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Multipliers within a Monetary Union.**

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Effects of Cross Country Fiscal Interdependence on Multipliers within a Monetary Union.

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Abstract

This paper analyzes the effects of time-varying fiscal policy behavior on output and consumption multipliers within a monetary union. The framework is that of a standard New Keynesian two-country model with distortionary taxes and Calvo price rigidities. I first show that multipliers differ significantly across fiscal regime mixes that follow a two-state Markov switching process. For each country, I differentiate between active, where spending is mainly deficit-financed, and passive, when spending is mainly tax-financed, behavior. Since this analysis is based on the Euro Area, I abstract from fiscal-monetary interaction and focus on member and union fiscal interdependence, including monetary imperfections and trade effects. My calibration results show that consumption multipliers to be small and negative. However, the output multiplier is positive and possibly larger than one, depending on the persistence and openness of a country. Moreover, the optimal fiscal regime mix is a combination of active/passive since the negative wealth effect is lowest and the terms of trade loss are the smallest. (JEL: R0; R11; R14; R21; R31)

Keywords: Fiscal Policy; Fiscal Multiplier; Multiplier; European Monetary Union; Regime Switching; Fiscal Policy Rules.

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1. Introduction

While traditional Keynesian theory states that government spending causes large consumption and output effects, neoclassical proponents argue for a relatively small if not negative effect. The Keynesian multiplier effect implies that an increase in fiscal stimulus drives up labor demand, increasing output and private consumption. The consequence is that the stimulus impact on output is more than the stimulus itself. However, in a dynamic framework, where prices respond flexibly, the stimulus often crowds out private consumption. This multiplier, in turn, is then often accompanied by a relatively small final effect on output itself.

This paper extends fiscal theory debates within a monetary union like the Euro Area. I develop the fiscal-monetary policy model using a standard New Keynesian framework with two countries and distortionary taxes. I then analyze the effects of time-varying fiscal policy behavior on output and consumption multipliers. The paper's two main innovations are, first, that the fiscal policy regime follows a time-varying two-state Markov Switching process and, second, there are open trades within the Euro Area. By including the fiscal regime switching process, the model can address the fiscal policy efficacy for a member state that has little monetary policy control.

My model follows the framework of Davig and Leeper (2011), who analyze the effects of monetary-fiscal interactions on multipliers that differ across time-varying regimes within a standard New Keynesian Model. Unlike Davig and Leeper (2011), however, I focus on domestic and foreign fiscal regime mixes, allowing governments to follow a Taylor-style policy rule associated with Markov Switching reaction coefficients. In my model, as central banks within a monetary union do not set their monetary policies independently, the focus lies on the effects of fiscal policies on consumption and output multipliers across member states given a particular monetary policy. I also include open trade within a monetary union to capture the real price effects on consumption and output multipliers due to the terms of trade and price spillovers across member states (e.g. Auerbach and Gorodnichenko (2013), Vetlov et al. (2017), Corsetti et al. (2010)).

As the fiscal policy is the primary driver of consumption and output multipliers in my model, the choice of financing public expenditures, thus, plays an essential role in determining its effectiveness. Following Leeper (1991), I use the term *active* fiscal state as characterized by a deficit financed spending (via bond), while a *passive* fiscal state is financed by taxes. While under lump-sum taxes, it does not matter whether public spending is done via taxes or deficit (i.e. Ricardian equivalence), Ricardian equivalence does not necessarily hold under distortionary income taxes: tax-financed spending creates more significant pressure on a household's current budget. The works by, for example, Canova and Pappa (2007), Fatas and Mihov (2001) or Gali et al.

(2007), thus, state that deficit financing guarantees larger fiscal multipliers. However, although this effect has been empirically documented in previous literature, for the EMU members, for example, the effect might not occur as each member state requires to satisfy the Maastricht Treaty deficit financed measures.

My main empirical results are as follows. Regardless of fiscal policy type, the Ricardian Equivalence could be reconciled by introducing transition probabilities for fiscal policy states. More specifically, I show that most multipliers are below one and even negative for private consumption. This result is a consequence of the price increase in domestic goods, which worsens the terms of trade, and the distortionary income taxation. However, I also show that the multipliers increase when domestic fiscal policy follows active within a passive union and whenever there is a union-wide stimulus. Consequently, this result suggests some support for spillover effects, where a member state's welfare increases due to neighbor's externality. Moreover, in case of a union-wide shock, the multiplier increases GDP more and consumption even less due to an overall crowding out that makes substitution towards foreign products more difficult.

The paper is structured as follows: Section 2 presents a literature review on multipliers and the importance of the financing decisions and spillovers across countries. Section 3 motivates the use of Markov Switching fiscal policy rules within the EMU. Section 4 presents a standard New Keynesian Model with Calvo (1983) price frictions, distortionary taxes, and fiscal policy rules with time-varying coefficients. Section 5 analyzes the mechanisms of various channels that the multipliers function. Section 6 shows the results of a country individual and a union-wide fiscal shock. Section 7 presents various transition graphs that show the dependence between active and passive behavior levels on the size of multipliers. Section 8 concludes.

2. Literature Review

I briefly outline both Keynesian and Neoclassical literature that deal with fiscal policy multiplier effects. The neoclassical view an increase in government spending leads to a negative wealth effect reducing consumption and rising labor supply, which the causes wages to decline. This *crowding out* of private spending is argued by the shift in labor supply and the succeeding decline in wages (Christiano and Eichenbaum (1992), Baxter and King (1993)). The Keynesian view on the other side focuses on the channel through labor demand, increasing as a response to public spending, shifting wages up. However, the fully pro- and counter cyclical movements of wages are not consistent with actual data (Christiano and Eichenbaum (1992), Fatas and Mihov (2001)). Thus, whether consumption is crowded in or out seems to depend on other factors as well. Baxter and King (1993) and Fatas and Mihov (2001) argue with a RBC Model that

fiscal multipliers on output are around one while private consumption is crowded out. This effect is larger the less productive, longer the duration of the shock is and the more of it is financed by distortionary taxes. While under Ricardian Equivalence it does not matter whether taxes or deficit is increased since households face a dynamic maximization problem taking into account future increases in revenues. However when the market faces imperfections or distortions the financing character matters for private agents decision. So Kirsanova et al. (2007) and Ferrero (2009) come to the same conclusion by using a New Keynesian model. Whether government spending is financed by taxes or deficit matter when there are frictions in the market, and more so when these taxes cause distortion. Work that considers lump sum taxes instead find in general output multipliers larger than one (Gali et al. (2007), Christiano et al. (2011)). Tax financed spending is then just a forwarded financing, compared to deficit, causing a dynamic effect but no distortions. The difference between tax and deficit financed stimulus is made even larger when Rule-of-Thumb households are added. These agents consume their current income fully and so are directly affected by an increase in taxes due to the loss of intertemporal substitutability. Thus, an increase in lump-sum taxes rather than deficit induces a negative wealth effect for those households, while others will still try to smooth consumption. So it is no wonder an inclusion of Rule of Thumb agents leads to severe differences in multipliers depending on the way of financing (Eggertsson and Krugman (2012), Gali et al. (2007), Corsetti et al. (2010)). However with distortions, taxes should matter for both kinds of households.

