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Miriam Reiss, BA Bakk.rer.soc.oec.

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EFFECTS OF FISCAL POLICY ON THE REAL ECONOMY – EVIDENCE FROM AUSTRIA

Miriam Reiss

ABSTRACT

This thesis investigates the effects of fiscal policy shocks on economic activity, based on a review of theoretical and empirical literature as well as a structural vector autoregression (SVAR) model. In the context of the literature review, the effect of fiscal policy on the real economy is broken down into five transmission channels: (i) consumption, (ii) wealth and labor supply, (iii) the role of monetary policy, (iv) the interest rate and (v) the exchange rate regime. A central insight from this review is that the underlying assumptions of theoretical models and country-specific characteristics as well as econometric methodologies in empirical models have a crucial impact on resulting multipliers. The empirical analysis is performed using quarterly data for Austria over the period 1996Q1-2014Q4. The main results can be summarized as follows: GDP does not show a significant response to an expansionary government consumption shock for the full sample. If the sample is restricted to the pre-crisis period, the effect becomes significant, with a multiplier of 0.4 on impact and a maximum of 1.6 after one year. The long-term interest rate responds with an increase, while inflation, employment and private consumption do not show a significant response.

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LIST OF ABBREVIATIONS

ARRA	American Recovery and Reinvestment Act
BP	Blanchard-Perotti
DSGE	Dynamic Stochastic General Equilibrium
EC	European Commission
ECB	European Central Bank
EMU	Economic and Monetary Union of the European Union
GDP	Gross Domestic Product
IMF	International Monetary Fund
MPK	Marginal Product of Capital
NK	New Keynesian
OECD	Organization for Economic Co-operation and Development
RBC	Real Business Cycle
SVAR	Structural Vector Autoregression
VAR	Vector Autoregression
ZLB	Zero Lower Bound

1. INTRODUCTION

Fiscal policy is widely used by governments to stimulate the economy and combat recessions. Particularly drastic measures have been taken during the recent crisis. The United States Congress, for example, passed the *American Recovery and Reinvestment Act* (ARRA) in 2009 – a massive stimulus package aimed at boosting the US economy with a projected cost of $831 billion between 2009 and 2019 (Congressional Budget Office 2012). Following recommendations by the International Monetary Fund (IMF, see Spilimbergo et al. 2008) and the European Commission (EC, see EC 2008), European governments implemented similar stimulus packages, such as the *Konjunkturpakete I & II* in Austria and Germany. Together with the tax reform, the Austrian stimulus packages amounted to almost €12 billion for the years 2008 and 2009, or 4.2% of nominal GDP in 2008 (Breuss, Kaniovski and Schratzenstaller 2009). Economists, however, far from agree on the effectiveness of discretionary fiscal policy measures in stimulating the economy. Equivalently, there is no consensus regarding to what extent austerity measures harm or benefit economic recovery. The latter have been taken more recently by European governments in the face of the debt crisis (e.g. the Austrian *Konsolidierungspaket 2012-2016*), as well as the US government in an effort to avoid the so-called "fiscal cliff".[1]

The effects of fiscal policy are of particular importance in a monetary union like the European Economic and Monetary Union (EMU), where single countries have no independent control over monetary policy. In such unions, fiscal policy is the main tool to counteract unilateral economic shocks. This also holds for other countries when the transmission channels of monetary policy are disrupted, as they have been in the course of the financial crisis. There has been an ongoing debate regarding the effects of fiscal policy and, in particular, the size of fiscal multipliers. Most prominently, the IMF (2012), the EC (2012) and the European Central Bank (ECB, see ECB 2012) demonstrated disagreement on this issue when they published contrasting statements in late 2012.[2]

[1] The term "fiscal cliff" refers to tax increases and spending cuts in the United States, which would have automatically come into effect when certain federal laws expired by the end of 2012. The *American Taxpayer Relief Act of 2012*, which involved moderate tax increases, was passed by the US Congress in the beginning of 2013, in order to avoid the larger tax increases associated with the fiscal cliff.

[2] The IMF (2012) argued that they had previously underestimated fiscal multipliers which had led to wrong economic forecasts that were too optimistic. This statement was followed by a more detailed statistical analysis by Blanchard and Leigh (2013). The EC (2012) responded by criticizing the use of past forecast errors as evidence for higher multipliers. The ECB (2012) emphasized the importance of focusing on long-term effects of consolidation which they claim to outweigh negative short-term effects. To this end, the ECB estimated an own set of multipliers to support their argument.

This thesis sets out to explore the effects of fiscal policy measures on the real economy, drawing on existing literature as well as empirical evidence for the Austrian case. First, I provide a review of theoretical and empirical contributions on the subject, examining various transmission channels that determine the effects of fiscal policy on economy activity. In particular, I investigate the consumption channel, the wealth/labor supply channel, the role of monetary policy, the interest rate channel and the role of exchange rate regimes. A central insight from the literature review is that multiplier values resulting from different models crucially depend on underlying assumptions and transmission channels incorporated in these models. Existing evidence regarding the various channels is quite mixed, suggesting that country-specific characteristics and econometric methodologies have an influence on empirical results.

In addition, I conduct an empirical analysis using a structural vector autoregression (SVAR) model and quarterly data for Austria from 1996 to 2014. While fiscal policy has an expenditure and a revenue side, I focus on the expenditure side and do not explicitly discuss the effects of revenue-based fiscal measures. In my empirical analysis, I have to further restrict my focus to the effects of shocks to government consumption, which is only one component of government spending (the other two being, in general, government investment and transfer payments). This limitation is due to a lack of appropriate data. I find that output does not show a statistically significant response to an expansionary government consumption shock for the full sample. If, however, the sample is restricted to the pre-crisis period, the effect becomes significant, despite the shock being less persistent. The multiplier takes a value of 0.4 on impact and 1.6 at the maximum. The interest rate responds positively, while the effects on inflation, employment and private consumption are insignificant.

The remainder of the thesis is organized as follows: Section 2 gives a short introduction on the concept of the fiscal multiplier. Section 3 provides some theoretical background on the effects of fiscal policy, followed by a review of existing empirical literature in section 4. In section 5, I discuss the main insights I draw from the literature review and derive implications for my own empirical analysis. Section 6 provides information on the data and econometric methodology I use and presents the results of my analysis. Section 7 concludes.

2. THE FISCAL MULTIPLIER

The most common concept to measure the effects of fiscal policy on the real economy is the fiscal multiplier. The fiscal multiplier is in general defined as the change in an economic variable – usually output – in response to a unit change in a fiscal variable – usually government spending or one of its components. Various definitions of the fiscal multiplier are used in the literature.[3] The concept that is most widely used is the impact multiplier, which is defined as follows:

$$\varphi_{\text{impact}} = \frac{\Delta Y_t}{\Delta G_t},$$

where Δ denotes the deviation from the baseline value of the respective variable. The impact multiplier gives the immediate response of output to a change in government spending in the period the impulse occurs. For the remainder of this paper, I refer to the impact multiplier simply as multiplier. An alternative concept that is also frequently reported is the multiplier at horizon T, which gives the (non-cumulative) response of output to a fiscal stimulus after a specified number of periods:

$$\varphi_T = \frac{\Delta Y_{t+T}}{\Delta G_t}.$$

A special case of this concept would be the peak multiplier, which reports the largest effect over a given time horizon:

$$\varphi_{\text{peak}} = \max_T \frac{\Delta Y_{t+T}}{\Delta G_t}.$$

Another common approach to reporting effects of fiscal policy is to summarize the effects over a given time horizon, resulting in the cumulative multiplier:

$$\varphi_{\text{cumulative}} = \frac{\sum_{j=0}^{T} \Delta Y_{t+j}}{\sum_{j=0}^{T} \Delta G_{t+j}}.$$

Multipliers can also refer to the responses of economic variables other than output. Examples would be the consumption multiplier, the investment multiplier or the employment multiplier. Similarly, instead of or in addition to spending multipliers, many contributions investigate the effects of changes in revenue variables, most commonly in

[3] See, e.g., Spilimbergo, Symansky and Schindler (2009) for an overview of the most common multiplier concepts.

the form of tax multipliers. However, since I focus on the effects of spending shocks, I do not consider tax multipliers in this thesis.

It is important to always specify which definition is used when reporting multiplier values, especially if a definition other than the impact multiplier is applied. Different multiplier concepts used in theoretical as well as empirical literature represent only one reason why one should be careful when comparing estimates across different studies. Other limitations to the comparability of multipliers are discussed in section 5.

3. THEORETICAL BACKGROUND

The question of the effect of fiscal policy on economic activity is a core issue of macroeconomic analysis and has therefore concerned economists for a long time.[4] The idea of a multiplier effect was first introduced by Kahn (1931). Especially since Keynes discussed the government spending multiplier in his General Theory (1936), there has been ongoing controversy regarding this subject. As a consequence, there is a wide range of theoretical literature dealing with fiscal multipliers and related issues. Recent publications typically employ dynamic stochastic general equilibrium (DSGE) models, such as New Keynesian (NK) or real business cycle (RBC) models, to analyze the effects of fiscal policy shocks. Therefore, I focus on DSGE related literature in the following section.

There are different approaches one could choose to review theoretical literature on fiscal multipliers. I focus on different channels that transmit fiscal policy. The effect of fiscal policy on economic activity can be broken down into various transmission channels of which I discuss the following: (i) consumption, (ii) wealth and labor supply, (iii) monetary policy, (iv) the interest rate and (v) exchange rate regimes.

3.1. Consumption channel

Since private consumption accounts for the largest part of aggregate demand, its reaction to a fiscal policy shock is crucial for the size of fiscal multipliers. However, there has been broad disagreement regarding this relationship in economic literature. The point of

[4] In theoretical literature on the effects of fiscal policy, the expressions “government spending/expenditure” and “government consumption/purchases” are often used synonymously, since government investment and transfers are not modelled separately in simple models. In the following section, I adopt the terminology used in the respective papers.

contention mainly lies in the way households are assumed to behave, especially in which way consumption depends on their income.

Classical Keynesian theory typically assumes an aggregate consumption function which states that consumption depends only on current disposable income.[5] Since an increase in government spending or a decrease in taxes is assumed to be equivalent to an increase in households' disposable income, Keynesian consumption theory predicts an increase in private consumption, i.e. a crowding-in effect, following such a fiscal policy measure. The size of the effect depends on the marginal propensity to consume, i.e. the proportion of disposable income that is spent on consumption.

This view stands in contrast to the permanent income hypothesis proposed by Friedman (1957). This hypothesis states that a household's consumption level does not only depend on current income, but also on expected future income, i.e. the household's permanent income. Households are assumed to have a desire to smooth consumption over their life cycle. Hence, according to this hypothesis, it would be necessary to assess the effect of a fiscal policy shock on households' *permanent* income in order to evaluate its effect on private consumption. The concept of Ricardian equivalence addresses this question.[6] The equivalence theorem postulates that an increase in government spending financed by debt issuance is not perceived to have a positive effect on households' net wealth, because agents are forward-looking and anticipate future tax increases required to repay public debt. This implies that an increase in government spending financed via a public deficit can be considered equivalent to a corresponding measure financed by parallel tax increases. Consequently, households will not increase or might even decrease their consumption expenditures following a rise in government spending – depending on how the spending shock is assumed to affect household income. If an increase in government spending does not imply a rise in household income, then the negative effect of higher taxes on household wealth dominates and there is a crowding-out effect of government spending on private consumption.

However, the concept of Ricardian equivalence has been subject to wide criticism. For instance, Elmendorf and Mankiw (1999) outline various possible reasons why it might not hold. First, it is debatable whether consumers actually take into account future tax burdens when their planning horizon is limited. Unless some altruistic bequest motive is

[5] A consumption function of this kind is, for example, used in textbook versions of the IS-LM model (see, e.g., Blanchard and Johnson 2013).
[6] The concept of Ricardian equivalence is based on an essay by Ricardo (1888) and was later substantiated by Barro (1974, 1979).

presumed, households may not care about tax increases that only affect future generations.[7] Furthermore, agents may face credit constraints due to credit market imperfections or may be myopic in general. Another aspect brought up by Elmendorf and Mankiw is that governments could in principle postpone repayment of their debt indefinitely, which theory holds to be possible if the rate of economic growth is larger than the interest rate on government debt. Finally, Ricardian equivalence may not hold in the case of distortionary taxation, as discussed in subsection 3.2.

The two conflicting views regarding the effect of a fiscal shock on private consumption – crowding in vs. crowding out – are both featured in recent contributions on fiscal multipliers. Some models are based only on infinitely-lived "Ricardian" households, while others also include "Keynesian" households into their analysis. Baxter and King (1993) provide a prominent example of a contribution of the former kind. Using a simple RBC model, the authors analyze the effect of various fiscal policy interventions on economic activity. Increases in government spending are assumed to be financed by parallel tax increases – debt financing is not explicitly considered. The authors argue that both financing options are equivalent, referring to the reasoning of Barro (1974). In the model of Baxter and King, an increase in government purchases implies a decrease in households' disposable income, which induces agents to reduce consumption in response to a positive spending shock.

In contrast to theoretical models that assume Ricardian equivalence for all individuals, some recent studies examine the effect of including different types of consumers into the analysis of fiscal multipliers, e.g. Galí, Vallés and López-Salido (2007).[8] These authors highlight the importance of assumptions regarding households' consumption behavior. In particular, the authors consider two types of households. First, there is a fraction $(1 - \lambda)$ of Ricardian households that have full access to capital markets where they can buy and sell assets. The remaining fraction λ consists of so-called "rule-of-thumb" households that do not have access to capital markets and therefore simply consume all of their current labor income. Thus, the latter type of households does not exhibit forward-looking or

[7] A corresponding framework is provided by overlapping generations (OLG) models, as for example the one developed by Diamond (1965). In the Diamond OLG model, individuals are assumed to live for two periods. In the first period, they work and earn labor income, which they partly spend on consumption. The other part is saved for the second period when individuals do not work anymore. They spend their entire savings on consumption in the second period. Hence, individuals optimize over their limited life cycles, leaving no bequests for future generations.

[8] Mankiw (2000) calls for such an alteration to standard models, referring to empirical evidence which suggests that current income does have a significant influence on consumption spending. Possible explanations that Mankiw discusses are that, on the one hand, consumers might not have fully rational expectations and, on the other hand, an appreciable share of households has net worth near zero which hampers consumption smoothing.

Ricardian behavior and can be viewed as Keynesian households. The period utility function common to both household types is given by

$$U(C_t, N_t) = \log C_t - \frac{N_t^{1+\varphi}}{1+\varphi}, \tag{3.1}$$

where C_t and N_t denote consumption and hours of work, respectively, and $\varphi \geq 0$. Due to their access to capital markets, Ricardian households are able to optimize over their life cycles and seek to maximize

$$E_0 \sum_{t=0}^{\infty} \beta^t \, U(C_t^o, N_t^o), \tag{3.2}$$

where $\beta \in (0,1)$ denotes the discount factor and the superscript o refers to optimizing households, subject to a sequence of budget constraints given by

$$P_t(C_t^o + I_t^o) + R_t^{-1} B_{t+1}^o = W_t P_t N_t^o + R_t^k P_t K_t^o + B_t^o + D_t^o - P_t T_t^o \tag{3.3}$$

and the capital accumulation equation

$$K_{t+1}^o = (1-\delta) K_t^o + \phi\left(\frac{I_t^o}{K_t^o}\right) K_t^o. \tag{3.4}$$

An optimizing or Ricardian household receives income from various sources in each period: labor income $W_t P_t N_t^o$ (where W_t denotes the real wage and P_t the aggregate price level), income from renting capital to firms $R_t^k P_t K_t^o$ (where K_t^o denotes the household's capital holdings and R_t^k is the real rental rate), payoff B_t^o from riskless one-period bonds carried over from the previous period, as well as dividends D_t^o from ownership of firms. T_t^o denotes lump-sum taxes or transfers (if negative) paid or received by Ricardian households, which can be different from the tax rate for rule-of-thumb households. Ricardian households spend their income on consumption $P_t C_t^o$, investment $P_t I_t^o$ and aforementioned riskless one-period bonds. Capital evolves according to equation (3.4), where $\delta \in (0,1)$ denotes the depreciation rate and the term $\phi(I_t^o / K_t^o) K_t^o$ determines in which way investment expenditure influences the capital stock, allowing for capital adjustment costs. It is assumed that $\phi' > 0$ and $\phi'' \leq 0$, with $\phi'(\delta) = 1$ and $\phi(\delta) = \delta$.

