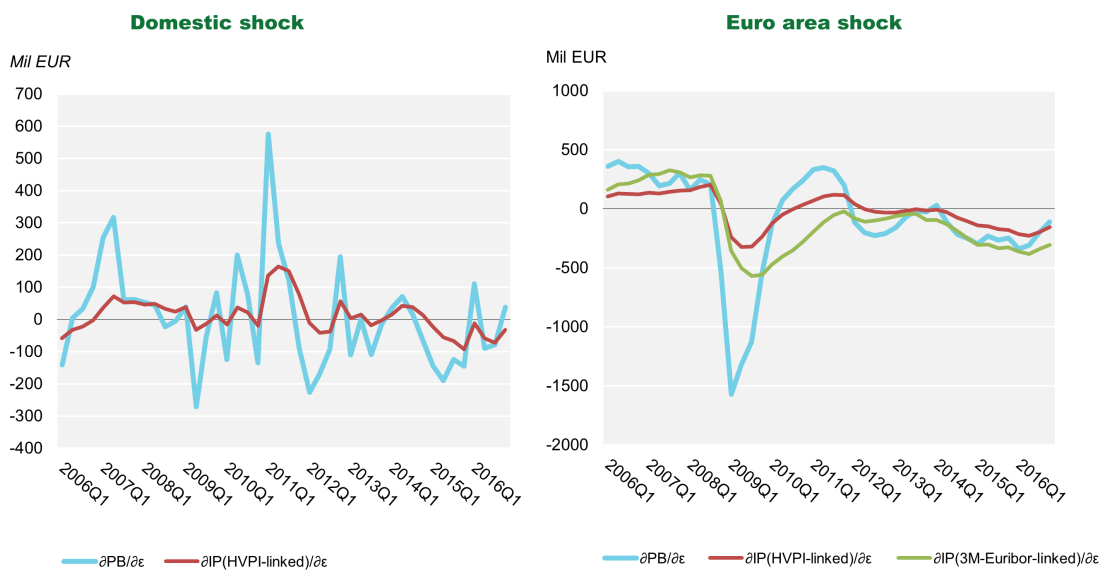
Source: own calculations.

Figure 4.2: Demand shock-induced variance of the budget balance
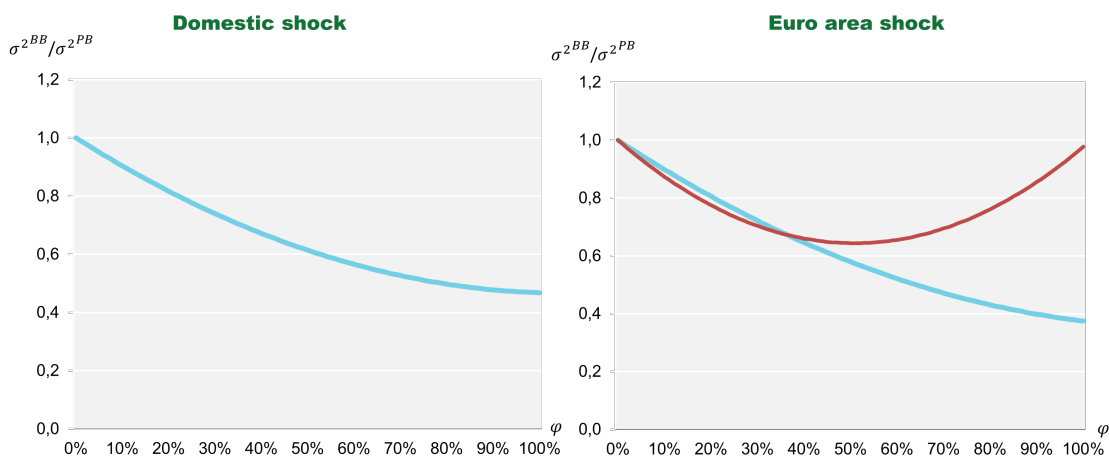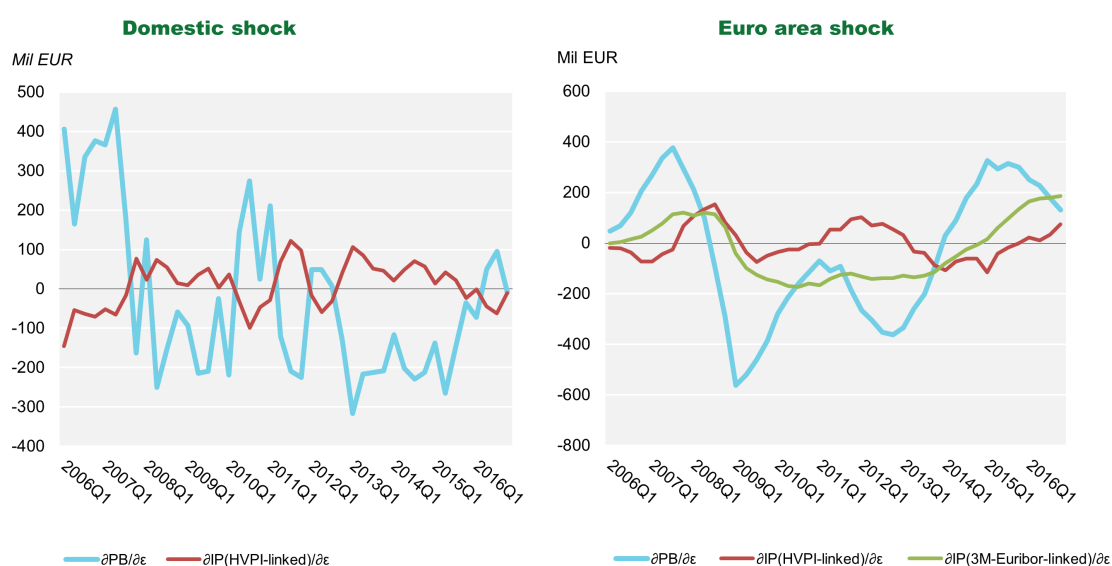