The instrument chosen to finance government spending decides on the size and sign of multipliers. Despite the great need to identify this fiscal behavior, there is no commonly accepted rule such as the Taylor rule for monetary policy. Thus, instrument and set up differ significantly across papers. While in large countries the focus should lie on output stabilization, within a currency union the monetary inflexibility increases the need for individual shock absorption and inflation control (Ferrero (2009), Portes and Wren-Lewis (2015)). Inflationary pressure on union level should in general be avoided to prevent the central bank from raising the interest rates and leading to lower welfare. Kirsanova et al. (2007), which use a similar NK-Model as the one in this paper analyze the optimal policy rule. The authors find support for a rule that reacts on output, inflation but also terms of trade to stabilize the economy, due to the large importance of trade in currency unions. A similar set up is used by Gali et al. (2007) though, fiscal policy is reacting with taxes on expenditures and debt level based on the work by Leeper (1991). However, in these previous papers fiscal behavior was not changing across time, especially not stochastic.

While for the monetary Taylor rule many paper investigate further the effect of time varying coefficients on macroeconomic variables and claim a better fit to actual data (Davig and Doh (2014)), this is not often done for fiscal rules. The central bank

is said to differ between states of active inflation targeting and reluctant behavior, but most literature keeps fiscal policy within a reserved, tax financing state throughout the analysis (Bianchi (2012)). In the last years empirical evidence points to regime instability not just in the monetary but also in the fiscal sector. Blanchard and Perotti (2002), Gechert and Rannenberg (2018) and Mittnik and Semmler (2012) find that the size of multipliers varies across the business cycle, Auerbach and Gorodnichenko (2013) further accounts for the time varying character of fiscal coefficients, but all base their analysis on the business cycle rather than financing decision of public spending, as it is done in this paper. Favero and Monacelli (2005) show that a VAR Regime switching fiscal rule echoes the existing data much better than a constant regime, mostly characterized by a high response of taxes to a government spending increase. Based on this approach the New Keynesian model from Davig and Leeper (2011) implements time varying monetary but also fiscal coefficients. Thereby the authors define fiscal policy to respond with taxes towards changes in debt, output and government spending. Davig and Leeper (2011) claim that this reaction is switching across active and passive states, where passive is defined to show a high response of taxes on spending, while active can be interpreted as expansive fiscal behavior (Leeper (1991)). As a result, these switches across regimes matter significantly for the value of impact multipliers.

While in the work from Davig and Leeper (2011) fiscal and monetary states are interacting such that different regime mixes define their interdependence, within a currency union this fails to represent the reality. Since monetary policy is central, fiscal policy remains the only option to counteract individual shocks. So while in the US the central bank can perfectly adapt to federal governments behavior and vice versa, members of a currency union take monetary policy as given. However, as the union consists of numerous small countries larger focus should be given towards trade pattern and union wide fiscal policy (Kirsanova et al. (2007)). Such that a multi country model, displaying terms of trade and spillover effect between countries captures characteristics of EMU members better Vetlov et al. (2017). Blanchard et al. (2017) and Coenen et al. (2012) finds significant spillover of government stimulus between core members and the periphery. Auerbach and Gorodnichenko (2013) find proof for cross country spillover effects on multipliers, while in 't Veld (2013) argues these effects depend on the level of openness of each country. While similar to this paper, Cwik et al. (2011) finds that spillovers between members are rather small and even negative when the EURO is affected. However, in contrast I will focus on a multi-country model displaying only inter EMU trade. So the impact of government spending shocks within the country and on union level depend on its size and openness (Corsetti et al. (2010)).

So in contrast to previous work this paper focuses on fiscal multipliers for members within a currency union, where government behavior switches between active and passive states as in Davig and Leeper (2011), of which households are fully aware. However, the regime mixes define the interdependence between a members and the unions fiscal policy. Price level spillovers and terms of trade play a crucial role in determining the final impact on output and consumption. And so I will not just differentiate in the level of openness and importance but thereby also compare the case for a country individual as well as union wide fiscal stimulus.

3. Motivation- Some Empirical Findings

I use Markov Switching across regimes and their impact on the size of fiscal multipliers, as the data shows that there are structural breaks. As my analysis focuses on the effects within a monetary union, I use quarterly data on 13 European Currency Union members from 1995 to the end of 2020. I apply a Markov Switching VAR(1) on all three policies: A country's fiscal policy, the union wide fiscal policy and the monetary policy of the ECB. In each case the reaction coefficients switch across both states according to estimated transition probabilities. Depending on these coefficients all sectors are distributed within two states: active and passive.

$$\{Y^\tau\}_t = \mathbf{A}(\mathbf{S}_t^\tau)\{Y^\tau\}_{t-1} + \varepsilon_t, \text{ with } \{Y_t^\tau\} = \left\{1 \ \tau_t \ \hat{y}_t \ b_t \ g_t\right\}' \quad (1)$$

For the fiscal policies active behavior is defined by mainly deficit financing behavior and must own a reaction coefficient of tax revenue τ_t on government expenditures g_t that is smaller compared to the other regime. Further reaction towards outputgap \hat{y}_t and debt level b_t play an ancillary role. Estimation (1) is done for each member as well as on union wide level to determine its regimes across time. Active monetary policy is characterized by a larger reaction of nominal interest rate on increases in the union wide inflation. Thus, the regime with the largest coefficient on π_t determines the active one.

$$\{Y^m\}_t = \mathbf{A}(\mathbf{S}_t^i)\{Y^m\}_{t-1} + \varepsilon_t, \text{ with } \{Y_t^m\} = \left\{1 \ i_t \ \hat{y}_t \ \pi_t\right\}'$$

Since monetary policy is less flexible within a currency union I assume that nominal interest rate only react on the union wide price level and outputgap. For all three policies I then obtain state probabilities for both regimes, determining the likelihood of one in each period. So this serves as an indicator for when each state prevailed.

To show that these resulting regime switches serve as one indicator for different sizes of multipliers, latter need to change across time simultaneously. For that, I again run a Markov Switching VAR(1) of private consumption and output on government

expenditures, to determine structural brakes in consumption and output multiplier. To correct for endogeneity I included the country wide inflation π_t and interest rate i_t similar to Favero and Giavazzi (2010).

$$\{Y^k\}_t = \mathbf{B}(\mathbf{S}_t^k)\{Y^k\}_{t-1}, \text{ with } \{Y_t^C\} = [1, c_t, g_t, i_t, \pi_t]' \quad \{Y_t^Y\} = [1, y_t, g_t, i_t, \pi_t]'$$

The resulting coefficients then serve again as determinants for the regime classification. In this case I divide them into a *high Multiplier* and *low Multiplier* state, based on the size of the coefficient of g_t . Thus a larger reaction of private consumption or output towards an increase in government expenditures indicates higher impact and higher efficiency. Their respective state probabilities then serve as the dependent variable when analyzing the impact of regimes on them.