Rule-of-thumb households are not able to smooth their consumption path over time, due to their lack of access to the capital market. This household type faces the budget constraint

$$P_t C_t^r = W_t P_t N_t^r - P_t T_t^r, \tag{3.5}$$

where the superscript r refers to variables specific to rule-of-thumb consumers. This yields a level of consumption of such households that equals labor income net of taxes:

$$C_t^r = W_t N_t^r - T_t^r. \tag{3.6}$$

Assuming a competitive labor market, where households choose the quantity of working hours they supply based on the market wage, labor supply of Ricardian and rule-of-thumb households, respectively, must satisfy

$$W_t = C_t^o (N_t^o)^{\varphi} \tag{3.7}$$

and

$$W_t = C_t^r (N_t^r)^{\varphi}. \tag{3.8}$$

The weighted average of consumption and hours of the two household types then gives the aggregate levels of these variables:

$$C_t \equiv \lambda C_t^r + (1-\lambda) C_t^o \tag{3.9}$$

and

$$N_t \equiv \lambda N_t^r + (1-\lambda) N_t^o. \tag{3.10}$$

On the goods market, there are two types of firms. The single final good is produced by a representative, perfectly competitive firm, using differentiated intermediate goods as inputs. The latter are produced by a continuum of monopolistically competitive firms that use capital and labor as inputs. Intermediate goods firms are subject to Calvo pricing, introducing price rigidity into the model.[9]

Monetary policy is assumed to follow a simple linear interest rate rule:

$$r_t = r + \phi_\pi \pi_t, \tag{3.11}$$

where $r_t \equiv R_t - 1$ denotes the nominal interest rate, r is the steady state nominal interest rate, π_t is the inflation rate and $\phi_\pi \geq 0$. (3.11) can be interpreted as a Taylor rule with a zero coefficient on the output gap and a zero inflation target.[10]

[9] Price setting according to Calvo (1983) assumes that a firm can reset its price in a given period with a certain probability smaller than one. Hence, only an according proportion of firms can reset their prices each period, while the remaining firms have to keep their prices unchanged. The probability of a firm being able to reconsider its price is independent of the time since its last adjustment.

[10] The classical Taylor rule, introduced by Taylor (1993) to describe a central bank's reaction to changes in price levels or economic conditions, usually takes the form $r_t = \pi_t + r + \phi_\pi(\pi_t - \pi_t^*) + \phi_y(y_t - \bar{y})$,

Regarding fiscal policy, the authors assume a rule of the following form:

$$t_t = \phi_b b_t + \phi_g g_t, \tag{3.12}$$

where $g_t \equiv (G_t - G)/Y$ (i.e. the deviation of government spending from its steady state level, as a share of steady state output), $t_t \equiv (T_t - T)/Y$, $T_t \equiv \lambda T_t^r + (1-\lambda)T_t^o$ and $b_t \equiv ((B_t/P_{t-1}) - (B/P))/Y$. The government budget constraint is given by

$$P_t T_t + R_t^{-1} B_{t+1} = B_t + P_t G_t, \tag{3.13}$$

which indicates that repayments of bonds plus the value of government spending must not exceed inflows from taxes and debt issuance. In order to allow for stochastic fiscal shocks, government purchases are assumed to evolve according to a first-order autoregressive process

$$g_t = \rho_g g_{t-1} + \varepsilon_t, \tag{3.14}$$

where $0 < \rho_g < 1$, and the error term ε_t represents an i.i.d. government spending shock with constant variance σ_ε^2 and mean zero.

Combining the above model features, the authors derive linearized equilibrium conditions.[11] The condition that is particularly relevant for the analysis of consumption dynamics is the Euler equation for aggregate consumption, given by

$$c_t = E_t\{c_{t+1}\} - \sigma(r_t - E_t\{\pi_{t+1}\}) - \Theta_n E_t\{\Delta n_{t+1}\} + \Theta_\tau E_t\{\Delta t_{t+1}^r\}, \tag{3.15}$$

where lower-case letters denote log-deviations from steady state values of the corresponding variables. The coefficients used in the Euler equation are defined as follows:

$$\sigma \equiv (1-\lambda)\Gamma[\mu^p \varphi \gamma_c + (1-\alpha)]$$
$$\Theta_n \equiv \lambda\Gamma(1-\alpha)(1+\varphi)\varphi$$
$$\Theta_\tau \equiv \lambda\Gamma\mu^p\varphi,$$

where μ^p denotes the steady state price markup, α is the coefficient on capital in the intermediate firms' production function, $\gamma_c \equiv C/Y$ (i.e. the steady state consumption-output ratio) and $\Gamma \equiv (\mu^p \varphi \gamma_c + (1-\alpha)\big(1-\lambda(1+\varphi)\big))^{-1}$. The aggregate Euler

where π_t^* denotes the central bank's inflation target and $(y_t - \bar{y})$ denotes the output gap. Regarding the coefficients, it is generally assumed that $\phi_\pi > 1$ (Taylor principle) and $\phi_y > 0$.

[11] See Appendix C in Galí et al. (2007) for the derivations of these equilibrium conditions.

equation is the only log-linear equilibrium condition displaying a dependence of the share of rule-of-thumb consumers λ. The presence of these households is crucial for the implications of a fiscal policy shock, which becomes more evident when transforming (3.15) to obtain an expression in levels:

$$c_t = \Theta_n n_t - \Theta_\tau t_t^t - \sigma \sum_{k=0}^{\infty} E_t \{r_{t+k} - \pi_{t+k+1}\} \tag{3.16}$$

It can be seen that the share of rule-of-thumb consumers, via the coefficient Θ_n, directly influences the effect of employment on consumption. Hence, the increase in employment induced by higher government consumption may lead to an increase in aggregate consumption if the share of rule-of-thumb consumers is large enough. The intuition behind this result is as follows: an increase in government spending leads to a rise in demand for the final good and thus for intermediate goods. Since only a fraction of firms can adjust their prices, the remaining firms react by increasing production, which implies higher labor demand. In order for labor supply to meet demand, real wages have to increase, as suggested by equations (3.7) and (3.8). Hence, in this model, there is a positive co-movement of hours worked and the real wage level. Higher employment and higher real wages result in higher labor income and, consequently, in an increase in consumption of rule-of-thumb households. If this consumption increase is large enough, it can offset the dampening of aggregate demand that is caused by negative wealth effects generated by current or future higher tax levels taken into account by Ricardian households.

The authors finally examine the equilibrium effect of a government spending shock on consumption and output in various calibrations of the model. In what they refer to as the "neoclassical" calibration, where prices are fully flexible and the share of rule-of-thumb households equals zero, an increase in government spending implies crowding out of consumption. The effect on output is positive, but relatively small with a multiplier below one. Increasing the degree of price stickiness and the share of rule-of-thumb households substantially affects the results: the response of consumption becomes positive and the positive effect on output becomes stronger, yielding multiplier values around 2. This analysis shows how important assumptions on consumption behavior are for the size of fiscal multipliers.

Coenen and Straub (2005) provide a similar study, but with a particular focus on the euro area. The authors extend a NK model by including various real frictions associated with

the euro area, and by considering two types of households: optimizing or Ricardian agents, who can trade assets on the capital market and are therefore able to smooth their consumption path, and liquidity-constrained non-Ricardian agents, who do not have access to the capital market and therefore consume their current disposable income.[12] Their results, however, are different from those of Galí et al. One reason for that are different labor market specifications: Coenen and Straub assume wages to be sticky, being set by unions in a Calvo fashion. This implies that, after a government spending shock, the real wage increase following the rise in labor demand cannot be as large as in the model by Galí et al. The authors estimate their model for the euro area using Bayesian inference methods and compare a benchmark specification without non-Ricardian households with other specifications including this type of agents. In the benchmark case, aggregate consumption falls after an increase in government spending due to the negative wealth effect perceived by Ricardian consumers. However, in contrast to the findings of Galí et al., even when non-Ricardian households are included into the specification, the response of aggregate consumption is still negative. Hence, the rise in real wages is not sufficient for the increase in consumption of non-Ricardian agents to offset the negative wealth effect. Accordingly, the fiscal multiplier does not exceed unity in any of the considered specifications.

In summary, the consumption channel seems to be quantitatively important for the size of fiscal multipliers in theoretical models. However, there is no common approach to model consumer behavior. Further discussion of this channel together with a review of empirical literature on the effects of fiscal policy on consumption is provided in subsection 4.1.

3.2. Wealth/labor supply channel

The wealth/labor supply channel describes how fiscal policy influences economic activity through wealth effects which, in turn, stimulate labor supply. This channel is, in fact, very closely related to the consumption channel and, in particular, the concept of Ricardian equivalence.

Barro and King (1984) were among the first to investigate the implications of a government spending shock on labor supply. In a model that features infinitely-lived agents with time-separable preferences with respect to consumption and leisure (i.e. past consumption and leisure do not affect current preferences), the authors examine the effect

[12] Another example of an analysis that incorporates similar distinct consumer types is provided by Perotti (1999), who investigates the different responses of consumption to government expenditure shocks in normal times compared to times of fiscal stress.

of an increase in government purchases on the consumption and labor supply choices of households. The associated increase of the (future) tax burden is anticipated by agents and leads to a negative wealth effect via their intertemporal budget constraint. Hence, households behave in a Ricardian fashion. As a consequence, agents reduce their levels of consumption and leisure, since both are assumed to be normal goods. Thus, agents countervail the negative wealth effect by increasing their labor supply. This, in turn, leads to a rise in output.

The wealth/labor supply channel is incorporated in most neoclassical model frameworks that have been developed since Barro and King introduced this channel. As in the majority of these models government spending is assumed to crowd out private consumption, the positive effect of spending shocks on labor supply is often the main expansionary force on output. Baxter and King (1993) provide an extensive analysis of how the implications of this channel vary with different assumptions regarding the nature and financing of the government spending shock. The authors set up a simple neoclassical model featuring infinitely-lived, optimizing households and public finance rules that allow for various kinds of fiscal policy interventions. They examine both short-run and long-run effects of such interventions. First, they consider the benchmark case of a permanent increase in government purchases financed by lump-sum taxes. Following the negative wealth effect induced by this spending shock, households reduce both consumption and leisure. Output increases, but the fiscal multiplier does not exceed unity in the short run. In the long-run, the permanent increase in labor supply raises the marginal product of capital and thus leads to higher investment, resulting in an increase of the capital stock. This dynamic interaction of labor and capital yields a long-run multiplier larger than one, even though consumption continues to fall.[13] The effects of a temporary spending shock on output are still positive, but much weaker. The reason for this lies in the smaller wealth effect, causing a less pronounced increase in labor supply and, hence, in the capital stock. Following this analysis of a spending shock financed by lump-sum taxes, the authors also investigate in which way results change when distortionary taxation is considered instead. In the case of distortionary taxation, Ricardian equivalence does in general not hold. An increase in the tax rates on labor income entails disincentives on the labor market, which negatively affects the tax base and, in turn, requires even higher tax rates. The authors refer to this spiral of labor supply and tax rates as a "supply-side multiplier". Due to this unfavorable effect, output falls

[13] A similar argument of capital accumulation in response to an increase in government expenditure is used by Aiyagari, Christiano and Eichenbaum (1992), who also find that fiscal multipliers can exceed unity in neoclassical models when government spending shocks are sufficiently persistent.

rather than increases in response to the increase in government spending. The magnitude of the output decline depends on the elasticity of labor supply with respect to tax rates. This holds true for permanent as well as temporary spending shocks and illustrates the importance of the way of financing for the impact of fiscal policy measures.

Distortionary taxation as a source of adversity in the context of the wealth/labor supply channel is also discussed by Uhlig (2010). In a baseline neoclassical growth model, he examines the effect of a debt-financed increase in government spending on output in the short run as well as in the long run. It is assumed that the repayment of debt is associated with an increase in distortionary taxes on labor income in the future (in contrast to the parallel tax increase in the model by Baxter and King (1993)). The author calibrates his model according to the circumstances of the ARRA of 2009. In the short run, the negative effect of future taxation on households' wealth again induces the latter to increase their labor supply, resulting in an expansion of output with a fiscal multiplier significantly larger than one. Uhlig argues, however, that it would be misleading to only consider the short-run implications of such a fiscal policy shock. This becomes evident once the time horizon is extended to periods when the accumulated debt has to be repaid: as in Baxter and King's model, higher tax rates reduce households' incentive to supply labor, which adversely affects output. In the long run, multipliers take on substantial negative values. Hence, according to Uhlig, a rise in government expenditure financed by debt issue that requires higher distortionary taxation in the future may have substantial favorable effects in the short run. However, they come at the price of persistent economic distress in the long run due to incentive effects on the labor market. It should, however, be noted that when looking at the response of labor supply to fiscal policy shocks, the outcome fundamentally depends on the elasticity of labor supply (see, e.g., Fatás and Mihov 2001).[14]

The above review of theoretical literature regarding the wealth/labor supply channel illustrates the importance of the financing of the government spending shock as well as its persistence for incentive effects on the labor market – if the channel is indeed effective. Its de facto quantitative relevance is, in fact, quite controversial. Typical results of neoclassical models might change fundamentally when the wealth effect of fiscal policy

[14] Fatás and Mihov (2001) investigate the implications of fiscal policy interventions for different values of labor supply elasticity. The authors find that an increase in government spending financed by a parallel increase of distortionary taxation has contractionary effects while spending shocks financed by lump-sum taxes or via a deficit may be expansionary if the elasticity of labor supply is sufficiently high.

measures on labor supply is eliminated, as Monacelli and Perotti (2008) suggest.[15] In subsection 4.2, I return to the question of the relevance of the wealth/labor supply channel when I look at corresponding empirical evidence.

3.3. The role of monetary policy

When analyzing the effects of fiscal policy on real economic activity, it is essential to take the reaction of monetary policy to fiscal shocks into account. It is well known that central banks around the world, most prominently the US Federal Reserve and the European Central Bank, vary in their priorities and, hence, in their degree of accommodation to fiscal policy measures.[16] In principle, an increase in government expenditure is expected to lead to a rise in expected inflation due to the increase in demand. It depends on the priorities of the monetary authority in which way monetary policy will respond to this: monetary policy can amplify, absorb or even reverse the effects of fiscal policy. In the following, I give a short overview of theoretical insights regarding the role of monetary policy in the transmission of fiscal policy.

Woodford (2011) provides a broad analysis of fiscal multipliers under various monetary policy regimes in a NK framework. The regimes considered are an unchanged path of the real interest rate, a strict inflation target as well as less strict monetary accommodation under a Taylor Rule. Since this model gives a useful overview of the implications of the different monetary policy regimes, it is presented in greater detail below. In addition, the author investigates the implications of the zero lower bound (ZLB) on the nominal interest rate, which I discuss later in this subsection.

On the household level, infinitely-lived consumers seek to maximize

$$\sum_{t=0}^{\infty} \beta^t [u(C_t) - v(N_t)], \tag{3.17}$$

where C_t and N_t denote consumption and working hours, respectively, and $\beta \in (0,1)$ denotes the discount factor.

On the goods market, a variety of differentiated goods is supplied by monopolistically competitive firms. There is no distinction between intermediate and final goods. Output is

[15] Monacelli and Perotti (2008) consider in their business cycle model two alternative specifications of agents' preferences, one allowing for a wealth effect on labor supply while the other does not. They show that when there is no such effect, an increase in government spending may, in contrast to common findings of neoclassical models, have a positive effect on consumption.

[16] See, e.g., Pollard (2003). While the Maastricht Treaty states price stability as the primary monetary policy goal of the Eurosystem, the US Federal Reserve System has three policy objectives: maximum employment, stable prices and moderate long-term interest rates.

assumed to be either consumed by households or by the government, which requires that in equilibrium

$$Y_t = C_t + G_t \tag{3.18}$$

in each period. Firms use a constant returns-to-scale technology with capital and labor as inputs and are subject to Calvo pricing, with a fraction $(1 - \alpha)$ of firms being able to reset their price in a given period. The labor market is assumed to be competitive with fully flexible wages. The path of government spending is given by a sequence $\{G_t\}$, such that $G_t \to \bar{G}$ for large t, i.e. government spending converges to a constant level in the long run. Government purchases are financed by lump-sum taxes, where the exact timing of taxation is assumed to be irrelevant due to Ricardian equivalence.

As indicated before, increases in government spending are usually associated with higher (expected) inflation. In a standard NK model, the dynamics that lead to higher inflation are as follows: increased government expenditure induces a rise in demand. Firms react by increasing their prices (if they are given the chance to do so) and labor demand. The increase in labor demand leads to rising real wages and thus higher real marginal cost, which in turn forces firms to further increase prices. Woodford (2011) discusses different ways in which monetary policy may react to the increase in expected inflation. In the benchmark case, the central bank seeks to maintain an unchanged path for the real interest rate.[17] This policy can be illustrated in the context of a Taylor rule of the form

$$i_t = \bar{i}_t + \phi_\pi \pi_t + \phi_y \log(Y_t/\overline{Y}), \tag{3.19}$$

where i_t denotes the central bank's policy rate, π_t is the inflation rate, $\log(Y_t/\overline{Y})$ is a measure for the output gap and the sequence $\{\bar{i}_t\}$ is chosen so that $\bar{i}_t \to \overline{r}$, $\overline{r}$ denoting the steady-state level of the real interest rate. It is assumed that in the long run, monetary policy brings about zero inflation (i.e. $\pi_t \to 0$ for large t). A constant-real-interest-rate policy implies that monetary policy has to set the nominal interest rate such that $r_t = \overline{r}$ for all t, since $\overline{r}$ is the only constant real interest rate consistent with convergence to the steady state in the long run. The central bank thus has to offset any change in the inflation rate induced by a fiscal policy shock by adjusting the nominal rate such that the real rate remains unchanged. What does this mean for the government spending multiplier? From the preferences of households (3.17), intertemporal optimality requires

[17] This case can be viewed as the dynamic equivalent to the analysis of increased government spending in an IS-LM model where monetary policy is assumed to react such that the interest rate remains unchanged.

$$\frac{u'(C_t)}{\beta u'(C_{t+1})} = e^{r_t} \tag{3.20}$$

to hold in each period. It follows that under a constant real interest rate, $C_t = C_{t+1}$ for all t, which implies that consumption will be equal to its steady-state level $\overline{C}$ in each period. Substituting this into (3.18) gives

$$Y_t = \overline{C} + G_t \tag{3.21}$$

for all t. That is, private consumption is neither stimulated nor crowded out by a temporary government spending increase when the real interest rate does not change. Hence, the government spending multiplier, given by dY_t/dG_t, is equal to one under a constant-real-interest-rate policy.