Source: own calculations.

4.2 Supply shocks

The impact of domestic and euro area supply shocks on primary balance and interest payments is presented in figure 4.3. Corresponding to standard economic theory Austrian-HICP and GDP growth dynamics show a strong negative correlation. This is the reason why the use of inflation-indexed debt amplifies the variance of the budget balance for all variable-rate-ratios. This is true irrespectively of whether the shock hitting the Austrian economy is of domestic or euro area origin (figure 4.4).

**Figure 4.3:** Supply shock-induced reaction of primary balance and interest payments

Source: own calculations.

The theoretically arbitrary shock reaction of Euribor interest rates turns out to show a positive correlation to GDP growth rates for the period 2006 to 2016. Therefore contrary to inflation-indexed debt, 3M-Euribor-linked debt has the potential to insure the government budget against euro area supply shocks. The hedging potential of this instrument substantially depends on the share of debt linked to the Euribor rate. In our analysis the budget balance variance connected to euro area supply shocks is minimized if 83% of public debt are held in 3M-Euribor-linked debt instruments.

4.3 Monetary policy shocks

By definition euro area GDP growth rates are positively correlated to euro area inflation rates and negatively correlated to euro area interest rates in the case of monetary policy shocks. The transmission to the Austrian economy is characterized by the same

Figure 4.4: Supply shock-induced variance of the budget balance
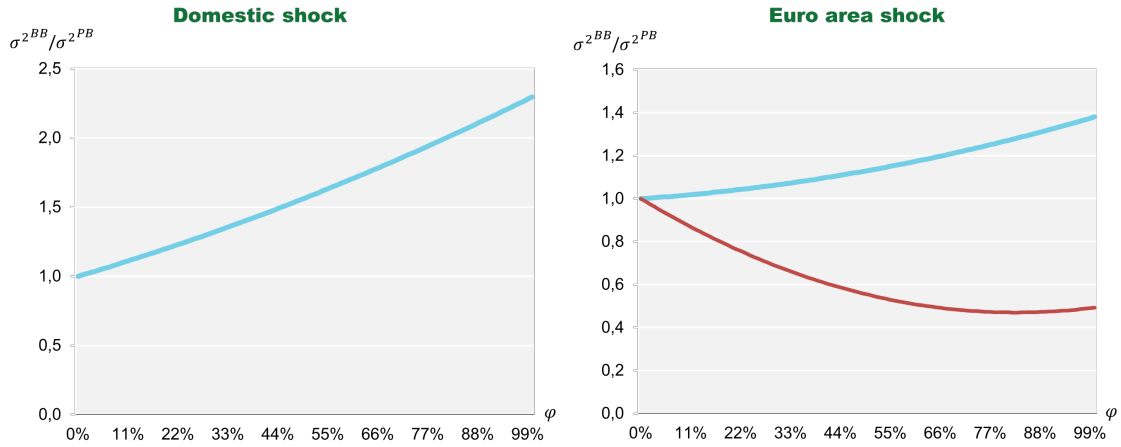
Source: own calculations.

pattern. Thus, inflation-indexed debt clearly carries the potential to smooth the budget balance while 3M-Euribor-linked debt amplifies the variance of the budget balance. Our simulations (figure 4.5) underline this theoretical fact. The "negative" hedging or shock-amplifying potential is steadily increasing in the share of debt held in variable rate instruments.