Thus, the identification of an impact of regimes on multipliers is based upon the fact that a higher probability of being in one fiscal or monetary state should have a statistically significant effect on the state probabilities of the multiplier regimes. Subsequently, I deduct the three state probabilities of being in active policy regimes as independent variables and measure their impact on the likelihood of being in a high Multiplier regime.

I use a Fixed Effects Regression with Panel data, where ζ_t and η_t are included to correct for country and time fixed effects,

$$\begin{aligned} Prob(S^c = 1)_t = & \beta_0 + \beta_1 * Prob(S^\tau = 1)_t + \beta_2 * Prob(S^{\tau*} = 1)_t + \\ & + \beta_3 * Prob(S^m = 1)_t + \zeta_t + \eta_t, \end{aligned} \quad (2)$$

where S takes the value of one whenever on regime is active, or for the multiplier case in a large multiplier environment. And so the coefficients $\hat{\beta}_i \forall i \in [1, 3]$ describe the estimated probability increases of being in a high Multiplier state by an increase in the state probabilities for active fiscal and monetary policies, compared to a their passive opponent. A positive significant value would imply that whenever the likelihood for being in a active policy increases it is more probable to be in a high multiplier state. Thus, this would prove regime switches appear in the data and that those do have an effect on the size of multipliers. Table 1 displays the results of the estimation process.

| active | high | $Prob(S^c = 1)$ | $Prob(S^c = 1)$ | $Prob(S^y = 1)$ | $Prob(S^y = 1)$ |
|---------------------------------------|------|----------------------------|---------------------------|----------------------------|----------------------------|
| $S^\tau = 1$ | | -0.157986*** (0.030106) | -0.175681*** (0.03176) | -0.118217*** (0.030061) | -0.139424*** (0.142097) |
| $S^{\tau*} = 1$ | | 0.197991*** (0.044117) | 0.114051* (0.065417) | 0.24699*** (0.044051) | 0.142097** (0.065282) |
| $S^i = 1$ | | -0.028684 (0.033994) | -0.030389 (0.033980) | 0.087929*** (0.033943) | 0.085885** (0.187911) |
| $(S^\tau = 1) \times (S^{\tau*} = 1)$ | | - | 0.156789* (0.090284) | - | 0.187911** (0.090098) |

TABLE 1. Results for the estimation of (2), statistical significance at 1% ***, 5% ** and 10% *

The first two columns represent the results for the consumption multiplier, the latter show the models with the regime probabilities for a higher output multiplier. In the last row I include an interaction term consisting of both fiscal policy regime probabilities to identify whether the active country internal fiscal policy shows a different effect when taking into account the fiscal policy on union level. The results show that the probability of being in an active union wide fiscal policy and in an active monetary policy state increases the likelihood for the existence of being in a high multiplier regime. While the effect is negative for the state probabilities of the active domestic fiscal policy the multipliers are positive when the foreign fiscal policy is more likely to be active. All estimators are statistically significant in the case of output multipliers, while for the consumption multipliers the effects are not significant for the monetary policy. However, overall data shows that the assumption for Markov switching regimes is valid and that these regimes do have a statistically significant effect on the size of fiscal multipliers.

4. Model

My model uses the open economy framework by Rabanal (2009) where two open countries are used to replicate the European Monetary Union. One representing a specific member country the foreign opponent displays the rest of the union. The high share of inner European trade supports the assumption of the respective country only trading with other members. However, it needs to be mentioned that the inclusion of extra-EU trade would change resulting multipliers significantly for some members. In contrast to Rabanal(2009) I leave out nontradable goods for simplicity and add a governmental sector in both countries needed for my analysis.

4.1. Households

Households maximizes a standard CRRA utility function consisting of a consumption C_t , labor L_t and monetary assets M_t ,

$$E_t \sum_{i=0}^{\infty} \beta^i \left[\frac{(C_{t+i})^{1-\chi}}{1-\chi} - \frac{(L_{t+i})^{1+\omega}}{1+\omega} + \frac{(M_{t+i}/P_{t+i})^{1-\kappa}}{1-\kappa} \right] \quad (3)$$

with β as the intertemporal discount factor, χ as the intertemporal inverse elasticity of substitution and ω defining the inverse elasticity of intratemporal substitution. Agents seek to maximize their lifetime utility over an infinite horizon with respect to the following budget constraint, equating their labor income and return on bonds with their expenditures,

$$C_t + \frac{B_t}{P_t} + \frac{M_t}{P_t} \leq (1 - \tau_t) \frac{W_t}{P_t} L_t + \frac{(1 + r_{t-1})B_{t-1}}{P_t} + \frac{M_{t-1}}{P_t}. \quad (4)$$

The channel for intertemporal substitution goes through government bonds or monetary assets, first is benefited with the return r_t , the nominal interest rate which is set by the European Central Bank (ECB). This makes it possible for households to smooth their consumption over time. Maximizing (3) with respect to the budget constraint of the representative agent yields the following optimality conditions describing the households intra- and intertemporal behavior:

$$L_t^\omega = (1 - \tau_t) \frac{W_t}{P_t} C_t^{-\chi} \quad (5)$$

$$C_t^{-\chi} = \beta E_t \left[C_{t+1}^{-\chi} (1 + r_t) \frac{P_t}{P_{t+1}} \right] \quad (6)$$

$$\frac{M_t}{P_t} = \left(\frac{r_t}{1 + r_t} \right)^{-1/\kappa} C_t^{\chi/\kappa} \quad (7)$$

The first describes the households intratemporal decision equating the marginal utility of labor on the right hand side with the marginal disutility from labor in the utility function. This ensures the households indifference between labor in leisure within each period. By introducing distortionary income taxes, fiscal policy has a direct effect on real labor supply and thereby consumption to overcome Ricardian equivalence. Hence, a higher tax rate causes a negative wealth effect on leisure and consumption, while the latter is further decreased through the negative substitution effect. Equation (4) displays the agents optimal intertemporal path, where the substitution between today's and tomorrows consumption depends crucially on the interest rate, set by the monetary sector for the whole union. Thus, the nominal interest rate is equal across both countries, while the different CPI's can cause differences in the real return from savings. Equation (6) describes the demand of monetary assets, depending on the real interest rates and consumption weighted by its relative intertemporal elasticity of substitution.