Following this analysis of the benchmark case, Woodford (2011) considers a monetary policy regime where the central bank commits to a strict inflation target, in particular a zero inflation target. Zero inflation implies that those firms that are able to reset their price find it optimal not to do so, such that the optimal price p_t^* chosen by such firms satisfies $p_t^* = P_t$ in each period, where P_t denotes the general price level. This requires that in equilibrium $P_t = \mu S_t$ for all t, where S_t denotes nominal marginal cost of production and $\mu > 1$ is the markup factor. Hence, in case of an increase in government spending, monetary policy needs to create aggregate conditions such that marginal cost continues to satisfy $S_t = P_{t-1}/\mu$ despite the fiscal shock. This holds only if the equilibrium condition

$$u'(Y_t - G_t) = \mu \tilde{v}'(Y_t), \tag{3.22}$$

where $\tilde{v}'(Y) \equiv v(f^{-1}(Y))$ is the disutility to a household of supplying a quantity of output Y, is satisfied. Consequently, the multiplier is given by

$$\frac{dY}{dG} = \frac{\eta_u}{\eta_u + \eta_v}, \tag{3.23}$$

where $\eta_u > 0$ is the negative of the elasticity of u' and $\eta_v > 0$ is the elasticity of $\tilde{v}'$ with respect to an increase in Y. The multiplier is thus positive, but smaller than one. In order to maintain a constant zero inflation rate, the central bank has to counteract the increase in demand induced by a positive fiscal shock. This requires a sharp increase in the nominal interest rate, which prevents inflation from rising, but also leads to a decrease in private

consumption due to the implied increase in the real interest rate. As the author shows, (3.23) corresponds to the multiplier under fully flexible prices.

The third scenario Woodford analyzes is a moderate regime where the central bank follows a Taylor rule that accounts for both inflation and output stabilization. In particular, the Taylor rule takes the form

$$i_t = \overline{r} + \phi_\pi \pi_t + \phi_y(\hat{Y}_t - \Gamma \hat{G}_t), \tag{3.24}$$

where the response coefficients now satisfy $\phi_\pi > 1$ and $\phi_y > 0$, as in common versions of the Taylor rule. Γ denotes the multiplier given in (3.23), so that the term $(\hat{Y}_t - \Gamma \hat{G}_t)$ can be interpreted as the deviation of output from its flexible-price equilibrium level. It is thus also a measure of the output gap. Here, it is assumed that government purchases follow a deterministic path of the form $\hat{G}_t = \hat{G}_0 \rho^t$ for some $0 \leq \rho < 1$. The multiplier can then be derived from $\hat{Y}_t = \gamma_y \hat{G}_t$, where γ_y is given by

$$\gamma_y = \frac{1 - \rho + \psi\Gamma}{1 - \rho + \psi}, \tag{3.25}$$

with

$$\psi \equiv \sigma \left[\phi_y + \frac{\kappa}{1 - \beta\rho}(\phi_\pi - \rho)\right] > 0$$

and

$$\kappa \equiv (1 - \alpha)(1 - \alpha\beta)(\eta_u + \eta_v)/\alpha > 0.$$

The coefficient $\sigma \equiv {\eta_u}^{-1} > 0$ measures the intertemporal elasticity of substitution of private expenditure. It is then straightforward to show that $\Gamma < \gamma_y < 1$. Hence, a moderate monetary policy regime yields a multiplier that lies between those of the former two cases. It is larger than under strict inflation targeting, because the moderate regime allows for a slight increase in inflation following a spending shock. It is, however, smaller than under the constant-real-interest rate regime, i.e. below unity, because the central bank's effort to stabilize both inflation and output leads to an increase in the real interest rate. Concluding from this analysis, a fiscal stimulus is more effective the less a central bank is concerned with inflation stabilization. Davig and Leeper (2011) arrive at similar results.[18] These findings suggest that the interaction patterns of fiscal and monetary

[18] Davig and Leeper (2011) examine the implications of alternative combinations of active and passive fiscal and monetary policy regimes. They find the government spending multiplier to be largest under passive monetary/active fiscal policy and smallest under the opposite combination.

policy are highly important for whether fiscal policy can stimulate the economy in the desired way.

An issue of monetary policy that has gained importance in economic theory due to its practical relevance in recent years is the ZLB on the nominal interest rate. When the nominal interest rate is very close to zero and financial intermediation is malfunctioning, the ZLB becomes binding and monetary policy is heavily constrained in its actions. Recent experience shows that such a situation can be rather persistent. Woodford (2011) examines the implications of this constraint for the effectiveness of fiscal policy in addition to the three monetary policy regimes described above. He considers a situation where the economy faces deflation and a negative output gap. Under normal circumstances, the central bank would react to such a situation by cutting its policy rate. If, however, the ZLB on the nominal interest rate is binding, the central bank is unable to do so. In such cases, a fiscal expansion can be much more effective than in normal times. When the nominal interest rate is stuck at zero, the induced rise in inflation expectations leads to a decline of the real interest rate, amplifying the stimulating effect of increased government expenditure on economic activity. The boost in output again leads to higher expected inflation and thus a decrease in the real rate reinforcing the initial effect. In Woodford's model, this results in fiscal multipliers considerably larger than one, where the actual size depends on the expected persistence of the ZLB constraint. If it is expected to bind for an extended period of time, the multiplier can become very large, taking values larger than 2. Christiano, Eichenbaum and Rebelo (2011) arrive at a similar result. They also use a NK model with price rigidity to study the size of the government spending multiplier in a ZLB state. Similar to Woodford (2001), the authors find that multipliers become considerably larger when monetary policy is constrained and is expected to remain in this state for some time. They stress, however, the importance of timing. In reality, changes in government spending are usually subject to implementation lags. In order to be effective, the spending shock needs to be implemented while the ZLB is still binding. Otherwise, the positive effect on output is less pronounced.

In summary, monetary policy plays an important role in the transmission of fiscal policy to the real economy. If the central bank reacts aggressively to a fiscal expansion, the potential positive effect on output may be dampened substantially. Furthermore, recent findings suggest that a positive spending shock can be more effective in times of distress where financial intermediation is malfunctioning and monetary policy is constrained by the ZLB on the nominal interest rate. It is, however, important to bear in mind that a high degree of monetary accommodation – or the inability of a central bank to react – means

that a boost of economic activity may come at the cost of a considerable increase in inflation. Another important issue regarding the interconnections of monetary and fiscal policy is the exchange rate regime. Since this topic has been subject to particular attention in multiplier related literature, I discuss it in subsection 3.5.

3.4. Interest rate channel

Another channel through which fiscal policy shocks can influence economic activity is the interest rate channel. The real interest rate is a main determinant of investment and consumption and has therefore a crucial bearing on economic activity in general. While in the previous subsection, I focused on the discretionary response of the nominal interest rate determined by the degree of monetary accommodation, in the following I discuss forces that influence interest rates *apart* from monetary policy.

In order to analyze the effect of fiscal policy on the interest rate, it is sensible to look at short-run and long-run effects separately. A very simple framework for such an analysis in the short run is provided by the standard Keynesian IS-LM model. An increase in government spending induces a rise in aggregate demand, shifting the IS curve to the right along the LM curve. Output increases, and so does the interest rate due to the higher demand for liquidity. In the long run, the path of capital accumulation becomes relevant. Engen and Hubbard (2005) use another very simple model to illustrate the basic dynamics of the long-run interest rate effects of a deficit-financed fiscal policy shock. They draw their argument on a standard Cobb-Douglas production function:

$$Y = AK^{\alpha}L^{1-\alpha},$$

where $A > 0$ denotes total factor productivity, K and L denote capital and labor input, respectively, and $0 < \alpha < 1$. The interest rate r is determined by the marginal product of capital (MPK):

$$r = MPK = \alpha\frac{Y}{K} = \alpha A\left(\frac{L}{K}\right)^{1-\alpha}$$

The authors further assume that government debt D completely crowds out capital, i.e. $\partial K/\partial D = -1$. The intuition behind this assumption is that an increase in the government deficit is equivalent to a decrease in public saving. If private saving remains unaffected, this results in decreasing investment and thus a lower capital stock. Applying this assumption of crowding out, one gets:

$$\frac{\partial r}{\partial D} = \frac{\partial r}{\partial K}\frac{\partial K}{\partial D} = \alpha(1-\alpha)\frac{Y}{K^2} > 0$$

Hence, an increase in public debt leads to an increase of the interest rate. This result is intuitive, because, for a given level of labor input, the marginal product of capital increases when the capital stock decreases.[19]

However, both of the above arguments rely on the assumption that Ricardian equivalence does not hold: in the IS-LM model, the increase in government spending directly stimulates private consumption, and in Engen and Hubbard's benchmark framework, private savings are assumed to remain constant. If Ricardian equivalence were assumed to hold, then individuals would increase their savings after a positive fiscal shock, anticipating the future tax increases. The rise in private saving may offset the decline in public saving and, consequently, interest rates might not change. The importance of the Ricardian equivalence assumption in this regard is, for example, discussed by Elmendorf and Mankiw (1999). Similarly, the response of the interest rate may be weaker when capital markets are assumed to be open. Capital inflows from abroad may prevent the capital stock from shrinking. As Engen and Hubbard show in a subsequent quantitative analysis, the effect of a change in government debt on interest rates is indeed much smaller when the former is assumed to crowd out capital only to a partial extent. Hence, whether and by how much an increase in government spending and the induced change in the public budget deficit positively affects the level of the real interest rate critically depends on the response of private saving as well as the openness of the capital market.

The impact of a spending shock on the capital stock is, however, not the only aspect worth investigating. Corsetti, Kuester, Meier and Müller (2013) identify an additional channel through which fiscal policy can influence interest rates. They refer to this channel as the "sovereign risk channel". The model they use is a version of a NK model featuring heterogeneous households that either borrow or save through financial intermediaries. The crucial feature of the model is that sovereign risk can influence private financing costs by increasing the cost of financial intermediation. Hence, sovereign risk is not only reflected in yields on government debt, but also in financing costs faced by the private sector. The authors base this assumption on the observation that a higher risk of sovereign default also confronts firms with higher risk due to possible tax or tariff increases, strikes and unfavorable economic conditions in general. The resulting increase in credit spreads can be neutralized by monetary policy, in particular by a decline in the nominal interest

[19] A very similar framework is used by Laubach (2009). Laubach, however, allows for partial crowding out by introducing a general crowding-out parameter, i.e. $\partial K/\partial D = -c$.

rate. In order to isolate the implications of the sovereign risk channel, however, the authors assume that the central bank's policy options are constrained by the ZLB on the nominal interest rate. The model is calibrated based on US data and then used to determine fiscal multipliers under varying conditions. The authors find multipliers to be smaller when the sovereign risk channel is very powerful, i.e. when private risk premia react strongly to increases in public debt. This holds true in particular when the initial debt-to-GDP ratio is very high. The intuition behind the negative effect of the sovereign risk channel is straightforward: an increase in funding costs for the private sector discourages investment, which adversely affects the response of output to a government spending shock. Furthermore, the size of fiscal multipliers negatively depends on the expected duration of the constraint on monetary policy. In extreme scenarios where public finances are very unstable and monetary policy is expected to be constrained for several periods, fiscal multipliers can even become negative.

To sum up, from a theoretical point of view, expansionary fiscal policy – especially via its implications for the government deficit and debt level – is likely to have at least a small positive effect on the real interest rate. Interest rates are expected to respond more strongly the less private savings are affected by the spending shock, the more closed the domestic capital market and the higher the initial level of government debt. However, the interest rate channel is also affected by the exchange rate regime, as discussed in the next subsection.

3.5. Exchange rate regimes

The transmission channels of fiscal policy discussed above focused on closed economies. The openness of an economy, however, is crucial for the size of fiscal multipliers. In open economies, capital might crowd out in response to changes in domestic market conditions. This typically leads to adjustments of the exchange rate. This is why the exchange rate regime of the monetary authority plays an important role.[20]

The simplest framework for analyzing fiscal policy under different exchange rate regimes is provided by the Mundell-Fleming model, i.e. the extended version of the IS-LM model for a small open economy. In this model, a government spending shock has very different implications depending on whether exchange rates are fixed or flexible. Under a peg, the central bank is committed to maintain the current exchange rate at any price. The rise in

[20] One could in this context also examine a "trade channel", i.e. the role of the openness of an economy in the effectiveness of domestic fiscal policy. It can be expected that an increase in demand following a fiscal expansion may be to some extent covered by imports and, hence, multipliers may be lower in economies that exhibit a high degree of openness to trade.

aggregate demand induced by an increase in government expenditure leads to an increased demand for liquidity. If this demand is not met, the domestic interest rate increases, leading the currency to appreciate. Hence, the central bank has to raise the money supply in order to keep the interest rate constant. This combination of expansionary fiscal and monetary policy results in a fiscal multiplier that exceeds unity. If exchange rates are flexible, however, there is no need for accommodative monetary policy. Interest rates increase and, consequently, the currency appreciates. The latter leads to a decline in net exports which offsets the initial boost in aggregate demand and reverses the positive effect on the interest rate. If the central bank does not react in any way, the fiscal multiplier will be equal to zero.[21]

Born, Juessen and Müller (2013) further investigate the transmission of fiscal policy under different exchange rate regimes in a NK model of a small open economy. Similarly to the works by Galí et al. (2007) and Coenen and Straub (2005) discussed in subsection 3.1, the model used by Born et al. features two household types: households that trade assets with agents in the rest of the world and households that do not participate in asset markets, referred to as "asset holders" and "non-asset holders", respectively. As in the models discussed above, the latter simply consume all of their current labor income. In contrast to the Mundell-Fleming model, it is not the behavior of net exports that determines the effects of fiscal policy under fixed versus flexible exchange rates in this model. Instead, the authors identify private expenditure, i.e. consumption of the two household types, as the critical factor. First, the authors examine the response of asset holders' consumption to the spending shock. Under a floating exchange rate regime, the central bank reacts to the increase in inflation. Since monetary policy is assumed to follow a standard Taylor rule, the nominal interest rate is raised more than one-to-one in response to the higher inflation rate, i.e. the Taylor principle is fulfilled. Hence, in contrast to the Mundell-Fleming model that does not consider price dynamics, inflation is the driving force for monetary policy in this model. The central bank intervention leads to an increase in short-term as well as long-term interest rates. Asset holders take these into account and reduce their current consumption. Under a peg, the nominal interest rate has to remain constant. The increase in inflation therefore leads to a lower short-term real interest rate. In the long run, however, purchasing power parity is assumed to hold and thus the long-term real interest rate increases, reversing the rise in inflation. Again, asset holders' consumption decreases, but by less than under flexible exchange rates where the

[21] It should be noted that the Mundell-Fleming model has been subject to criticism. Dornbusch (1976) pointed out that the introduction of exchange rate expectations to the model can lead to very different implications regarding the effects of monetary policy.

effect on the long-term real interest rate is stronger due to contractionary monetary policy. Turning to non-asset holders, interest rates become irrelevant, because their consumption solely depends on their current income. As explained in the context of the consumption channel in subsection 3.1, employment and wages increase following a rise in public demand in standard NK models. The induced increase in disposable income leads non-asset holders to raise their consumption levels. Since under a floating exchange rate regime, asset holders' consumption declines more sharply than under a peg, the negative effect on aggregate demand is stronger and wages rise to a smaller extent. Hence, the increase in non-asset holders' consumption is less pronounced under flexible exchange rates. Altogether, the impact of a spending shock on private consumption expenditure is more positive (or less negative, depending on the assumed distribution of household types) the less flexible the exchange rate regime. The authors' calibration of the model thus results in a fiscal multiplier larger than one under a peg, but well below one under a floating regime. Alternative calibrations yield higher floating-regime multipliers if monetary policy is assumed to react less strongly to increased inflation, and multipliers below unity in both regimes if there is full asset market participation.

A contrasting view on the degree of transmission of fiscal policy under alternative exchange rate regimes is provided by Corsetti, Kuester and Müller (2013). They also use a version of the NK model, however abstracting from limited asset market participation and introducing a fiscal policy rule that allows for different forms of financing. Assuming that a positive spending shock is simply financed by future tax increases, they find the multiplier to be larger under a peg than under a float. This is in line with the results of both Born et al. and the Mundell-Fleming model. However, if the fiscal expansion is financed by future spending cuts in addition to tax increases, their results change markedly. The anticipation of future spending cuts leads to a lower inflation rate compared to the benchmark case, because under sticky prices, forward-looking firms adjust their prices to the expected fall in demand in advance. If this negative effect on inflation is sufficiently strong, the long-term real interest rate may decrease instead of increase, leading to a boost of private demand and output. Under a fixed exchange rate regime, the central bank would have to counteract in order to maintain exchange rate parity. Under a float, however, the currency may depreciate following the fall in the interest rate, inducing a rise in net exports that amplifies the positive effect on output. Hence, under a policy of "spending reversal", the fiscal multiplier might actually be larger under flexible exchange rates than under a peg.

In conclusion, there is little doubt that exchange rate regimes have a significant influence on the transmission of fiscal policy to the real economy. While conventional theory typically predicts that fiscal policy is more effective in stimulating the economy under a fixed exchange rate regime than under a floating regime, recent work by Corsetti, Kuester and Müller (2013) suggests that this ranking may, in fact, be reversed under certain conditions. I examine the corresponding empirical evidence in subsection 4.2.