Figure 4.5: Primary balance, interest payments and variance of the budget balance induced by monetary policy shocks
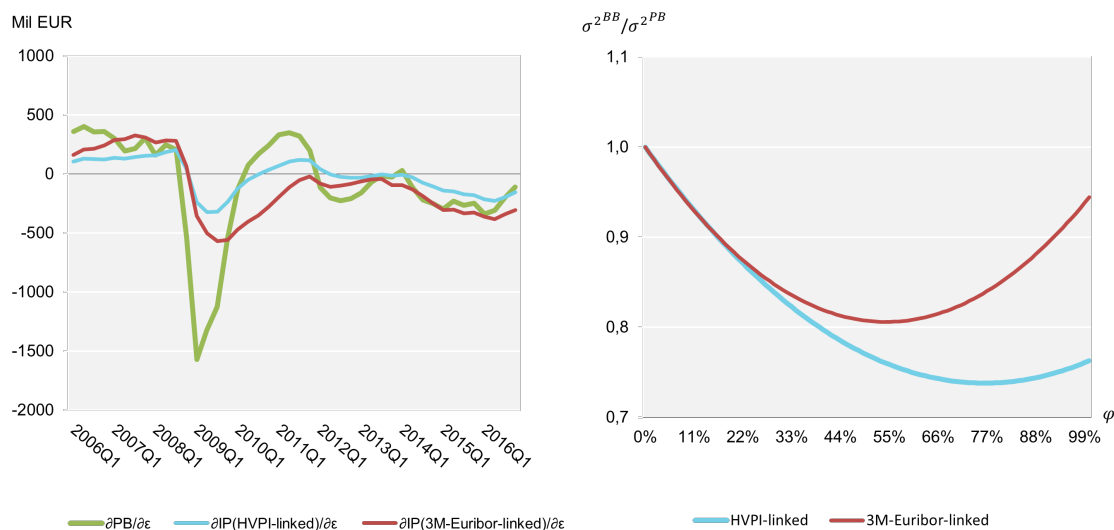

Source: own calculations.

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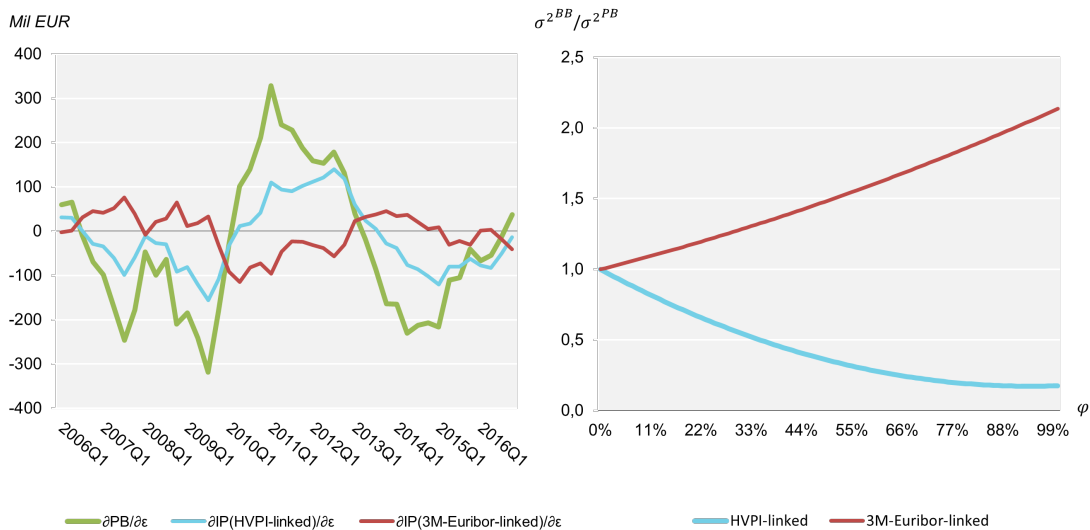
4.4 Aggregate shocks