The consumption index C_t consists of a domestically produced or imported continuum of slightly differential products according to Dixit Stiglitz monopolistic competition, which ensures each producer some market power through imperfect substitutability among their goods. Consumers maximize their utility by first determining the optimal size of their consumption basket and then decide on their weight towards the different kinds of goods.

$$C_t = \left[(1 - \lambda)^{\frac{1}{\nu}} (C_t^H)^{\frac{\nu-1}{\nu}} + \lambda^{\frac{1}{\nu}} (C_t^F)^{\frac{\nu-1}{\nu}} \right]^{\frac{\nu}{\nu-1}}. \quad (8)$$

ν defines the substitutability between home and foreign goods. While the value of $1 - \lambda$ states the degree of home bias: How much households prefer consuming domestically produced goods relative to the imported ones. In both countries the two sectors produce various varieties of goods that are substitutable according to the parameter σ that defines as well the degree of firms market power due to monopolistic

competition.

$$C_t^H = \left[\left(\frac{1}{s} \right)^{\frac{1}{\sigma}} \int_0^s c_t(h)^{\frac{\sigma-1}{\sigma}} dh \right]^{\frac{\sigma}{\sigma-1}}; \quad C_t^F = \left[\left(\frac{1}{1-s} \right)^{\frac{1}{\sigma}} \int_s^1 c_t(f)^{\frac{\sigma-1}{\sigma}} dh \right]^{\frac{\sigma}{\sigma-1}}. \quad (9)$$

Hence, the demand for single varieties in each sector in home and foreign country evolve as,

$$c_{jt}^H = \left(\frac{p_{jt}^H}{P_t} \right)^{-\sigma} \left(\frac{1}{s} \right)^{\sigma} C_t^H \quad (10)$$

and

$$c_{jt}^F = \left(\frac{p_{jt}^F}{P_t} \right)^{-\sigma} \left(\frac{1}{1-s} \right)^{\sigma} C_t^F. \quad (11)$$

Consumption declines then with the sector specific relative price level and the parameter s both weighted with the degree of monopolistic competition. s defines the size of the European member country relative to the whole union. The larger s the greater the market power of the home countries sectors in the international comparison. Thus it can be constructed by $\frac{\lambda^*}{\lambda}$, the relative export intensity. This parameter will also be used later to construct monetary inflexibility.

Households in the foreign country face a similar composition of foreign and home produced goods, however their share of imports from the member country is weighted by λ^* , which is strictly smaller than λ since the EMU consists of many small countries. Furthermore the demand for varieties in (10) and (11) on the union wide level depends on the price of home and foreign produced goods relative to the price level P_t^* and not P_t . Thus, the demand functions for both countries by type of origin are given as,

$$C_t^H = (1 - \lambda) \left(\frac{P_t^H}{P_t} \right)^{-\nu} C_t, \quad (12)$$

$$C_t^F = \lambda \left(\frac{P_t^F}{P_t} \right)^{-\nu} C_t \quad (13)$$

$$C_t^{H*} = \lambda^* \left(\frac{P_t^H}{P_t^*} \right)^{-\nu} C_t^*, \quad (14)$$

$$C_t^{F*} = (1 - \lambda)^* \left(\frac{P_t^F}{P_t^*} \right)^{-\nu} C_t^* \quad (15)$$

Since there is no price discrimination and only one currency the law of one price has to hold such that the goods prices are the same in both countries. International risk sharing across both countries guarantees that,

$$RER_t = \frac{\mu^*}{\mu} = \frac{C_t^{*-\chi}}{C_t^{-\chi}} = \frac{P_t^*}{P_t} \quad (16)$$

where the ratio of marginal consumption needs to equal the relative price, such that no arbitrage is possible and goods are worth the same across trade partners. This can be derived by using the Euler equations from both countries given that the nominal

interest rate is the same since the central bank announces one for all. In equilibrium marginal utility needs to be balanced, since the price level will be the same across the union. Whenever domestic inflation rises, with decreasing marginal returns, foreign consumption has to exceed domestic demand.

4.2. Firms

In both countries monopolistic competitive firms produce tradable goods for domestic consumption and export. While all equations define the optimization problem for domestic firms, they show the same set up in the foreign country. Firms produce at constant returns to scale using labor as the only input factor.

$$y_t^H = Z_t L_t. \quad (17)$$

Z^N is defined as the domestic total factor productivity which follows an AR(1) process with identical and independently normally distributed errors denoted as ε_t^Z . Shocks in the production function create a positive or negative supply effect while leaving the other country directly unaffected, but allowing indirect effects through changes in the competitiveness.

$$\log(Z_t) = (1 - \rho_z)\log(\bar{Z}) + \rho_z \log(Z_{t+1}) + \varepsilon_t^Z, \quad \varepsilon_t^Z \sim i.i.d.N(0, \sigma_t^{z2}) \quad (18)$$

To induce market imperfections I use the assumption of price rigidities a la Calvo (1983), where only a share of $(1 - \theta)$ is able to adjust prices as a response to marginal cost variation in a certain period. The rest have to stick with their prices from last period. This causes imperfections in the market such that prices cannot adapt fully. Thus, money loses its neutrality and monetary policy has real implications.

Firms seek to maximize their expected present value of future profits taking into account the possibility of price adaptations in some periods. The optimal price level does therefore not just equal the marginal costs of labor, weighted by the market power of the firms, as in the fully price flexible economy but takes into account the imperfect and intertemporal structure of the optimization problem.

$$Max_{p_t^H(n)} E_t \sum_{k=0}^{\infty} \theta_H^k \beta^k \frac{C_{t+1}}{C_t}^{-\chi} \left[\left(\frac{p_t^H(n) \left(\frac{P_{t+k-1}^H}{P_{t-1}^H} \right)}{P_{t+k}} - MC_{t+k}^N \right) y_{t+k}^{H,d}(n) \right] \quad (19)$$

subject to their variety demand function for home produced goods:

$$y_{t+k}^{H,d}(n) = \frac{1}{s} \left[\frac{p_t^H(n)}{P_{t+k}^H} \left(\frac{P_{t+k-1}^H}{P_{t-1}^H} \right) \right]^{-\sigma} Y_{t+k}^H \quad (20)$$

which depends on the relative price level of the respective good and the willingness to substitute across them. The higher their price the lower the share of overall demand

goes towards these goods. Solving this maximization problem, yields for the optimal price level of the domestic firms,

$$\frac{\bar{p}_t^H}{P_t^H} = \frac{\sigma}{\sigma - 1} E_t \left[\frac{\sum_{k=0}^{\infty} \beta^k \theta^k \mu_{t+k} \left(\prod_{s=1}^k \frac{(\Pi_{t+s-1}^H)}{\Pi_{t+s}^H} \right)^{-\sigma} \frac{MC_{t+k}^N P_{t+k}}{P_{t+k}^H} Y_{t+k}}{\sum_{k=0}^{\infty} \beta^k \theta^k \mu_{t+k} \left(\prod_{s=1}^k \frac{(\Pi_{t+s-1}^H)}{\Pi_{t+s}^H} \right)^{1-\sigma} Y_{t+k}} \right] \quad (21)$$

with nominal marginal costs of $MC_t^N = \frac{W_t}{Z_t^N}$. Firms base their decisions on changes in the real marginal costs which are expressed in terms of the domestic goods prices. μ defines the marginal utility of aggregate consumption in the home country since both types of agents have the same elasticity of intertemporal substitution. In a flexible price environment there would be no intertemporal structure necessary and the optimal price would equal the marginal costs including the price markup for imperfect substitutability.