The above review shows that there is a myriad of theoretical contributions dealing with the effects of fiscal policy on the real economy. The size of fiscal multipliers varies considerably among different approaches, depending on what circumstances are assumed to prevail and which channels of transmission are incorporated in the models. In the context of the consumption channel, assumptions regarding the behavior of households play a crucial role – multipliers tend to be larger the less individuals are assumed to behave in a Ricardian fashion. The wealth/labor supply channel implies an increase in labor supply induced by the negative wealth effects of a government spending shock, but its quantitative relevance is debatable. Monetary policy has a considerable influence on the transmission of fiscal policy and may either reinforce or dampen its effects on the real economy. The real interest rate may be positively affected by expansionary fiscal policy, which represents another transmission channel. Finally, the effect of fiscal policy on economic activity also depends on the exchange rate regime maintained by the central bank. One could, of course, identify additional channels that determine the transmission of fiscal policy, but the ones I discussed account for a large part of the academic debate on fiscal multipliers. This is not only true for theoretical contributions, but also in the context of empirical analysis, which I have a look at in the following section.

4. REVIEW OF EMPIRICAL LITERATURE

In addition to the variety of theoretical literature dealing with the effects of fiscal policy on the real economy, there are also numerous empirical studies analyzing this effect.[22]

[22] The spending variable considered in empirical studies comprises in most cases government consumption as well as government investment. Transfer payments usually enter the analyses by being subtracted from taxes, yielding the net taxes variable. Hence, when I speak of government spending/expenditure in the following section, I mean the sum of government consumption and government investment.

The most widely used econometric approach in this context is the (structural) vector autoregression ((S)VAR) methodology.[23]

In the following, I briefly discuss some empirical evidence related to fiscal multipliers. I once again focus on the transmission channels considered in the previous section, namely (i) consumption, (ii) wealth and labor supply, (iii) monetary policy, (iv) the interest rate, and (v) the exchange rate regime.

4.1. Consumption channel

As discussed above, the size of fiscal multipliers crucially depends on the way private consumption reacts to changes in income. Campbell and Mankiw (1989) tackle this question in an empirical analysis using US data from the period 1953 to 1986. The authors conclude from an ordinary least squares estimation that the permanent income hypothesis does not hold in general, but rather that at least a fraction of households exhibit rule-of-thumb behavior, i.e. they consume their current income. Based on their data, Campbell and Mankiw estimate the share of such households to be around 0.5, while the rest of consumers are forward-looking and consume their permanent income. The authors find similar results for other countries. Consequently, if an increase in government spending leads to an increase in household income, then aggregate consumption is expected to rise to some extent. However, one should bear in mind that these results might change if more recent data were used.

Empirical studies investigating the effect of government spending shocks on private consumption largely support the claim of a positive effect. Fatás and Mihov (2001), for example, conduct a VAR analysis for US data from 1960 to 1996 and find that an increase in government spending has a significant and strong positive effect both on consumption and output. Their results suggest that the boost in output is to a large extent due to the increase in private consumption. Galí et al. (2007) as well as Blanchard and Perotti (2002) arrive at similar conclusions using US data in VAR models. In contrast to these results, Mountford and Uhlig (2009) find a very small increase in consumption of US households following a government spending shock, the increase being significant only on impact. Corsetti, Meier and Müller (2012) find no response of consumption at all for a panel of OECD countries. However, the latter only consider shocks to government consumption and do not include public investment in their fiscal variable. In summary,

[23] Since SVAR models represent a special application of vector autoregressive (VAR) models, the former are often simply referred to as VAR models in empirical contributions.

the majority of available empirical evidence suggests that consumption does at least not decrease in response to a rise in government expenditure.

In a VAR analysis of nineteen OECD countries in the period of 1965 to 1994, Perotti (1999) adds another perspective to this issue. He investigates the effects of government consumption shocks on private consumption in normal times compared to times of fiscal stress. In normal times, Perotti finds private consumption to strongly increase following a rise in government consumption, which is in line with the results discussed above. However, in times of a high budget deficit or high government debt, the response of private consumption is negative. The author then investigates the role of credit constraints in this context.[24] While in countries with a high degree of credit constraints the difference between "good" and "bad" times is very pronounced, countries with a low degree of credit constraints exhibit almost no such difference and only positive effects on private consumption. Hence, credit constraints seem to be crucial for the transmission of government spending shocks, as suggested by theory. However, following a different definition of good and bad times – namely expansions and recessions –, a number of recent contributions come to very contrary results. Auerbach and Gorodnichenko (2012, 2013), for example, find that the consumption multiplier (as well as the output multiplier) for US data is significantly larger in times of a negative output gap than in times of a positive output gap.[25]

Comparing empirical results in the context of the consumption channel with the theoretical considerations from subsection 3.1, the Keynesian view of crowding in tends to find more support in the data than the crowding-out hypothesis. Evidence also suggests that assumptions of heterogeneous household types, as for example implemented by Galí et al. (2007), are an appropriate way of modelling household behavior.

4.2. Wealth/labor supply channel

As indicated above in a theoretical context, the existence and magnitude of an effect of a fiscal shock on labor supply via the wealth channel depends on the elasticity of labor supply with respect to wealth. Since the wealth/labor supply channel applies to individuals that take into account how their wealth is affected by future tax increases, it seems sensible to consider estimates of *intertemporal* labor supply elasticity. Various empirical studies have provided such estimates. Altonji (1986), for example, finds an

[24] Perotti uses the maximum loan-to-value ratio of mortgages as a proxy for the degree of credit constraints in a country.
[25] See also Baum and Koester (2011) and Baum, Poplawski-Ribeiro and Weber (2012) for more evidence on fiscal multipliers over the business cycle (however without special focus on consumption multipliers).

intertemporal elasticity of labor supply between 0 and 0.35 for married prime-age males (see also MaCurdy 1981). Lee (2001), correcting for the finite sample bias of previous studies, finds higher values of around 0.5 for the same group, i.e. a 0.5% increase (decrease) in hours supplied to the labor market following a 1% increase (decrease) in lifetime wealth.

The effect of fiscal expansions on hours and employment has been investigated in several empirical contributions. It is, however, unclear whether changes in hours following government spending shocks are indeed due to wealth effects on labor supply or, for example, due to increased labor demand by firms. One therefore has to be cautious when interpreting such results. Employment tends to rise in response to an increase in government spending, as for example found by Fatás and Mihov (2001) for the United States or by Giordano et al. (2007) for Italy. Regarding aggregate hours, Fatás and Mihov find no significant effect, while Monacelli, Perotti and Trigari (2010) find an increase of this variable for US data. The latter also evaluate the effect of a fiscal shock on hours per employed individual, i.e. the intensive margin of labor supply and the actual variable of interest in the context of the wealth/labor supply channel. The authors find no significant change of hours per individual.

Summing up, evidence of a moderate intertemporal labor supply elasticity as well as a missing effect of a fiscal expansion on hours per individual indicate that the wealth/labor supply channel is hardly quantitatively relevant. However, drawing on theoretical arguments from Baxter and King (1993) and Uhlig (2010), the reason for a lack of response of hours could also lie in the distortionary nature of income taxes (see subsection 3.2). Furthermore, in reality, working times are in general fixed to some extent, making it difficult for individuals to adjust the number of hours they supply to the labor market.

4.3. The role of monetary policy

Theory predicts that the size of fiscal multipliers varies greatly depending on the way in which monetary policy reacts to changes in government spending. I was not able to find any evidence regarding the quantitative influence of the degree of monetary accommodation per se on fiscal multipliers. There is, however, evidence on the specific topic of the effectiveness of fiscal policy at the ZLB. In a very recent contribution, Ramey and Zubairy (2014) investigate the size of government spending multipliers at the ZLB of the nominal interest rate, compared to normal times. The authors use a large data sample

from 1889 to 2013 for the US economy and a state-dependent model estimation.[26] They find that fiscal multipliers are not significantly larger at the ZLB than in normal times in the full sample. Excluding World War II from the sample, the results are mixed, with higher multipliers at the ZLB at some horizons under certain specifications. These results are, however, not robust to alternative specifications. Altogether, the authors conclude that there is no robust evidence of higher multipliers at the ZLB. Hence, their evidence does not support the predictions of theory of increased effectiveness of fiscal policy when the ZLB is binding (see subsection 3.2).

For more evidence regarding the role of monetary policy in the transmission of fiscal policy, I refer to subsection 4.5 on exchange rate regimes. Exchange rate regimes represent one dimension of monetary policy. Hence, looking at empirical results concerning the effectiveness of fiscal policy under different exchange rate regimes also gives an idea of the role of monetary policy in general.

4.4. Interest rate channel

Empirical results regarding the response of the interest rate to fiscal policy shocks are quite mixed, due to different definitions of the interest rate and different methodologies in measurement.[27] Faini (2006) investigates the effect of fiscal policy on long-term real interest rates on government bonds in member countries of the EMU for the period 1979 to 2002. He finds that an increase in the public deficit or debt of one country leads to a small increase in the spreads of this country, but has a much larger impact on the overall level of interest rates in the EMU. This result suggests that considerable spillovers exist between economies in the currency union. Laubach (2009), who uses long-horizon forward rates and projections of deficit and debt for the United States, finds that Treasury yields rise following an increase in deficit or debt. The analysis of Italian data by Giordano et al. (2007) yields a hump-shaped response of the long-term nominal interest rate on government bonds to a positive shock in government consumption: it decreases on impact, but increases in the long run. Inflation rises on impact, implying a considerable fall in the real interest rate. The authors have no explanation for this result. Perotti (2004),

[26] Ramey and Zubairy's estimation is based on a local projection methodology developed by Jordà (2005). This methodology provides an alternative to VAR models. While VAR models extrapolate into distant time horizons from a given specification, Jordà's approach estimates local projections for each variable at each period of interest.

[27] In empirical studies that apply the SVAR methodology, the real interest rate is generally defined as the nominal interest rate on government bonds net of the inflation rate. However, different measures of the nominal interest rate (e.g. short-term vs. long-term rates) as well as different measures of inflation (e.g. consumer price index vs. GDP deflator) are used. Furthermore, some studies only investigate nominal interest rates.

who evaluates the effects of a government spending shock on nominal as well as real interest rates in five OECD countries, finds no clear pattern of response across countries and across time. Hence, the available evidence provides no clear-cut answer to the question in which way interest rates react to a fiscal policy shock.

In the theoretical context of the sovereign risk channel, Corsetti, Kuester, Meier and Müller (2013) conclude that the fiscal multiplier is smaller the higher the initial debt-to-GDP ratio. This relationship has been empirically investigated by Corsetti et al. (2012). Their findings are in line with the predictions of the theoretical model: the response of output to an expansionary fiscal shock is close to zero in their baseline scenario of sound public finances, but negative if government debt exceeds 100% of GDP. Ilzetzki et al. (2013) arrive at similar results for a threshold value of only 60% of debt-to-GDP.[28]

In summary, while different theoretical models tend to predict a positive response of the interest rate to a fiscal expansion (see subsection 3.4), the evidence in this regard is inconclusive. One reason for this discrepancy lies in the different definitions of interest rates. While theoretical models often focus on long-term effects on the marginal product of capital, empirical studies mostly investigate the effects on government bond yields in the short run. It is therefore difficult to compare empirical results to the predictions of theory. The existence of the sovereign risk channel, however, is widely supported by the data.

4.5. Exchange rate regimes

Theoretical considerations discussed in subsection 3.5 suggest that exchange rate regimes play a crucial role in the effectiveness of fiscal policy measures. This issue has also been investigated empirically. Born et al. (2013) conduct a VAR analysis of a large sample of OECD countries for the period of 1986 to 2011 and find that government consumption shocks are both more persistent and have significantly larger effects on output under a fixed exchange rate regime than under flexible exchange rates. The multiplier exceeds unity under a peg and is smaller than one, but still positive, under a float. Ilzetzki, Mendoza and Végh (2013) provide an even broader analysis with a sample of 44 countries, 24 of which are developing countries. Their estimation yields a negative multiplier under flexible exchange rates and a positive multiplier that exceeds one in the long run under a peg. Corsetti et al. (2012) arrive at similar results for a sample of OECD countries with a multiplier close to zero in the former, and positive, but below one, in the

[28] See also Perotti's (1999) results of a negative response of private consumption to a fiscal expansion in times of high public debt, as discussed in subsection 4.1.

latter case. These two studies also include an evaluation of monetary accommodation under alternative exchange rate regimes. According to Ilzetzki et al. (2013), monetary authorities lower their policy rates by more when they commit to a fixed exchange rate, compared to central banks operating under a flexible exchange rate regime. The authors identify the difference in the degree of monetary accommodation to be the main reason for the diverging multiplier values. This result is in line with the conventional theoretical considerations discussed in subsection 3.5, which assume monetary policy to be more accommodative under a peg. Corsetti et al. (2012), however, come to a contrasting conclusion and find monetary accommodation to be more pronounced under flexible exchange rates, which seems to conflict with their finding of a lower multiplier in this scenario. The authors leave the solution to this paradox to further research.

In summary, however, the available evidence on fiscal multipliers under different exchange rate regimes supports the predictions of theory: a fiscal stimulus is more effective under a fixed exchange rate regime than under a flexible regime.

In the following section, I discuss the insights I draw from the review of theoretical as well as empirical literature and derive implications for my own empirical analysis.

5. SYNTHESIS

The above review of theoretical and empirical literature on fiscal multipliers and the transmission channels determining these multipliers shows that there is no single, universally valid multiplier value. In the context of theoretical models, multipliers crucially depend on the underlying assumptions. The way in which households are assumed react to a change in current or permanent income determines the response of private consumption and labor supply to fiscal shocks. If monetary policy is assumed to be somewhat accommodative, then a fiscal stimulus can be much more effective than in a setting where the central bank is highly concerned with inflation stabilization. Assumptions about Ricardian equivalence, the nature of taxation (distortionary vs. lump-sum) or the openness of an economy also play an important role in the effectiveness of fiscal policy in theoretical models. So does the exchange rate regime that is assumed to be prevalent in an economy. Similar arguments hold for empirical contributions on the subject of fiscal multipliers. They arrive at very different results, which might be due to

country-specific institutional and historical characteristics, differences in the data and variables, but also to the specific methodologies used in these contributions. Examples for the latter are different identification strategies in the context of SVAR models, which I discuss in further detail in subsection 6.3, or different multiplier concepts. The argument of the importance of assumptions and methodologies is, for example, highlighted by Gechert and Will (2012), who conduct a meta-regression analysis on 89 theoretical and empirical studies to investigate in which way results regarding multiplier values depend on these characteristics. Output multipliers in these studies vary between -2.2 and 4, which illustrates how divergent such estimations can be. The authors find that important determinants of the multiplier include the nature of the fiscal impulse, the model class, the share of Keynesian agents, monetary policy specifications as well as the openness of an economy.

These considerations point to the problem that multipliers resulting from different models and empirical studies are in general comparable only to a limited extent. It is therefore advisable to be cautious when drawing deductions from results of a specific model or from a specific country. Hence, it is not possible to provide an unambiguous answer to the research question of the effects of fiscal policy on the real economy. The empirical analysis conducted in this thesis should in this sense be interpreted as an estimation for one single country for a limited time frame, based on a specific methodology. The comparability of my results is further limited due to the fact that I can consider only one component of government spending, namely government consumption. Most other empirical studies on fiscal multipliers include at least government consumption and investment in their expenditure variables. The multiplier values I obtain in my SVAR analysis should therefore not be compared to multipliers referring to government expenditure on both consumption and investment.

Despite these caveats, I am able draw some conclusions from the results discussed in the literature review as well as possible implications for the Austrian case. The consumption channel is subject to controversy in theoretical contributions, as models in the Keynesian tradition predict private consumption to be crowded in by a fiscal expansion while neoclassical models tend to predict crowding out. Evidence from the United States and other OECD countries, however, suggests that private consumption does at least not decrease and might even increase in response to an increase in government spending. Therefore, I expect a similar response of private consumption in my analysis.

As discussed in subsection 4.2, a review of existing evidence suggests that the wealth/labor supply channel is not very powerful, since hours per employed individual do not respond to a fiscal expansion.[29] However, there may be a positive response of employment in general. I include employment in an alternative specification of my model and expect a positive effect of an increase in government consumption on this variable.

As a member of the EMU, Austria has no autonomous power over monetary policy anymore. This power was officially given up with the launch of the euro in 1999. Austria had, however, participated in the European Exchange Rate Mechanism since 1995 and had before that maintained an informal peg to the Deutschmark since the 1970s. Hence, the scope of action of the Austrian central bank had been rather limited even before it joined the EMU. This implies that monetary policy can be regarded accommodative in the Austrian case over the period I consider in my empirical analysis (1996Q1 to 2014Q3). While the ECB is highly concerned with inflation stabilization in the euro area as a whole, it can be assumed that a unilateral fiscal policy measure in Austria does not lead to a response by the ECB. The same can be assumed with respect to the German Bundesbank before 1999. Furthermore, Austria has clearly maintained a fixed exchange rate regime over the sample period, considering that a monetary union represents the most extreme form of a fixed regime. As a consequence, one would expect the Austrian fiscal multiplier to be higher compared to countries with more flexible exchange rates and less accommodative monetary policy. Testing for this hypothesis, however, would go beyond the scope of this thesis, since I only look at data for Austria.