Now we turn towards the aggregate GDP growth shock hitting the Austrian economy over the years 2006 to 2016. Clearly the size of the underlying shocks, as identified in the historical shock decomposition, steers the effect of aggregate shocks. Our simulation shows that both considered variable rate instruments have the potential to smooth the budget balance since the correlation between GDP and HICP or between GDP and the 3M-Euribor rate is positive (figure 4.6). This is true for the whole set of viable variable-rate-ratios. We further highlight that in the case of inflation-indexed debt the hedging potential becomes larger than in the case of a 3M-Euribor-linked instrument if more than approximately 20% of public debt are held in variable rate instruments. Only for small variable-rate-ratios up to 35% does 3M-Euribor-linked debt outperform the hedging potential of inflation-indexed debt. The substantially higher hedging potential of inflation-linked debt for large shares of variable debt is mainly caused by its stronger hedging potential in the case of demand shocks. To a smaller extent this finding is due to the strong hedging potential of HICP-linked debt against monetary policy shocks, which outweighs the potential of 3M-linked debt to insure against supply shocks. Minimum variance of the budget balance is reached if 76% and 54% of public debt are held in inflation-indexed and floating rate debt instruments. Overall, inflation-indexed debt and floating rate debt have the potential to hedge more than 25% and close to 20% of cyclical movements of the primary balance.

Figure 4.6: Primary balance, interest payments and variance of the budget balance induced by aggregate shocks

Source: own calculations.

4.5   Insurance costs

The smoothing of the budget balance via variable interest payments, the scope of our analysis, clearly implies a variation of financing costs over time. In the case of negative GDP shocks the budget balance is hedged by a decrease in interest payments while a positive GDP shock is smoothed by an increase of interest payments. This implies insurance costs in the form of higher interest payments in times of positive economic shocks but insurance benefits in the form of lower interest payments in times of negative economic shocks. Over the period 2006 to 2016 Austrian economic growth was predominantly determined by negative GDP shocks. Therefore budget balance smoothing via variable rate instruments would have been accommodated through a reduction in interest payments. One quarter of Austrian public debt linked to the Austrian HICP would for example have reduced interest payments between 2006 and 2016 by 0.3 bn EUR. The same share of public debt linked to the 3M-Euribor would have reduced interest payments by 3 bn EUR.

5   Conclusions

Our work addresses the potential of variable rate debt to hedge government budgets against business cycle fluctuations. In particular we analyze the potential of interest payments linked to the Austrian HICP and the 3M-Euribor to counteract shock responses of the primary balance to monetary policy, supply and demand shocks. A simplified theoretical framework is used to show that both variable rate instruments can insure the government budget against demand shocks. We further highlight that in the case of supply shocks only inflation-indexed debt unambiguously hedges shock-induced budget developments, while the hedging properties of 3M-Euribor-linked debt depend on the relative importance of GDP and inflation dynamics to determine interest rates. In the case of monetary policy shocks only inflation-indexed debt can be used to smooth the budget balance. To empirically evaluate the hedging potential of variable rate debt for Austria, we employ a multi-country BVAR model to identify domestic and international macroeconomic shocks hitting the Austrian economy over the period 2006 to 2016. Besides supporting the theoretically obtained results, the empirical analysis shows that 3M-Euribor-linked debt can be used to smooth the government budget against macroeconomic supply shocks, indicating that the shock reaction of interest rates is strongly linked to GDP dynamics. Reflecting the aggregate hedging properties for all considered shocks, we show that both variable rate instruments have a substantial potential to insure the budget balance against aggregate macroeconomic shocks. Thus, the use of variable rate instruments creates additional room for automatic stabilizers to act freely. The main rea-

son for the large hedging potential at the aggregate level is based on the fact that demand shocks were the main drivers of business cycle fluctuations in Austria over the period 2006 to 2016. We further underline that the insurance fee connected to the smoothing of the budget balance via variable rate instruments can be positive or negative and crucially depends on the size and type of economic shocks hitting the economy. For our observation period 2006 to 2016, where economic shocks were predominantly negative, we find that the use of variable rate instruments would clearly have reduced Austrian interest payments. While our work convincingly highlights the potential of variable rate debt in insuring the government budget against macroeconomic shocks, we do not produce results for the optimal portfolio choice regarding to the use of variable rate instruments. This is the case since an optimal portfolio decision would have to reflect all potential candidates of the objective function (e.g. minimization of expected costs) subject to adequate weighting coefficients. In addition, existing constraints regarding interest payments (e.g. a certain percentage of GDP) and alternative risk metrics (e.g. interest-rate-risk) would have to be taken into account.

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