The aggregate price index of domestically produced goods, taking into account the adaption rigidities then yields,

$$P_t^H = [\theta (P_{t-1}^H)^{1-\sigma} + (1-\theta) \bar{p}_t^H]^{1-\sigma}. \quad (22)$$

Under full flexibility the aggregate price level of those goods would just simply be equal to the optimal price, since all firms could choose accordingly. In the foreign country firms face the same sort of problem but the share of firms that cannot adapt their prices is denoted as θ^* . So the Price index of the goods produced in the foreign country composes of:

$$P_t^F = [\theta (P_{t-1}^F)^{1-\sigma} + (1-\theta) \bar{p}_t^F]^{1-\sigma}. \quad (23)$$

Due to the trade relations, goods as well as their price level are imported into the partner country. The consumer price index in each country is then a by λ and λ^* weighted average of domestic and imported goods.

$$P_t = [(1-\lambda)(P_t^H)^{1-\nu} + \lambda(P_t^F)^{1-\nu}]^{1-\nu} \quad (24)$$

$$P_t^* = [\lambda^*(P_t^H)^{1-\nu} + (1-\lambda^*)(P_t^F)^{1-\nu}]^{1-\nu} \quad (25)$$

I then define the relative competitiveness of each country by the terms of trade expression,

$$ToT = \frac{P_t^F}{P_t^H}. \quad (26)$$

Rising prices in the domestic goods sector decrease the member countries competitiveness and will cause households to prefer imports and so benefit foreign production sector. The aggregated CPI within each country contains import prices and thus, is less sensitive to country individual shocks than domestic goods prices.

This price elasticity depends crucially on the level of openness of the member and is strictly decreasing with λ and λ^* . The larger the import share the greater the price level spillover and the lower the impact of policy changes on inflation.

The aggregate price level within the whole monetary union then evolves as,

$$P_t^{EMU} = P_t^s (P_t^*)^{1-s}, \quad (27)$$

where each Price level is weighted by the economic importance of the member country within the EMU. The larger the home country or the more important it is for the union the larger its impact on union wide policy decisions.

4.3. Monetary Policy

Within a Monetary Union the central bank operates as a decentralized actor controlling the interest rate for all member countries at the same time. This decision is more or less independent of country specific shocks and their individual deviations from steady state. The reaction of the interest rate is based upon a weighted average price level of the whole union,

$$P_t^{EMU} = P_t^s (P_t^*)^{1-s}, \quad (28)$$

where s can be interpreted as export intensity $\frac{\lambda^*}{\lambda}$. Thus the greater the parameter s the larger the impact of the respective country on monetary policy implications and the higher the fit between actual and necessary actions. So in contrast to a standard open economy model the interest rate will not necessarily react on inflationary pressure in each economy, despite the central banks inflation targeting. Gali and Monachelli (2005) show that balancing the EMU wide price level is still the best option, when full flexibility is not achievable. Accordingly the EMU wide output is build as,

$$Y_t^{EMU} = Y_t^s (Y_t^*)^{1-s}. \quad (29)$$

The central bank follows a standard Taylor rule reacting towards deviations in the union wide inflation rate as well as the union wide output relative to their steady state values. In log-linearized form we then get,

$$r_t = \rho_\pi \pi_t^{EMU} + \rho_y y_t^{EMU}. \quad (30)$$

Here the inflexibility of the monetary channel is modeled. The ECB does not react directly on changes of domestic inflation or output, but only on union level and so the perceived effect deviates from actual. In contrast to Leeper (1990), Fevero and Monachelli and others monetary policy is not assumed to switch between active and passive regimes, but rather to maintain strict inflation targeting. With price

level stability being the official goal of the European Central Bank, this assumption matches its behavior. So ρ_π is held fix on a value greater than one such that the nominal interest rate moves larger than one on one towards changes in the inflation rate such that the real interest rate increases. The focus of this analysis lies on fiscal policy regime switches and their impact on fiscal multipliers. For more information on the effect of different monetary policy states on the private consumption and output I refer to Davig and Leeper (2009), who show that within a single closed economy and a fully flexible monetary policy a reserved price level targeting leads to a larger multiplier through a lower rise in the interest rate and less intertemporal substitution of consumption among the households.

Due to the introduction of inflexibility an increase of nominal interest rates by more than the rise in aggregate inflation does not necessarily lead to an increase in the real interest rate faced by the member. Thus, active monetary policy might appear passive for single countries. The greater λ^* , or s respectively, the more active monetary policy is perceived as a single country.

4.4. Fiscal Policy

While monetary policy is commonly described by a Taylor rule, defining the behavior of fiscal policy differs across the literature. In this model I rely on the definition from Davig and Leeper (2009) that focuses on the financing decision of governments expenditures with taxes as their main instrument. However, in contrast to the previous work taxes are not lump sum but rather distortionary income taxes that respond state dependent.

$$\tau_t = \gamma_y(S_t^\tau)y_t + \gamma_b(S_t^\tau)b_t + \gamma_g(S_t^\tau)g_t + \varepsilon_t^\tau. \quad (31)$$

$$\varepsilon_t^\tau \sim i.i.d.N(0, (S_t^\tau)\sigma_t^2)$$

According to this rule fiscal policy in each country adapts its tax rate with respect to changes in their output, debt level and government expenditures. The reaction coefficients on all three variables as well as the variance of the error term switch according to a two state Markov chain. The variable S_t^τ defines the state fiscal policy is in in period t. Thus, in each state the taxes respond differently towards deviations in steady state.

As in Leeper (1990) I assume that these two states define different financing structures, named *active* and *passive*. Main focus on the determination of the regimes lies on γ_g . The larger it is the greater the share of expenditures that are tax financed. An active fiscal policy is defined as one with a low or even negative reaction coefficient γ_g such that the increase in expenditures are mainly financed with deficit, while at the same time the government reacts weakly or not at all to increases in debt and output. This active policy is sometimes also referred to as *expansionary* fiscal behavior. A

passive regime on the other hand is characterized by a tax financed policy and thus, a rather larger and definitely positive coefficient on the expenses, where simultaneously some effort for debt reduction is aimed such that γ_b is positive. In both regimes the coefficient on the output gap γ_y just defines the counter or pro-cyclical behavior of fiscal policy. This fact gains importance whenever there is only a country specific fiscal expenditure shock happening and so taxes in the other country mainly respond to their change in output but their spending does not differ.