In my analysis, the interest rate is defined by the 10-year nominal interest rate on government bonds. Theoretical models that investigate the long-run effects of fiscal policy on the real interest rate via changes in the capital stock therefore hardly provide any guidance for what to expect from my estimation. Considering the increase in sovereign risk associated with an expansionary fiscal policy shock, one could expect the interest rate to be positively affected by such a shock. Empirical evidence on the effects of fiscal policy on government bond yields, however, is quite mixed. Accordingly, I do not have specific expectations regarding the response of the interest rate in my analysis.

Based on both theoretical considerations and existing evidence discussed above, I expect a positive overall effect of an expansionary fiscal policy shock on output. However, in view of the large differences in multiplier values and considering that my analysis is

[29] It is, however, not possible to directly measure wealth effects of a fiscal policy measure on labor supply. As already mentioned, changes in hours per individual might also be due to higher demand for labor.

restricted to government consumption, I do not make any further hypotheses regarding the size of the multiplier – in particular, whether it is smaller or larger than one.

The effects of fiscal policy on the Austrian economy have been subject to investigation before. In 2009, both the Institute for Advanced Studies (Berger et al. 2009) and the Austrian Institute of Economic Research (Breuss et al. 2009) published studies examining the effects of the fiscal measures taken in Austria to combat the crisis. The measures considered comprise not only the stimulus packages of 2008 and 2009, but also the tax reform.[30] Conducted in 2009, both studies provide ex-ante analyses of these effects. Berger et al. (2009) use the *LIMA* model, while Breuss et al. (2009) base their analysis on the *WIFO-Macromod* model. Both are annual structural macroeconometric models for the Austrian economy, which are demand-driven, but also include supply side elements.[31] The models are normally used for medium-term economic forecasts. The effects of the measures are obtained by comparing the forecast including the reforms with a baseline forecast. Berger et al. estimate that the combined cumulative effects of the stimulus packages and the tax reform on real GDP amount to 1.0% in 2009 and 1.2% in 2010 (i.e. real GDP in 2009 is higher by 1.2% than it would have been without the reforms). Similarly, Breuss et al. find effects of 1.2% and 1.4% for 2009 and 2010, respectively. Since the stimulus packages mainly consisted in increases in government investment rather than government consumption, the effects of these packages are hardly captured in my analysis. Breuss et al. also report the values of fiscal multipliers featured in the two models. The *LIMA* model yields expenditure multipliers of 0.96 in year 1 and 0.98 (cumulative) in year 2. The corresponding multipliers in the *WIFO-Macromod* are 1.19 and 1.31, respectively. Hence, the two models provide different answers to the question whether the multiplier for Austria is smaller or larger than one. Once again, these estimates cannot be compared to the results of my analysis, since they refer to government expenditure on both consumption and investment.

In an investigation of the effectiveness of fiscal stimulus in various countries, the OECD (2009) reports separate multipliers for the components of government expenditure. The multipliers are estimated based on a survey of different macro models for OECD countries. For Austria, the estimated government consumption multipliers are 0.3 in year

[30] The stimulus packages included, for example, investments in infrastructure, credit programs and subsidies for firms, as well as increased spending on research and development. The tax reform mainly consisted in changes in income tax rates (see Berger et al. 2009 and Breuss et al. 2009). Effects of short-time work are not considered in the two studies.

[31] See Hofer and Kunst (2004) and Baumgartner, Breuss and Kaniovski (2004) for details on the LIMA model and the WIFO-Macromod model, respectively. Both models use mainly data provided by Statistics Austria, but the data sources are not explained in detail.

1 and 0.7 in year 2. Government investment multipliers are estimated to be 0.7 in year 1 and 1.1 in year 2, and multipliers referring to transfers to households are 0.2 and 0.6, respectively. Multipliers are also estimated specifically for the crisis scenario, yielding lower estimates (0.3 and 0.4 for government consumption, 0.7 and 0.9 for government investment, 0.2 and 0.4 for transfers). These results suggest that the effect of government consumption on output makes up only a relatively small portion of the whole effect of government expenditure. I therefore expect the output multiplier resulting from my analysis to be lower than common estimates of multipliers that also incorporate the effects of government investment.

The above review and critical reflection of existing theoretical literature and evidence gives an idea of the variety of approaches to investigating the effects of fiscal policy on economic activity. In the following section, I give an overview of the specific methodology and data I use for my empirical analysis of the Austrian case, as well as the results from this analysis.

6. EMPIRICAL ANALYSIS

In my empirical analysis, I use a SVAR model to investigate the effects of government spending shocks on the Austrian economy.[32] This approach is widely used in related literature.[33] However, in order to identify shocks, it is necessary to impose a structure on the error terms. These identifying assumptions are crucial for the results of the model and should therefore be chosen carefully. I apply an identification strategy proposed by Blanchard and Perotti (2002), but I also discuss alternative approaches to identifying shocks.

6.1. Data

The variables I incorporate in my baseline SVAR model are real government consumption expenditure, real GDP, the long-term nominal interest rate on Austrian government bonds and the inflation rate. In alternative specifications, I also include aggregate household consumption expenditure and total employment. Details on the definitions of the variables can be found in Table 1. I choose the long-term nominal interest rate on government bonds over the short-term rate, since long-term loans and debt

[32] The empirical analysis was performed using the statistical software *Stata 13*.
[33] Examples include Giordano et al. (2007), Fatás and Mihov (2001), Blanchard and Perotti (2002), Mountford and Uhlig (2009), Perotti (2004) and Ilzetzki et al. (2013).

securities make up by far the largest share of Austrian government debt. This share has ranged between 88% and 98% over the past 20 years (see Figure 1).

I obtained the data on government consumption expenditure, GDP, household consumption expenditure and employment from the Eurostat national accounts database (Eurostat 2015a, 2015b), and the interest rate data from the ECB interest rate statistics database (ECB 2015). The inflation rate is based on the implicit GDP deflator. The data on government and household consumption, GDP (both the variable itself and the data used for calculating the inflation rate) and employment are seasonally adjusted and adjusted by working days, as provided by Eurostat. I use quarterly data, which is also important for the identification of shocks (see subsection 6.3 and Appendix B). The Eurostat national accounts data are available from 1996Q1 onwards, yielding a sample period ranging from 1996Q1 to 2014Q4.

As mentioned above, appropriate data to investigate the effects of shocks to government expenditure as a whole is not readily available. There is hardly any data available that reliably measures government investment in Austria. One reason for this lack of data is that only part of investment expenditure related to the public sector is officially attributed to the public sector in national accounts, as Grossmann and Hauth (2010) point out.[34] The latter estimate the structure and level of investment in infrastructure in Austria from 1995 to 2008 for the private and public sector combined. However, since this definition is very broad, and since the data are provided only at annual frequency and do not cover all of my sample period, I cannot use Grossmann and Hauth's data. Consequently, my analysis is restricted to the effects of shocks to government consumption.

Another caveat of my model is that it does not contain a tax variable. Most empirical contributions that investigate the effects of fiscal policy based on SVAR methodology also include a revenue variable, in particular taxes net of transfers. However, neither Eurostat nor Statistics Austria provide appropriate data on taxes over the full sample period. Unfortunately, I therefore do not include taxes into my specification.

The development of the variables of my SVAR model over the sample period is plotted in Figures 3a and 3b. Real GDP followed an increasing trend from 1996 to 2008, but fell abruptly in the following periods when the Austrian economy was hit by the crisis. It slightly recovered from 2010 on, but has more or less stagnated since 2012. Real

[34] There has, however, been a revision to the classification of economic units to the private sector or the government sector under the recently introduced European System of Accounts (ESA) 2010, which became mandatory for EU member countries in 2014 (see, e.g., Statistics Austria 2014a).

government consumption has mostly increased over the sample period, however at a slower rate since 2010. This can be attributed to the consolidation measures recently taken by the Austrian government, which strongly affected government consumption (in particular via structural measures in the public sector).[35] Government consumption measured as a ratio of GDP (not depicted) has also exhibited a decreasing pattern, with the exception of the early crisis periods when GDP fell. The 10-year nominal interest rate on government bonds has followed a strongly decreasing trend over the sample period and fell from 6.5% in 1996 to just under 1% at the end of 2014. The rate of inflation, as measured by the change in the GDP deflator, has fluctuated a lot over the observed period, exhibiting no clear trend. Real consumption expenditure of private households has almost steadily increased over the sample period, but has remained at a rather constant level since late 2011. Similarly to government consumption, private consumption as a share of GDP (not depicted) has fallen over the sample period, with the exception of the episode of negative GDP growth in 2008 and 2009. Total domestic employment also exhibits a clearly increasing pattern. However, this holds once again with the exception of the early crisis periods of 2008 and 2009, when employment first stagnated and then decreased.

6.2. Specification of the SVAR model

The benchmark specification of the SVAR model contains four variables: real GDP y_t, real government consumption g_t, the 10-year nominal interest rate i_t and inflation π_t. GDP and government consumption data are log-transformed. The reduced-form VAR is then given by the following equation:

$$X_t = \mu_0 + \mu_1 t + A(L)X_{t-1} + u_t, \tag{5.1}$$

where $X_t = (g_t, i_t, y_t, \pi_t)'$ denotes the vector of endogenous variables, μ_0 is a constant, t is a linear time trend, $A(L)$ is a lag polynomial and $u_t = (u_t^g, u_t^i, u_t^y, u_t^\pi)'$ is the vector of reduced-form disturbances. Details on the derivation of the SVAR model are provided in Appendix B.

Based on likelihood ratio tests as well as the Akaike information criterion, I choose a lag length of two quarters.[36] The Lagrange multiplier test suggests that there is no residual

[35] The consolidation measures included, for example, a hiring freeze, a pay freeze and other structural measures in the public sector, measures to increase (early) retirement age, only moderate increases in pensions, reforms in the health care sector and reforms of subsidies (Bundeskanzleramt 2012).

[36] For the full sample, the Akaike information criterion is lowest at two lags when a maximum of eight lags is considered. The p-value of the likelihood ratio test of three lags against the null hypothesis of two lags is

autocorrelation at this lag order.[37] Moreover, augmented Dickey-Fuller tests for the presence of unit roots were performed for each variable and indicate that all of them, except for the inflation rate, are integrated of order one. However, it is common practice in SVAR literature to nevertheless estimate the model with the variables entering in levels rather than in differences. This practice relies on results of Sims, Stock and Watson (1990).[38]

In addition to the benchmark specification, I consider two alternative 4-variable specifications where GDP y_t is replaced by the logs of consumption of private households c_t and employment e_t, respectively, in the vector of endogenous variables.

6.3. Identification of shocks

Different approaches to identifying shocks have been used in empirical contributions on fiscal multipliers. They usually involve restrictions on elasticities of the included variables. The identification strategy I use is often referred to as the Blanchard-Perotti (BP) approach. It was developed by Blanchard and Perotti (2002) and extended by Perotti (2004) to include additional variables. This approach relies on institutional information regarding the relationships among the included variables. In particular, it is assumed that government spending is predetermined within one quarter and therefore not affected contemporaneously by shocks to the other variables. The identification procedure and the related assumptions are explained in detail in Appendix B. The timing of tax collection and elasticities of revenue variables are usually also considered in the context of the BP approach. Due to the lack of data on taxes, however, my analysis does not involve such considerations.

Caldara and Kamps (2008, 2012) provide an overview of the most commonly used approaches and investigate whether different identification schemes lead to differences in multiplier estimations. The approaches they discuss are the recursive approach, the BP approach, the sign restriction approach and the narrative approach.[39] The recursive approach was proposed by Sims (1980) and reflects the contemporaneous effects among variables solely in their ordering. While the variable ordered first is assumed not to react

0.163, confirming the choice of two lags. For the reduced sample, the selection criteria do not provide a clear choice. Hence, I also estimate the model using three and four lags, respectively, in order to check for the robustness of my results.

[37] The p-values for the null hypothesis of no residual autocorrelation at two lags are 0.314 for the full sample and 0.394 for the reduced sample.

[38] Sims et al. (1990) show that the cointegrating vector can be ignored in VAR models if the sample size is sufficiently large.

[39] In their 2012 paper, Caldara and Kamps additionally consider the penalty function approach to sign restrictions. This approach can be viewed as an augmented version of the pure sign restriction approach.

contemporaneously to shocks in the other variables, the variable ordered second is assumed to be affected by shocks to all but the first variable, and so forth. In the case of my analysis, the BP approach is almost equivalent to the recursive approach, since I do not include a tax variable (see Appendix B). In the sign restriction approach, which was developed by Mountford and Uhlig (2009), restrictions are imposed on the shape and direction of the impulse responses. In addition to fiscal policy shocks, Mountford and Uhlig also consider business cycle shocks and monetary policy shocks. Finally, the narrative approach involves the identification of shocks based on the study of historical fiscal episodes. For example, Romer and Romer (2010) identify post-war tax policy shocks in the United States from narrative records, such as Congressional reports and presidential speeches. Ramey (2011) also uses narrative sources to identify episodes of increased military spending associated with wars. Using common data for the United States from 1947 to 2006, Caldara and Kamps (2012) estimate SVARs based on the different identification strategies. They find that spending multipliers – both with respect to output and private consumption – are larger for the BP and the recursive approaches than for the sign restriction and narrative approaches. The authors explain this discrepancy by the lower estimates of the output elasticity of government spending provided by the former two approaches. The differences in multipliers, however, tend to diminish in the long run. These results once again make clear that multiplier estimates based on different methodologies should be interpreted with caution.

6.4. Results

The impulse responses to a positive shock to government consumption are depicted in Figure 4 to Figure 7. The responses of government consumption itself, GDP and private consumption are scaled such that they depict the euro response of the respective variables to a one euro increase in government consumption.[40] They can therefore be interpreted as non-accumulated multipliers (see multiplier at horizon T, φ_T, in section 2). The responses of the interest rate and the inflation rate reflect changes in percentage points, following a one percent increase in government consumption. Regarding employment, the impulse responses give the percentage change in employment in response to a one percent increase in government consumption. In the following, the expression "statistically significant" refers to zero not being included in the 95% confidence interval.

[40] The original impulse responses with respect to these variables reflect elasticities, as they give the change in the logarithm of the respective variable, following a unit increase in the logarithm of government consumption. The original responses are transformed by multiplying them by the ratio of the respective variable to government consumption. This ratio is evaluated at the mean over the respective sample period (see, e.g., Caldara and Kamps 2008).

Figure 4 shows the impulse responses of government consumption, GDP, the 10-year nominal interest rate and the inflation rate to a positive government consumption shock for the full sample period. The fiscal shock is rather persistent and does not entirely die out over the horizon of 20 quarters. The response of real GDP is slightly positive in the first periods after the shock and turns negative after approximately two years. The multiplier takes a value of only 0.1 on impact and peaks at 0.4 after 4 periods. However, the response of output is not significantly different from zero in any period, which contrasts most of the previous empirical findings I discussed above. The response of the nominal interest rate to a one percent government consumption shock follows a hump-shaped pattern: it increases significantly in the first five periods and slowly returns to its baseline level thereafter. The effect is, however, not particularly strong, amounting to 3 basis points on impact and a maximum of 11 basis points after five quarters. The effect on inflation – quite surprisingly – is negative in the first period (a decrease by 33 basis points), but negligible in all other periods. Consequently, the *real* interest rate responds positively to the fiscal shock.

The insignificant response of GDP to a government consumption shock is rather puzzling, considering the at least small positive effects of expansionary fiscal shocks found in previous studies. However, since some fundamental economic relationships have ceased to be in force during the recent crisis, it can be expected that this is also true for the relationships I investigate. I therefore additionally performed my analysis for the pre-crisis period, i.e. up to 2007Q4. The impulse responses based on this restricted sample are depicted in Figure 5. The results fundamentally change, compared to the estimation based on the full sample. The fiscal shock is far less persistent and dies out after five quarters. Its hump-shaped effect on GDP, however, is much stronger: the multiplier takes a value of 0.4 on impact and reaches its maximum at 1.6 after four quarters. These estimates are larger than the government consumption multipliers estimated by the OECD (2009), discussed in section 5, and support my hypothesis of a positive effect on output. The effects are statistically significant between the second and the sixth quarter. Finally, GDP returns to its baseline level after approximately three years. The response of the interest rate is similar to the previous scenario, with an increase of 3 basis points on impact and a maximum 12 basis points after four quarters. The effect on inflation is less pronounced than in the full-sample scenario (it decreases by 16 basis points on impact) and not significant in any period. Together, these results imply that the real interest rate increases. This result supports the predictions from theory discussed in subsection 3.4.

I also performed the SVAR for the remaining sample from 2008Q1 onwards, i.e. the period since the onset of the crisis in the euro area. However, model convergence in maximum likelihood iteration was not achieved in this case. The results should therefore not be interpreted, which is why the impulse responses are not depicted. Possible reasons for the lack of convergence may be the smaller sample size or that the identifying restrictions are not suitable for the crisis period.

In Figure 6, the impulse responses of the alternative specification including real consumption of households instead of GDP are shown. The results are also based on the restricted pre-crisis sample period. Private consumption somewhat increases in the first periods following the shock, then falls slightly below its baseline level after 10 quarters, and finally returns to its initial level. The consumption multiplier takes a value of almost zero on impact and peaks at 0.3 after one year. The effects of consumption are, however, not statistically significant in any period. Hence, neither the crowding-out nor the crowding-in hypotheses are supported by my findings.

Finally, the results of the second alternative specification, which includes employment instead of GDP, are shown in Figure 7. Employment shows no significant response whatsoever to an expansionary government consumption shock. The very broad confidence interval also suggests that the response of employment is estimated rather imprecisely by the SVAR model. My expectation of a positive effect on employment could therefore not be confirmed.