Government spending follows an AR(1) process with identical and independently distributed error terms,

$$\log(G_t) = (1 - \rho_g)\log(\bar{G}) + \rho_g\log(G_{t-1}) + \varepsilon_t^g + \varepsilon_t^{gU}, \quad \varepsilon_t^g, \varepsilon_t^{gU} \sim i.i.d.N(0, \sigma_g^2) \quad (32)$$

while ε_t^g defines country specific shocks and ε_t^{gU} government spending shocks that affect both countries so acts on union wide level. While the first is used as the general measure for stabilization within a monetary union, since all governments maintain fiscal independence. Union wide measures become more important with greater interdependence between the countries. Examples as the financial crisis or the current pandemic are just some examples where shocks affect the whole union and increase the need for EMU wide fiscal policy measures.

The fiscal consumption index resembles the one from private households, but with the constraint that only domestically produced varieties can be demanded by fiscal authorities in each country,

$$G_t^H = \left[\int_0^s g_t(h)^{\frac{\sigma-1}{\sigma}} dh \right]^{\frac{\sigma}{\sigma-1}}; \quad (33)$$

where again σ defines their substitutability. Using equation (8) for the aggregate domestic demand then yields the goods market clearing condition,

$$Y_t = C_t^H + C_t^{H*} + G_t \quad (34)$$

so the production is divided into domestic private and public demand as well as exports towards the rest of the union. Just like the private sector, the government is constraint by its budget in each period.

$$G_t = \tau_t w_t L_t + \frac{M_t - M_{t-1}}{P_t} + \frac{B_t}{P_t} - \frac{(1 + r_{t-1})B_{t-1}}{P_t}. \quad (35)$$

So the expenditures as well as the costs for past debt needs to be financed by tax revenues, new debt as well as gain through seignorage. Hence, debt cannot explode and needs to be paid back eventually. Through iteration I receive the condition of,

$$\frac{B_t}{P_t} = \sum_{i=0}^N \frac{s_{t+i}}{(1+r_t)^i} + \frac{\Delta M_t}{(1+r_t)^i} + \frac{B_{t+N}}{P_{t+N}((1+r_t)^i)} \quad (36)$$

When N goes to infinity the last fraction approaches zero and so the present value of surpluses equals the current liabilities in order to guarantee stability. Larger government spending in period t leads to a decrease in primary surpluses when not fully financed by an increase in tax revenue. So the more active, or deficit financing the fiscal stimulus is the greater the debt burden which puts pressure on the flow constraint.

5. Model Mechanisms

In the following section I describe various channel mechanisms for the fiscal multipliers.

5.1. Monetary Inflexibility

Fiscal Solvency. Passive and active regimes differ in their financing structure: While passive regimes finance the greatest share of governments expenses through taxes, active behavior puts greater weight on debt. In order to satisfy (36) the latter can then be either discounted by a high price level reducing its real value or the costs for refinancing drops such that new debt becomes relatively cheap. Otherwise future surplus needs to raise through intertemporal substitution of taxes and pay back affiliated debt eventually. Fiscal solvency therefore depends on monetary behavior. In the case of perfect fiscal and monetary interdependence there are two environments that yield unsustainable paths. First active behavior on both sides would raise refinancing costs while government keeps financing through deficit, as a result debt would follow an explosive path. Furthermore, when fiscal policy remains passive and finances its spending mainly by taxes and monetary policy would not rise interest rates then the price level is not determined since the model yields multiple solutions. Subsequent work by Davig and Leeper (2011) claim that without Markov Switching only regimes where one is active and the other passive yield feasible and sustainable results. Passive Fiscal Policy, often also referred to as Ricardian Policy, puts low pressure on the budget constraint. Even with monetary policy raising interest rates, debt can be paid back by taxes eventually. When the central bank does not react with strong inflation targeting, fiscal policy is able to deficit-finance and the price level has to adapt such that (35) still holds.

With inflexible monetary policy its behavior might be perceived differently within each individual member. Considering the log linearized form of the governments budget constraint:

$$b_{t+1} = r_t + \frac{1}{\beta}(b_t - \pi_t - \zeta s_t). \quad (37)$$

All variables are expressed in their deviations to steady state, s_t is the primary surplus and ζ is the share relative to \bar{b} . A temporary fiscal expenditure shock leads to a sudden decrease in surplus, ceteris paribus increasing debt in the next period. Other options are a decrease in the interest rate to lower costs, or an increase in π_t to devalue debt in the current period. However, when monetary policy temporarily reacts to fiscal policy variables, the price level will adapt such that this condition still holds despite governments activeness. This theory follows *Fiscal Theory of Price Level* (Cochrane (2001)) and can be characterized as fiscal dominance. In case fiscal policy is behaving Ricardian and finances a large share through taxes, the budget condition yields a unique solution only when monetary policy is controlling interest rates and price level actively, referred to as monetary dominance. By inserting the Taylor rule and substituting the weighted EMU price equation I obtain,

$$b_{t+1} = (\alpha_\pi s - 1 + \rho)\pi_t + \alpha_\pi(1 - s)\pi_t^* + \alpha_y y_t^{EMU} + \frac{1}{\beta}(b_t - s_t). \quad (38)$$

Without inflexibility there would be no dependence on output or price level of the foreign country. Furthermore, the multiplier of domestic inflation would be $(\alpha_\pi - (1 + \rho))$ instead, which in case of active monetary policy is most definitely positive, since α_π is strictly greater than one. Meanwhile when government spending rises and increases inflation there is no option other than to stabilize it with taxes (increase surplus), yielding a feasible active/passive mix. The imperfect monetary channel leads to an inclusion of the friction parameter $s \in (0, 1)$. Now the left part of the multiplier $(\alpha_\pi s - (1 + \rho))$ decreases and will only allow a positive sign in front whenever α_π is very large. So the smaller the country and the lower its s , the more an active monetary policy is perceived as being passive. Thus, fiscal and monetary interactions differ across members depending on their size: Small countries can become more active than others and still satisfy the budget constraint, since monetary policy will remain passive from their individual standpoint. Being a member of a monetary union therefore requires more fiscal dominance and stabilization.

Intertemporal Saving Decision. Inflexible monetary policy does not only lead to greater fiscal dominance in price level determination, but also changes the savings path for households. To see this point, use the Taylor rule and equation for aggregate EMU wide price level. I obtain the following equation,

$$\chi \Delta c_{t+1} = (\alpha_\pi s)\pi_t - \pi_{t+1} + \alpha_\pi(1 - s)\pi_t^* + \alpha_y y_t^{EMU}. \quad (39)$$

A fiscal demand shock will increase the price level π_t . The more active the central bank, the greater the pressure on the right hand side of the equation. However, the smaller s the less impact monetary policy has on households behavior. Domestic agents will perceive the central bank as passive and the real rate will be low. This

leads ceteris paribus to a lower Δc_{t+1} , and lets the household to save less within a monetary union. Smaller countries therefore show a flatter savings path and higher current consumption than other members.

5.2. Fiscal Channels

Private Households. When increasing government spending in period t , fiscal policy needs to ensure these are either financed today via taxes or transferred into future periods by taking up more government debt. Latter is nothing but an intertemporal shift in tax burden. However, taxes in the model are not lump sum and so cause beside a negative wealth effect and distortions in households behavior. Log linearizing (5) shows different effects through increases in the tax rate,

$$\omega l_t = w_t - \frac{\tau}{1-\tau} \tau_t - \chi c_t. \quad (40)$$

Equation (40) shows that as tax rate τ_t increases we have an overall loss in disposable income which ceteris paribus decreases leisure and consumption. At the same time it distorts households behavior towards more leisure and less demand. These two effects are larger whenever fiscal policy behaves passive and the elasticity of substitution is large.

Ricardian Equivalence. In general New Keynesian models with lump sum taxes whether government spending is financed by taxes or deficit is irrelevant. An increase in deficit will then just require a payback through taxes in future periods. Since households are fully rational they anticipate future tax increase and save the necessary amount in the current period. However, the set up of this New Keynesian model breaks Ricardian equivalence when distortionary income taxes exist. The distortions cause a change in prices and current households behavior. Active governments substitute today's distortion through future distortion having a smaller impact on households current behavior. Thus, without the introduction of income taxation both fiscal regimes would have the same effect on households and financing would not matter.

By introducing Markov Switching, Ricardian Equivalence could still hold in the current New Keynesian set up. Transition probabilities yield the likelihood of switches across states. Consequently, an active regime today has then a certain probability of switching to a passive one, the larger the more likely this becomes. Since these are known by forward looking households and taken into account in their decision making process, high probabilities decrease the difference between both regimes. On the one side, this reduces the benefit through low current taxes, on the other side, it also improves the effect of the passive regime. Being in a current active regime implies larger deficit today, but due to regime switches higher taxes tomorrow causing households to save more today for this future event. So the larger distortions (τ) and

transition probabilities (p_{ij}) are the more Ricardian Equivalence is lost for the model and the greater the difference between both fiscal regimes.

Firms Labor Demand. When income tax rises and wage is kept constant, both income and substitution effects work against increasing labor supply. However, firms face higher demand through ε_t^g and producers increase their labor demand as well as wages. Since prices are not fully flexible, labor demand is then not directly offset by labor supply. Thus, the greater price rigidities the higher labor demand and wages. Firms optimal pricing equation below shows the aforementioned point:

$$\pi_t^H = \frac{(1 - \theta_t^H)(1 - \beta\theta_t^H)}{\theta_t^H} (w_t - t_t^H - z_t) + \beta(\pi_{t+1}^H), \quad (41)$$

where t_t^H denotes the relative price of home produced goods to the aggregate price level. As the latter contains import prices, it is less affected by fiscal demand shocks than P_t^H . While consumers decide on their labor supply based on the nominal wage discounted by the aggregate price, labor demand depends on real wages expressed in terms of domestic prices. Thus, the greater the share of imports in the consumption basket the larger the net labor effect.

Within a passive fiscal regime, higher current tax rates reduce the net return of labor and according to equation (40), would reduce households willingness to work. Lower labor supply increases wages more and hence, also the marginal costs face by firms, increasing domestic prices further. This mechanism depends crucially on the labor supply elasticity and the friction parameter θ_H , defining the pace of adaption.

Trade Channel. In a open New Keynesian Model, fiscal stimulus shocks do not only affect the domestic but also trade partners economy. The greater the interactions between the two countries, so the larger λ and λ^* , the more spillover effects come into play and change foreign variables as well. A domestic fiscal demand shock acts inflationary and directly increases domestic goods prices. Thereby passive regimes increase the pressure on the price level further than a active government. These higher domestic prices then worsen the Terms of Trade and make foreign goods relatively cheaper. Households in both countries experience a negative wealth effect and switch towards foreign products. According to the weighted firms' pricing equation,

$$\pi_t^* = \lambda^* \pi_t^H + (1 - \lambda^*) \pi_t^F, \quad (42)$$

however, domestic price increases will also cause foreign inflation to rise whenever λ^* is large. This spillover effect leads to an approach in competitiveness and also to a reaction of monetary policy since the overall EMU wide inflation will then be more affected.

By combining the domestic and foreign Euler equation through the universal interest rate, the linearized condition for international risk sharing is as follows:

$$-\sigma(c_t^* - c_t) = -\sigma(c_{t-1}^* - c_{t-1}) + \pi_t^* - \pi_t. \quad (43)$$

Domestic fiscal shocks will cause a greater increase in domestic CPI than on foreign inflation through price level spillover. Thus, to secure equality the marginal consumption of domestic households needs to increase relatively. Due to decreasing returns to scale this implies a decline in private consumption in the home country, or an increase in foreign consumption. This effect increases with share of imports and decreases with the share of exports. Active fiscal policy induces lower foreign adjustment by causing less inflationary pressure.

Passive fiscal policy causes the same amount of additional demand, increasing production but at the cost of higher wealth and greater distortions in private consumption. Thereby, greater trade benefits households but not producers, due to terms of trade and substitutability of goods.

6. Calibration and Estimation

The model is calibrated and estimated on the Spanish and EMU wide economy. By having one central bank but multiple fiscal authorities the European monetary union states an interesting example for the analysis of fiscal impact on economic multipliers. The prevailing view on fiscal and monetary cooperation before building the EMU was dominated by a strong inflation and price level targeting monetary authority, and a government that kept debt stable. This monetary dominant regime, however, requires complementary fiscal behavior, which becomes difficult in such a setting Debrun et al. (2021). Even more so when the central bank works at the zero lower bound, as could be witnessed since the government debt crisis in 2010. Meanwhile, since each country's fiscal policy is constraint by the Maastricht criteria, the budget balance needs to hold without the interference of the monetary sector. This leads to a strong need for a fiscal dominance and price level determination. I choose Spain as a representative example for an average sized member of the EMU. Furthermore, it shows one of the largest debt to GDP ratio within the union.