In order to check for the robustness of my results, I estimated some common modified versions of my SVAR model. Figure 8 depicts the impulse responses of GDP to a one euro government consumption shock for five different models: the benchmark model, models with respectively three and four lags instead of two, a model including a quadratic trend instead of a linear trend and a model without a trend variable. All models are based on the reduced sample period up to 2007Q4. The alternative models mostly provide slightly lower estimates of the effect of GDP, but the differences are rather small. The same holds for the estimation based on the full sample, as well as the responses of the other included variables, which are not depicted. Summing up, the results of the SVAR for the specification I use appear to be robust to minor changes in the model setup.

7. CONCLUSIONS

This thesis investigates the effects of fiscal policy shocks on key macroeconomic variables. I provide a review of theoretical literature as well as existing evidence on the subject of fiscal multipliers, breaking down the transmission of fiscal policy into five channels: the consumption channel, the role of monetary policy, the wealth/labor supply channel, the interest rate channel and the role of exchange rate regimes. Furthermore, I conduct an empirical analysis for Austria, based on a SVAR approach and quarterly data from 1996 to 2014.

The review of theoretical contributions has illustrated that basic assumptions and transmission channels that are assumed to be effective in the various models are highly crucial for the effects of fiscal policy measures resulting from these models. Results depend, for example, on the behavior of households (and, consequently, whether government spending crowds in or crowds out private consumption), on the degree of monetary accommodation, on whether labor supply is assumed to be affected by fiscal shocks, on the response of the real interest rate and on the prevailing exchange rate regime.

An important finding from the SVAR analysis is that the effects of fiscal policy on output are fundamentally different when considering a restricted sample period of the pre-crisis years (up to 2007Q4), as compared to the results based on the full sample. While the response of GDP to an expansionary government consumption shock is not significant in the latter case, it is quite substantial when recent data since the onset of the crisis are excluded: the multiplier takes a value of 0.4 on impact and peaks at 1.6 after one year. The effect dies out after approximately three years. The real interest rate responds to the fiscal shock in a hump-shaped pattern, exhibiting a significant increase in the first year after the shock and returning to its baseline level thereafter. The effect on inflation is negative on impact, but rather short-lived. In alternative specifications for the restricted sample, I find that neither the response of the consumption of private households nor the effect on employment are statistically significant.

A positive effect of a fiscal expansion on the level of output is in line with the findings of both theoretical models and previous empirical studies. The size of the multiplier is difficult to compare to estimates from other studies, since I only consider the effects of government consumption (as opposed to a spending variable that also includes government investment). While previous evidence on the response of the interest rate is rather mixed, theory tends to predict an increase. This prediction is supported by the

results from my analysis. Private consumption is found by most existing empirical studies to increase in response to a positive fiscal shock. As regards theory, there is no consensus on the direction of this effect. My findings suggest that private consumption is neither substantially crowded in, nor crowded out by government consumption. Similarly, my results do not support the conjecture that employment may increase in response to a fiscal expansion.

There are, however, some shortcomings to my empirical analysis. Unfortunately, I was not able to obtain appropriate data on government investment and taxes. One should therefore be cautious when comparing my results to findings from studies which use a broader definition of government spending. It would provide for an interesting task to further investigate the data situation in Austria with respect to these variables and possibly construct own data, but this would have gone beyond the scope of this theses. Furthermore, it is important to bear in mind that the use of different identification strategies in the context of SVAR models can lead to differences in results. The BP approach is only one of several common approaches used in literature on the effects of fiscal policy.

Comparing results from different identification schemes for the Austrian case – in a similar way as Caldara and Kamps (2008, 2012) did for the United States – would be an interesting task for future research. Another potential topic for further research would be to decompose government consumption into its components and investigate, for example, exclusively the effects of an increase in compensation of government employees. Such an analysis could provide useful policy implications. Finally, it would be interesting to re-conduct the SVAR analysis in a few years when more data from the period since the onset of the crisis are available. Since I did not obtain any robust results for this period, a repeated estimation in the future could provide insights regarding what influence the crisis has had on the effectiveness of fiscal policy. Moreover, since the ECB key interest rate has virtually reached the ZLB recently, such an analysis in the future could contribute to the discussion of fiscal multipliers at the ZLB.

Overall, this thesis provides an insight into the controversy over the effects of fiscal policy on economic activity and illustrates why different models in this context often lead to divergent results. Furthermore, my empirical analysis can be regarded a significant contribution to the rather scarce range of evidence for Austria and can be extended into several directions outlined above.

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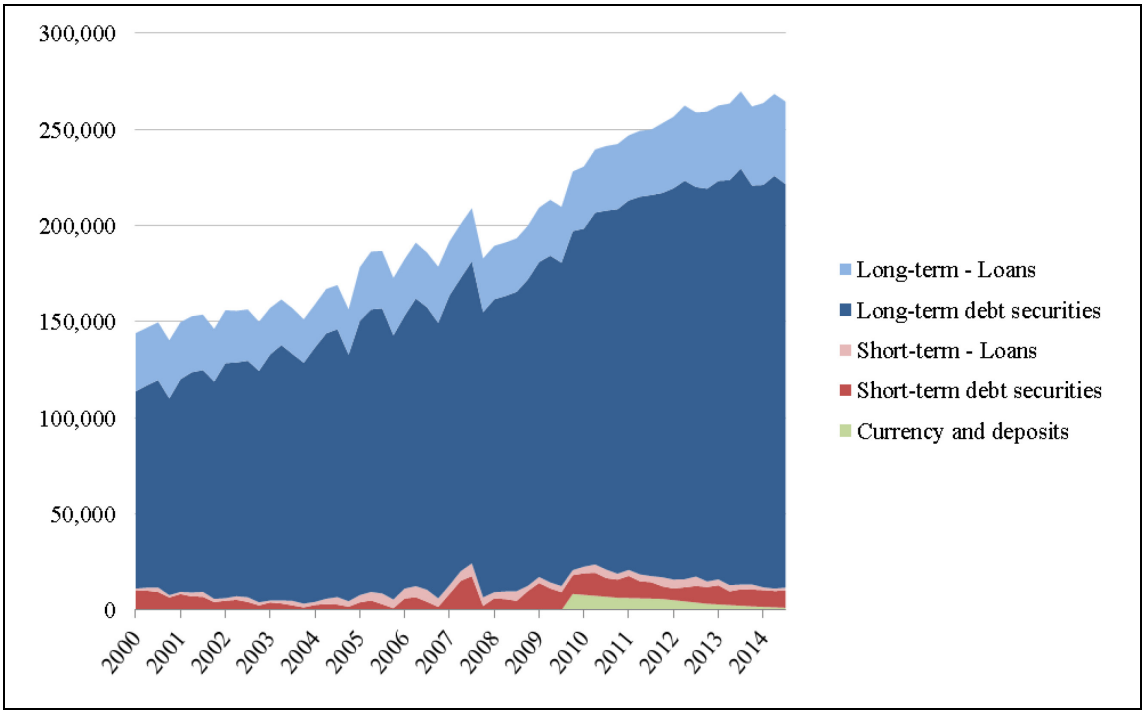
APPENDIX A: TABLES AND FIGURES

Table 1: Definitions of variables used in SVAR model

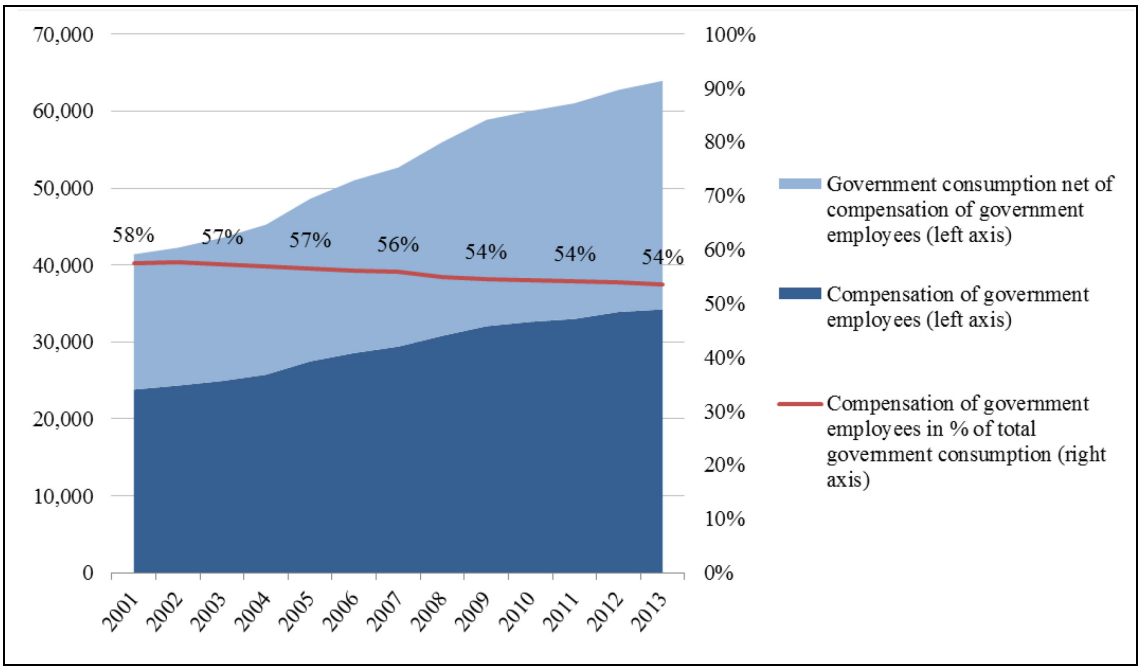
Variable	Definition	Data source
Government consumption	Final consumption expenditure of general government, seasonally adjusted and working day adjusted, expressed in chain linked volumes in million euros at prices of 2010	Eurostat quarterly national accounts (ESA2010), GDP and main components (namq_10_gdp)
GDP	Gross domestic product, seasonally adjusted and working day adjusted, expressed in chain linked volumes in million euros at prices of 2010	Eurostat quarterly national accounts (ESA2010), GDP and main components (namq_10_gdp)
Household consumption	Final consumption expenditure of households, seasonally adjusted and working day adjusted, expressed in chain linked volumes in million euros at prices of 2010	Eurostat quarterly national accounts (ESA2010), GDP and main components (namq_10_gdp)
Employment	Total employment according to domestic concept, seasonally adjusted and working day adjusted, in thousand persons	Eurostat quarterly national accounts (ESA2010), Population and employment (namq_10_pe)
Interest rate	Secondary market yields on government bonds, 10 years maturity, in % per annum	ECB Statistical Data Warehouse, interest rate statistics
Inflation	Quarter-on-quarter inflation rate based on GDP deflator and multiplied by 4 in order to reflect yearly changes, calculated with seasonally adjusted and working day adjusted GDP data, in %	Eurostat quarterly national accounts (ESA2010), GDP and main components (namq_10_gdp)

Figure 1: Decomposition of Austrian government debt into debt components, in million euros at current prices, quarterly data, 2000Q1-2014Q3



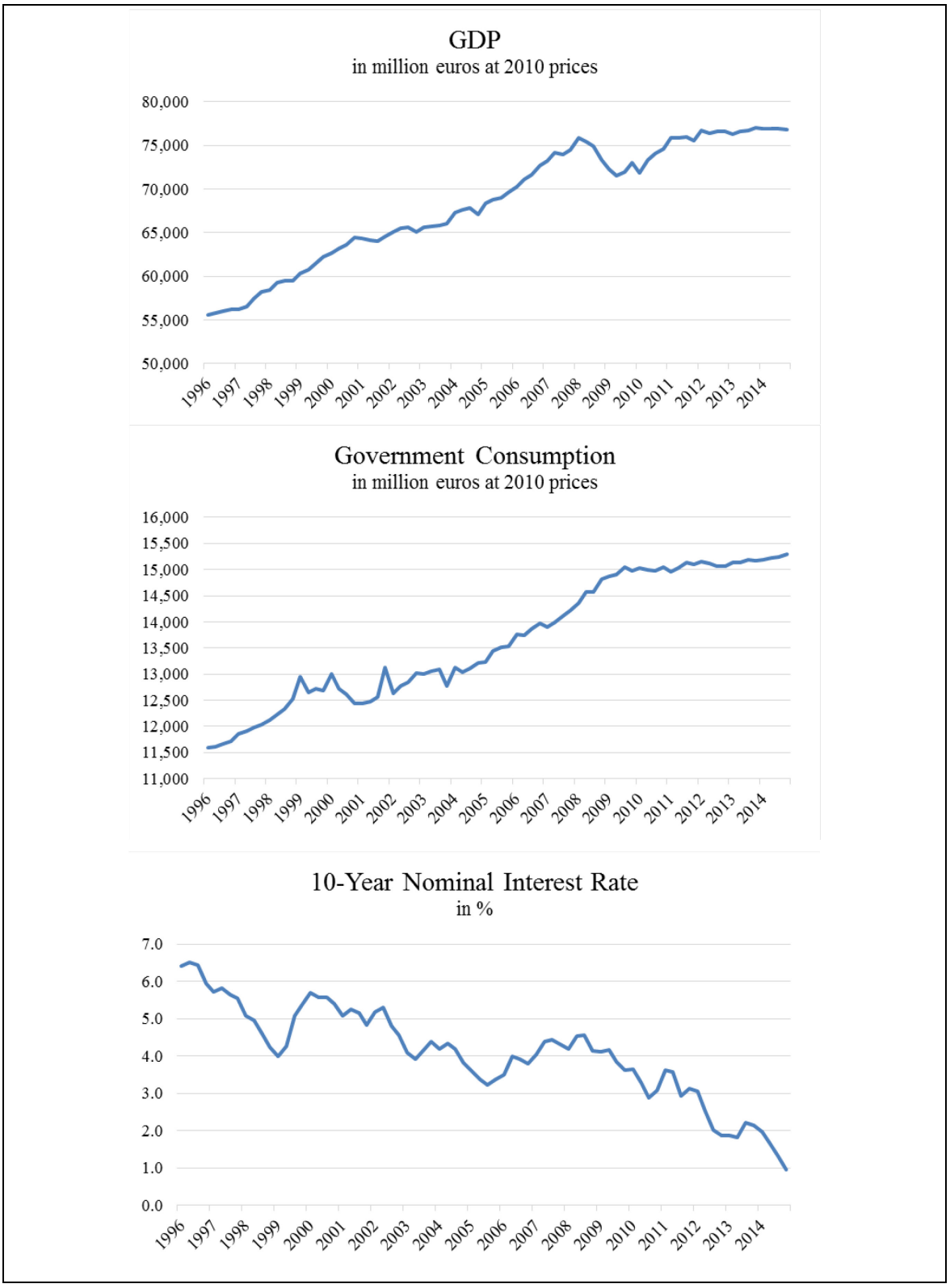
Source: Eurostat (2015c).

Figure 2: Compensation of government employees as a share of total government consumption, in million euros at current prices (left axis) and in % (right axis), annual data, 2001-2013



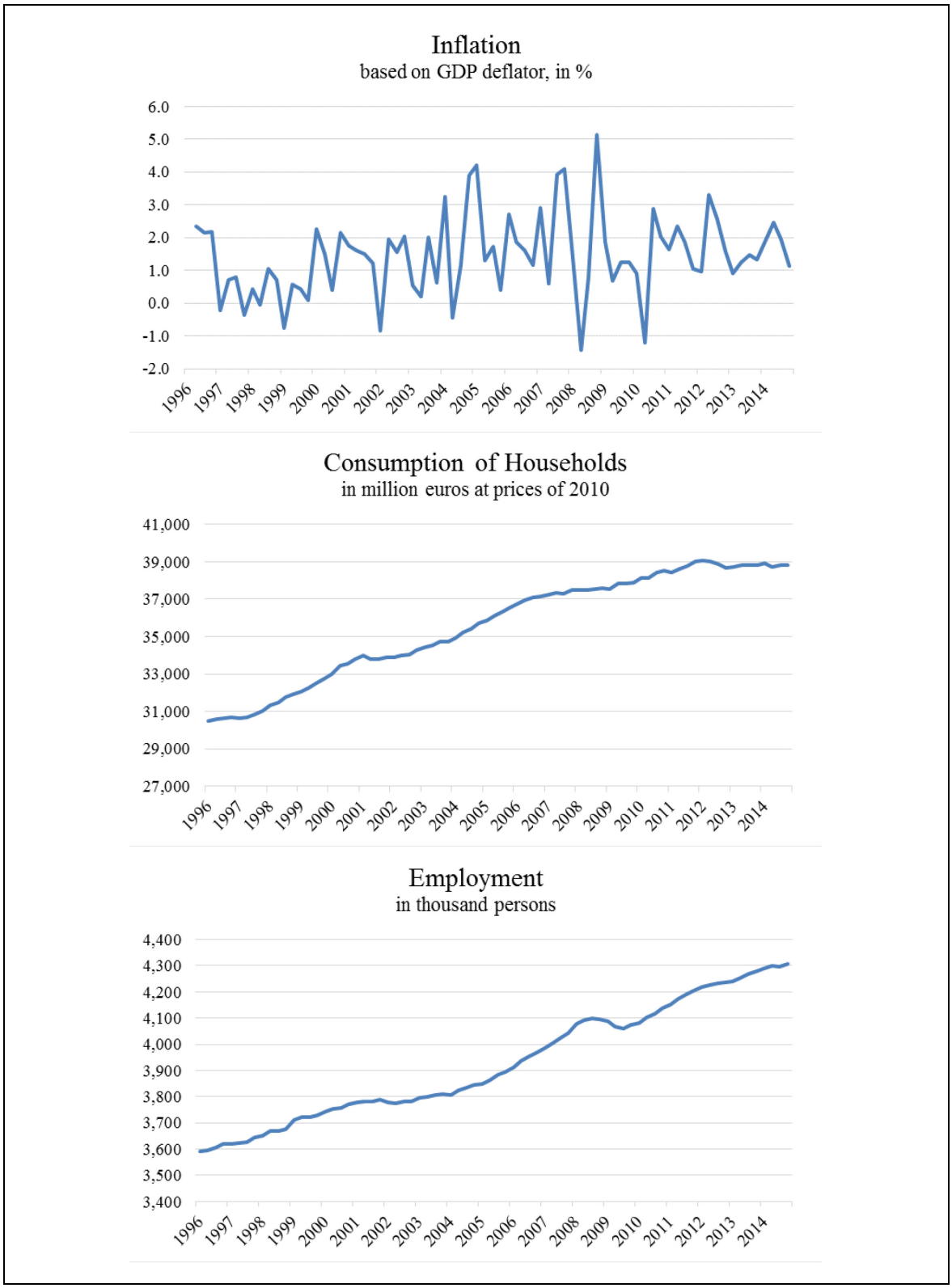
Sources: Statistics Austria (2014b), Eurostat (2015a).

Figure 3a: Variables used in SVAR model, quarterly data, 1196Q1-2014Q4



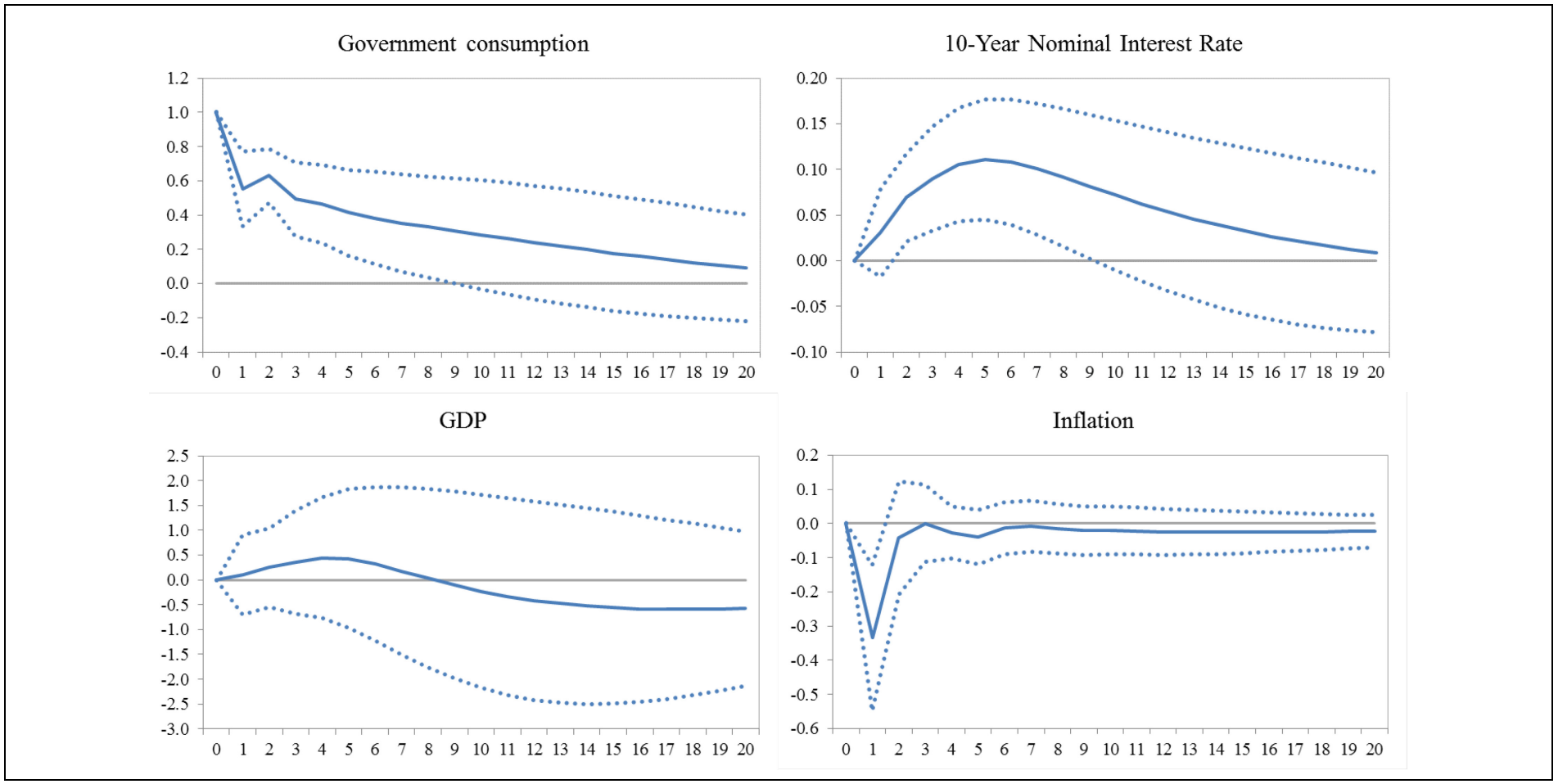
Sources: Eurostat (2015a), ECB (2015). See Table 1 for details on definitions of variables.

Figure 3b: Variables used in SVAR model, quarterly data, 1196Q1-2014Q4



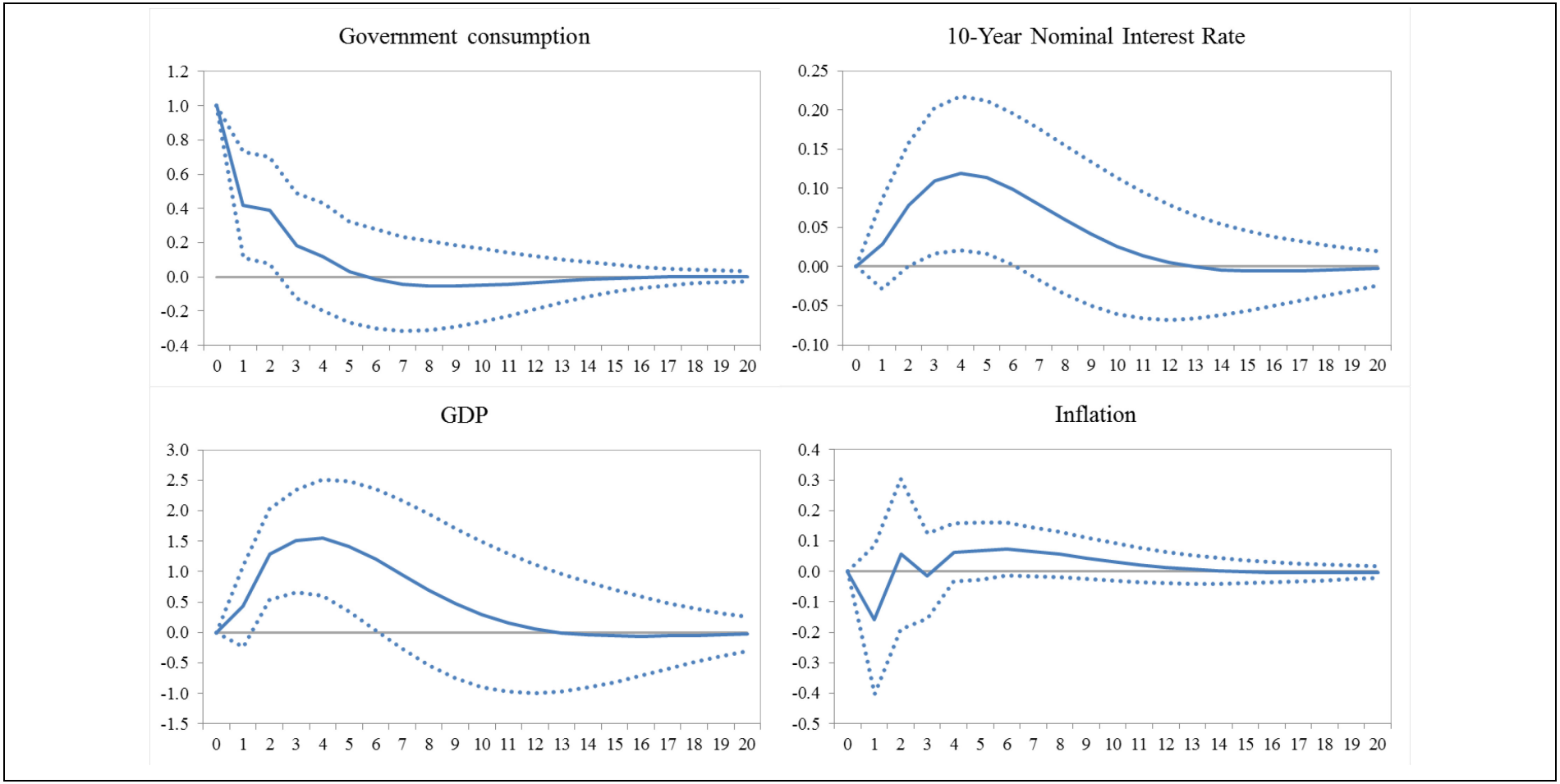
Sources: Eurostat (2015a, 2015b). See Table 1 for details on definitions of variables.

Figure 4: Impulse responses to a positive government consumption shock: benchmark specification, full sample



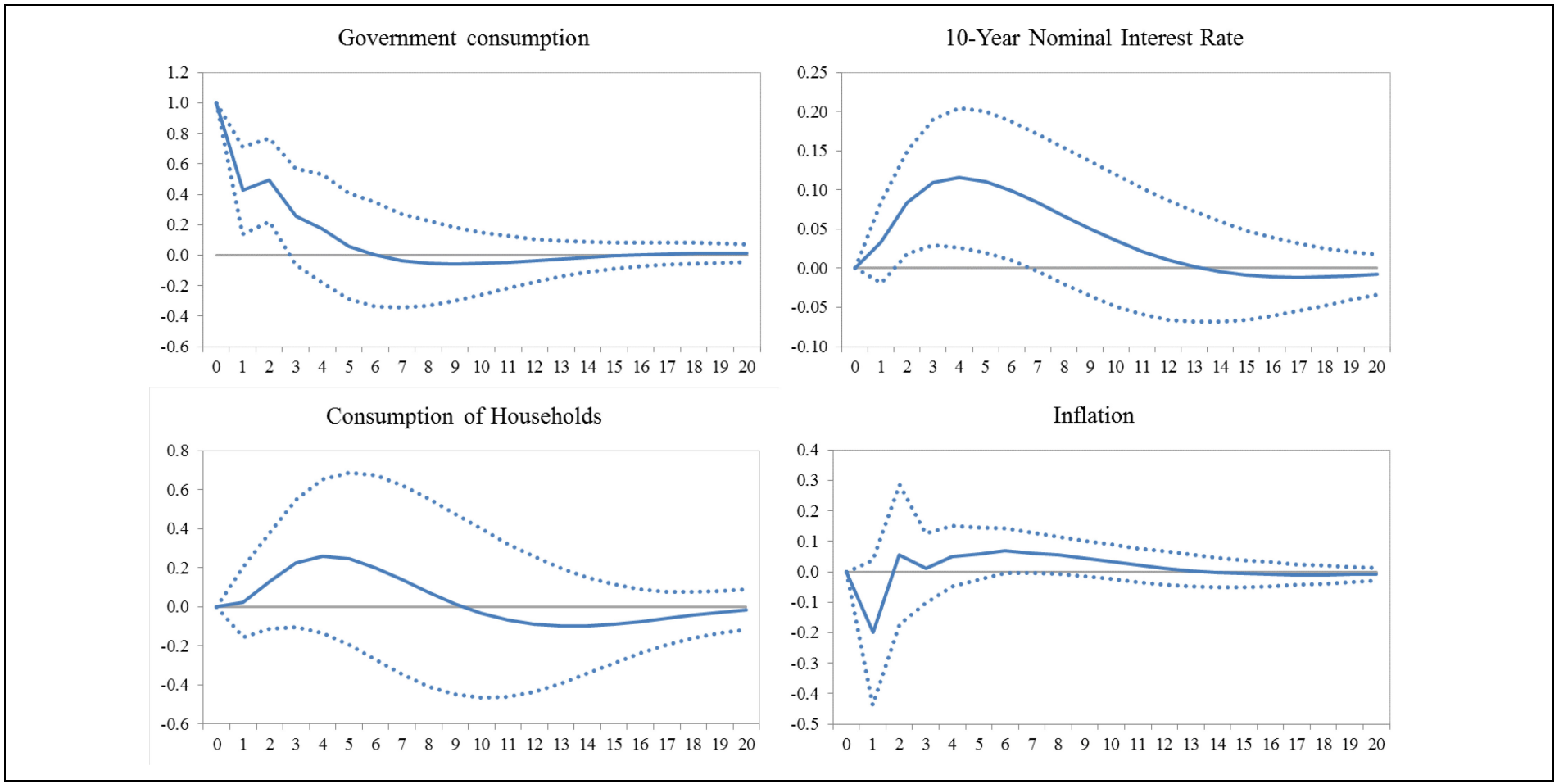
Note: The solid lines represent the impulse responses, the dotted lines the 95% confidence interval based on asymptotic standard errors. The responses can be interpreted as deviations from the baseline and are shown for a horizon of 20 quarters. The responses of government consumption and GDP are scaled such that they depict the euro response of the respective variable to a one euro increase in government consumption. The responses of interest rate and inflation depict the change in percentage points following a one percent increase in government consumption.

Figure 5: Impulse responses to a positive government consumption shock: benchmark specification, reduced sample up to 2007Q4



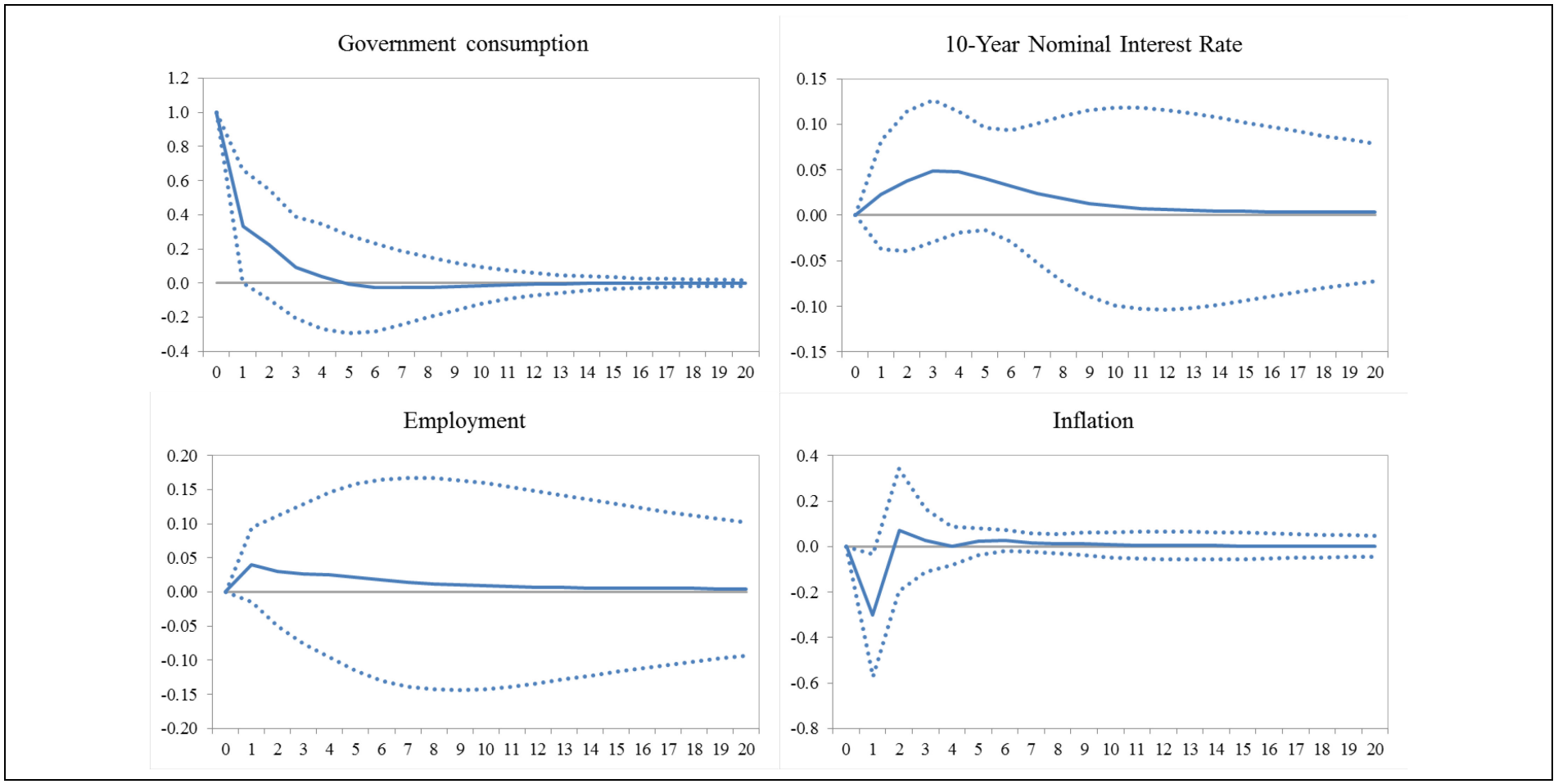
Note: The solid lines represent the impulse responses, the dotted lines the 95% confidence interval based on asymptotic standard errors. The responses can be interpreted as deviations from the baseline and are shown for a horizon of 20 quarters. The responses of government consumption and GDP are scaled such that they depict the euro response of the respective variable to a one euro increase in government consumption. The responses of interest rate and inflation depict the change in percentage points following a one percent increase in government consumption.

Figure 6: Impulse responses to a positive government consumption shock: specification with consumption, reduced sample up to 2007Q4



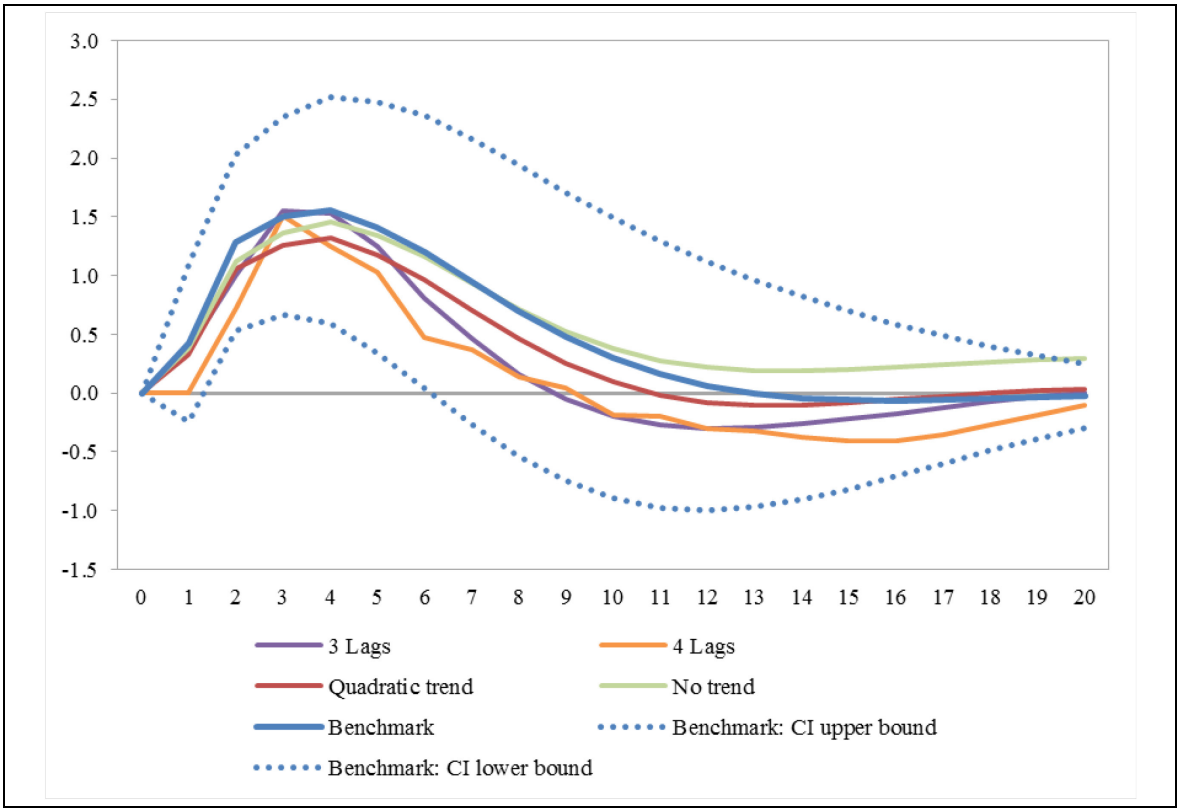
Note: The solid lines represent the impulse responses, the dotted lines the 95% confidence interval based on asymptotic standard errors. The responses can be interpreted as deviations from the baseline and are shown for a horizon of 20 quarters. The responses of government consumption and consumption of households are scaled such that they depict the euro response of the respective variable to a one euro increase in government consumption. The responses of interest rate and inflation depict the change in percentage points following a one percent increase in government consumption.

Figure 7: Impulse responses to a positive government consumption shock: specification with employment, reduced sample up to 2007Q4



Note: The solid lines represent the impulse responses, the dotted lines the 95% confidence interval based on asymptotic standard errors. The responses can be interpreted as deviations from the baseline and are shown for a horizon of 20 quarters. The response of government consumption reflects the euro response to a one euro increase in government consumption. The response of employment is scaled such that it depicts the percentage change in employment following a one percent increase in government consumption. The responses of interest rate and inflation depict the change in percentage points following a one percent increase in government consumption.

Figure 8: Impulse response of GDP to a positive government consumption shock: benchmark specification and alternative models, reduced sample up to 2007Q4



Note: The responses are scaled such that they depict the euro response of GDP to a one euro increase in government consumption. The dotted lines represent the 95% confidence interval of the benchmark specification. The responses can be interpreted as deviations from the baseline and are shown for a horizon of 20 quarters.

APPENDIX B: THE SVAR MODEL

Consider the following reduced-form VAR model:[41]

$$X_t = A(L)X_{t-1} + u_t, \tag{A.1}$$

where X_t, $t = 1, \dots, T$, is a k-dimensional vector of endogenous variables, $A(L)$ is a lag polynomial of order p and u_t is a k-dimensional vector of reduced-form disturbances with $E[u_t] = 0$, $E[u_t u_t'] \equiv \Sigma_u$ and $E[u_t u_s'] = 0$ for $s \neq t$.[42] The reduced-form disturbances u_t are in general contemporaneously correlated. Hence, the effects of a change in one element of u_t on y_t (i.e. the impulse responses) have no causal interpretation. Therefore, it is necessary to transform the reduced-form model into a structural model. The structural model used here is often referred to as the AB-model (see, e.g., Lütkepohl 2006). Equation (A.1) is pre-multiplied by the $(k \times k)$ matrix A_0:

$$A_0 X_t = A_0 A(L) X_{t-1} + B e_t, \tag{A.2}$$

which implies

$$A_0 u_t = B e_t. \tag{A.3}$$

Equation (A.3) describes the relation between the structural innovations e_t and the reduced-form innovations u_t. The structural innovations e_t are assumed to be mutually uncorrelated. Impulse responses with respect to these innovations therefore have a causal interpretation. Following from the assumption of the e_t's being uncorrelated, the covariance matrix $E[e_t e_t'] \equiv \Sigma_e$ is diagonal. The coefficients of the matrix A_0 describe the contemporaneous relations between the endogenous variables. In order for the structural model to be identified, a number of restrictions need to be imposed on the A_0 and B matrices. By construction, $u_t = A_0^{-1} B e_t$, and hence $\Sigma_u = A_0^{-1} B B' A_0^{-1\prime}$. The latter is a system of $\frac{1}{2}k(k+1)$ equations, since the covariance matrix is symmetric about the diagonal. A_0 and B have k^2 elements each. Consequently, at least $2k^2 - \frac{1}{2}k(k+1)$ restrictions are required in order for the system to be identified. In my specification, four endogenous variables are included ($k = 4$), which implies that I need 22 restrictions.

[41] The derivation of the SVAR model and its identification are based on Lütkepohl (2006) and Caldara and Kamps (2008).
[42] The constant and the linear time trend are omitted from the notation for simplicity.

The identification restrictions I use are based on an approach developed by Blanchard and Perotti (2002). The authors include three variables in their model: government spending, net taxes and GDP. Perotti (2005) extends the analysis to also include the interest rate and inflation. Neither of the two works goes into detail with respect to the identification procedure. However, Caldara and Kamps (2008) give a detailed description of the approach, making it possible for me to follow it in the context of my analysis.

The diagonal elements of the A_0 matrix – reflecting the contemporaneous relationship of an endogenous variable with itself – are set to one, and the B matrix is restricted to a diagonal matrix.[43] This yields the following system of equations, describing the relationships between the reduced-form innovations u_t and the structural innovations e_t for my model:

$$u_t^g = \alpha_{gi} u_t^i + \alpha_{gy} u_t^y + \alpha_{g\pi} u_t^\pi + \beta_g e_t^g$$
$$u_t^i = \alpha_{ig} u_t^g + \alpha_{iy} u_t^y + \alpha_{i\pi} u_t^\pi + \beta_i e_t^i$$
$$u_t^y = \alpha_{yg} u_t^g + \alpha_{yi} u_t^i + \alpha_{y\pi} u_t^\pi + \beta_y e_t^y$$
$$u_t^\pi = \alpha_{\pi g} u_t^g + \alpha_{\pi i} u_t^i + \alpha_{\pi y} u_t^y + \beta_\pi e_t^\pi$$

In order for the system to be identified, it is necessary to impose restrictions on six additional parameters. The BP approach draws these restrictions from institutional information, since the coefficients of the A_0 matrix can also be interpreted as elasticities. The output elasticity of government consumption α_{gy} is set to zero, because it is assumed that, due to implementation lags, there can be no discretionary response of government consumption to changes in output within one quarter. This is the reason why it is important to use quarterly data rather than annual data. Since interest payments are not included in the definition of government consumption, the interest rate elasticity of government consumption α_{gi} is also set to zero. The inflation elasticity of government consumption $\alpha_{g\pi}$ is set to -0.5. Perotti (2005) explains this by the component of government spending that captures compensation of government employees not being indexed to the price level within one quarter. This implies that real government consumption falls to some extent when inflation increases. In Austria, compensation of government employees has made up slightly more than half of government consumption over the sample period (see Figure 2). It therefore seems adequate to follow Perotti's argument and also set $\alpha_{g\pi}$ to -0.5. However, the results are robust to using different

[43] Alternatively (as in Caldara and Kamps 2008), the B matrix can be restricted to an identity matrix. This corresponds to a rescaling of the system of equations and does not have any influence on the resulting impulse responses.

values of $\alpha_{g\pi}$.[44] The remaining coefficients are determined by means of recursive ordering of the variables. The ordering is based on assumptions regarding the contemporaneous relationships of the variables. Ordering the interest rate second (and setting α_{iy} and $\alpha_{i\pi}$ to zero) implies that the interest rate does not react contemporaneously to output or inflation shocks, but might react to government consumption shocks. Output is ordered third, implying that it might react contemporaneously to shocks to government spending or the interest rate, but not to inflation shocks. Inflation is ordered last and is therefore assumed to be potentially affected by shocks to any of the other variables. Caldara and Kamps (2008), using US data, apply a different ordering with the interest rate entering last. They justify this ordering by arguing that the interest rate is set as a function of the output gap and inflation in the central bank reaction function. While this argument might hold for the United States, it cannot be applied to Austrian monetary policy over the sample period, as discussed in section 5. Moreover, both in Caldara and Kamps' and my analysis, the interest rate is defined as the yield on government bonds rather than the central bank key interest rate. It therefore seems inadequate to refer to the central bank reaction function. Hence, assuming that the long-term nominal interest rate on government bonds does not react contemporaneously to output or inflation shocks, I decided to order the interest rate variable second. The estimation results are, however, robust to applying the ordering proposed by Caldara and Kamps. The above identification procedure yields the following relationships between the reduced-form and the structural innovations, written in matrix form:

$$\begin{bmatrix} 1 & 0 & 0 & 0.5 \\ -\alpha_{ig} & 1 & 0 & 0 \\ -\alpha_{yg} & -\alpha_{yi} & 1 & 0 \\ -\alpha_{\pi g} & -\alpha_{\pi i} & -\alpha_{\pi y} & 1 \end{bmatrix} \begin{bmatrix} u_t^g \\ u_t^i \\ u_t^y \\ u_t^\pi \end{bmatrix} = \begin{bmatrix} \beta_g & 0 & 0 & 0 \\ 0 & \beta_i & 0 & 0 \\ 0 & 0 & \beta_y & 0 \\ 0 & 0 & 0 & \beta_\pi \end{bmatrix} \begin{bmatrix} e_t^g \\ e_t^i \\ e_t^y \\ e_t^\pi \end{bmatrix}$$

The BP approach usually involves an additional equation for the tax variable, featuring the elasticities of taxes with respect to the other variables. Since I do not include a tax variable in my SVAR model, I leave out the coefficients in the A_0 and B matrices referring to this variable. The resulting A_0 and B matrices look very similar to the corresponding matrices from a purely recursive identification approach. In the recursive approach, the A_0 matrix is a lower triangular matrix with 1's in the diagonal, while the B matrix is a diagonal or identity matrix (see Caldara and Kamps 2008). The only

[44] I estimated the model for values of $\alpha_{g\pi}$ between -0.3 and -0.7.

difference is the coefficient $\alpha_{g\pi}$, which is set to -0.5 in order to capture the effects of inflation on real government consumption.

The identification scheme described above is also used for the estimation of the alternative specifications, in which GDP is replaced by private consumption and employment, respectively. Hence, it is assumed that the contemporaneous relationships between GDP and the other included variables also hold for private consumption and employment.

GERMAN ABSTRACT

Diese Arbeit untersucht die Effekte von fiskalpolitischen Schocks auf ökonomische Aktivität auf Grundlage eines Überblicks über theoretische und empirische Literatur sowie eines strukturellen Vektorautoregressionsmodells. Im Rahmen des Literaturüberblicks wird der Effekt von Fiskalpolitik auf die Realwirtschaft in fünf Kanäle gegliedert: (i) Konsum, (ii) Vermögen und Arbeitsangebot, (iii) die Rolle von Geldpolitik, (iv) der Zinssatz und (v) das Wechselkursregime. Eine zentrale Erkenntnis aus dem Literaturüberblick liegt darin, dass die theoretischen Modellen zugrundeliegenden Annahmen sowie länderspezifische Charakteristika und die ökonometrische Methologie in empirischen Modellen einen bedeutenden Einfluss auf die resultierenden Multiplikatoren haben. The empirische Analyse wird anhand von Quartalsdaten für Österreich über den Zeitraum 1996Q1-2014Q4 durchgeführt. Die wesentlichen Ergebnisse können wie folgt zusammengefasst warden: Das BIP zeigt keine signifikante Reaktion auf einen expansiven Schock auf den öffentlichen Konsum, wenn der gesamte Beobachtungszeitraum herangezogen wird. Werden nur Daten aus dem Zeitraum vor der Krise verwendet, so ergibt sich ein signifikant positiver Effekt mit einem Multiplikator, der im ersten Quartal bei 0,4 liegt und sein Maximum von 1,6 nach einem Jahr erreicht. Der langfristige Zinssatz reagiert mit einem Anstieg, während Inflation, Beschäftigung und privater Konsum keinen signifikanten Effekt aufweisen.

CURRICULUM VITAE

MIRIAM REISS

PERSONAL DATA

Date of Birth: March 23, 1990
Nationality: Austrian
E-Mail: miriam.m.reiss@gmail.com

EDUCATION

since 10/2012 **Mag.rer.soc.oec. (MSc equivalent) in Economics at University of Vienna**

Research oriented

Thesis title: *Effects of Fiscal Policy on the Real Economy – Evidence from Austria*
Advisor: Monika Gehrig-Merz

10/2009 - 10/2012 **Bakk.rer.soc.oec. (BSc equivalent) in Economics at University of Vienna**

Thesis title: *Bank levies in the European Union: Motives, Implementation and Problems* (German title: *Die Bankenabgabe in der EU: Motive, Ausgestaltung und Probleme*)
Advisor: Margit Schratzenstaller-Altzinger

10/2008 - 08/2012 **BA in Sociology at Univeristy of Vienna**

Thesis title: *Solidarity-based Economy as an Alternative Economic Concept: Opportunities and Problems* (German title: *Solidarische Ökonomie als alternative Form des Wirtschaftens: Chancen und Probleme*)
Advisor: Stefanie Knauder

Graduation with distinction

09/2011 - 01/2012 **Studies in Economics at University of Copenhagen**

Under the Erasmus Mobility Program

WORK EXPERIENCE

since 03/2013 **Research Assistant**

Applied research in the Health Economics and Health Policy Group

Institute for Advanced Studies, Vienna

03/2014 - 06/2014 **Teaching Assistant**

Macroeconomics

University of Vienna

10/2013 - 01/2014	**Teaching Assistant** Organizing a self-organized lecture entitled *Europe – Economic and Political Perspectives* University of Vienna
10/2010 - 01/2011	**Teaching Assistant** Linear Algebra University of Vienna

SCHOLARSHIPS

Performance Scholarship

financed by Austrian Federal Ministry for Science and Research

2009, 2012	BSc Sociology
2010, 2011	Bakk.rer.soc.oec. Economics
2013, 2014	Mag.rer.soc.oec. Economics

Mobility Scholarship of the Erasmus Program

Winter semester 2011/2012 (University of Copenhagen)

Member of the Class of Excellence

at the Faculty of Business, Economics and Statistics at University of Vienna

LANGUAGE SKILLS

German	mother tongue
English	fluent
French	independent
Danish	basic

COMPUTER SKILLS

MS-Office, STATA, EViews, SPSS

PUBLICATIONS AND RESEARCH REPORTS

Czypionka, T., G. Röhrling, F. Kronemann and M. Reiss (2015): Schwerpunkt Spitalsfinanzierung: Woher kommt das Geld?/Hospital financing: Where does the money come from? *Health System Watch*, I-2015. Vienna: Hauptverband der österreichischen Sozialversicherungsträger.

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