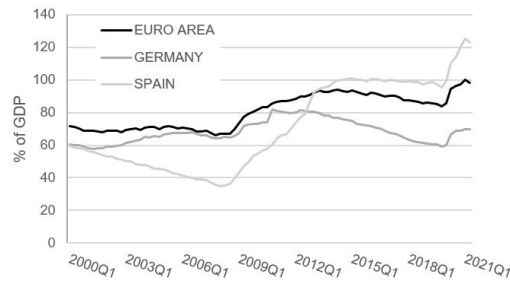


FIGURE 1. Debt to GDP ratio, Source: Eurostat

Fiscal stimulus needs to imply large multipliers for low costs, otherwise the pressure on debt grows. The current pandemic lead to even stronger rises in debt across the union with Spain passing the 120% ratio in 2021.

Another argument for Spanish economy portrays an appropriate example is the strong indication for fiscal dominance over the past years.

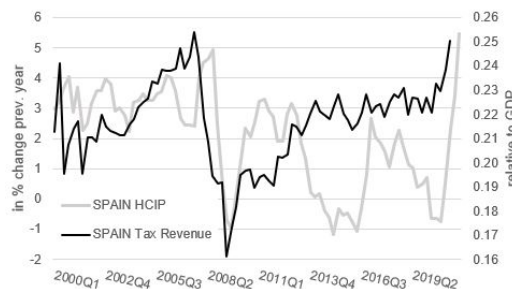


FIGURE 2. Spain: Tax Revenues (right), HCPI (left), Source: Eurostat

Since Spain's entrance into the currency union changes in the tax revenues come hand in hand with deviations in the price level. Meanwhile monetary policy was changing little. These observations suggest a necessity for sustainable fiscal strength and useful for the following analysis.

The parameter values are taken partly from Rabanal (2009), such as the share of Spanish products on the EMU market as well as the persistence parameters for the different shocks.

The parameter value, η , takes the value of the long term ratio of governmental consumption in overall gross domestic production in Spain and for the rest of the European Area: 0.182 and 0.206 respectively. The importance of each member and its weight on the decision making process by the ECB is measured as its share on EMU's aggregate production. Since Spain has a rather large economic power, this yields a value of around 10%. The time discount rates are calibrated such that in equilibrium they match the long term real interest rate in both countries. The elasticity of substitution between domestically and foreign produced goods ν is received by the estimated reaction coefficient of the imported good share to changes in its relative price level. The Calvo price rigidities are taken from Alvarez et al. (2005) for the

Spanish economy and on union level from Dhyne et al. (2005), where the price stability is greater. The estimation result of consumption growth on changes in the interest rate serve as approximations of the intertemporal elasticity of substitution ($1/\chi$) for both countries. Additionally the reaction coefficients of labor hours supply on changes in the wage level are used to define the intratemporal elasticity of substitution. While due to data availability I assume the Frish labor supply elasticity of 1 on the union wide level. All results can be found in Table 2. **Calibration Results**

| Parameter | Calibrated Value | Data used |
|--------------------------------------|--------------------|---|
| ρ_g, ρ_g^* | 0.9965, 0.9877 | Government Spending Persistence $\ln(G_t) = \beta_0 + \rho_g \ln(G_{t-1}) + \varepsilon_t^G$ |
| σ_g, σ_g^* | 0.0143, 0.00503 | Standard Deviation of residual ε_t^G and $\varepsilon_t^{G^*}$ |
| $\rho_z, \rho_z^*, \rho_{zEU}$ | 0.9766, 0.9667 | GDP per Capita Spain, EA $\ln(Z_t) = \beta_0 + \rho_z \ln(Z_{t-1}) + \varepsilon_t^z$ |
| $\sigma_z, \sigma_z^*, \sigma_{zEU}$ | 0.00821, 0.00681 | Standard Deviation of residual ε_t^z and $\varepsilon_t^{z^*}$ |
| η | 0.1823 | Ratio of Government Spending to GDP for Spain |
| η^* | 0.2058 | Ratio of Government Spending to GDP for EA no Spain |
| s | 0.1013 | Ratio of Spanish GDP in EMU |
| λ | 0.16 | Rabanal (2009) (Eurostat 1996-2007) |
| λ^* | 0.015 | Rabanal (2009) (Eurostat 1996-2007) |
| β | 0.9635 | Long run real Interest rate on Spanish Government Bonds ($1 + r = 1/\beta$) |
| β^* | 0.9671 | Long Run Real Interest Rates on European Government Bonds |
| ν | 1.3498 | Elasticity of substitution between Home and Foreign goods in Spain $\ln(M/(D - M)) = \beta_0 + \nu \ln(P_D/P_M) + \varepsilon$ |
| θ | 0.79 | Alvarez et al. (2005) |
| θ^* | 0.849 | Dhyne et al. (2005) |
| $1/\sigma$ | 0.1432 (0.0756) | Intertemporal Elasticity of Substitution Spain $\Delta \ln(c_t) = \beta_0 + \frac{1}{\sigma} \ln(1 + r_t) + \varepsilon$ |
| $1/\sigma^*$ | 0.1351 (0.0407) | Intertemporal Elasticity of Substitution EMU estimated as above |
| ω, ω^* | 1 | Frish Labor Supply Elasticity |

TABLE 2. Parameter values used in the model, calibrated, estimated and from literature

Since the states are unknown the log likelihood function differs across both regimes, depending on the certain set of parameters. The estimation procedure¹ uses a weighted average of the likelihood function in each state, where the weights are given by the state's probabilities. However, since the weighting scheme and so the probabilities themselves are unknown and follow a Hidden Markov Chain, the iterative algorithm starts with an a-priori guess and updates the probabilities in each period according to,

$$Pr(S_t = j | \psi_t) = \frac{f(y_t | S_t = j, \psi_{t-1}) Pr(S_t = j | \psi_{t-1})}{\sum_{j=1}^2 f(y_t | S_t = j, \psi_{t-1}) Pr(S_t = j | \psi_{t-1})}$$

for $k=2$ states. Where the probability of being in a state j conditional on the current information set ψ_t is the ratio of the state's weighted conditional density given previous information in the joint densities across both states. Perceiving the set of

1. The Markov Switching policy parameters are received using the MATLAB package MS Regress by Perlin (2015) applying a unique equation log likelihood estimation on the fiscal policy functions noted in (25) based on Hamilton (1994).

probabilities we then receive the log likelihood in form of,

$$\ln(L) = \sum_{t=1}^T \ln \left[\sum_{j=1}^2 f(y_t | S_t = j, \Theta) Pr(S_t = j | \psi_t) \right].$$

Which denotes a weighted average of conditional densities, described by function f , given the two States. Results are displayed in Table 1. and 2., showing the different coefficients across both regimes in Spain and EMU respectively.

| | passive Regime | active Regime |
|------------|------------------------|-----------------------|
| γ_y | 0.2025*** (0.0218) | -0.4312 (0.5695) |
| γ_b | 0.0122*** (0.0035) | -0.1005 (0.0994) |
| γ_g | 0.5172*** (0.0022) | 0.3179*** (0.0867) |
| σ^t | 0.00001*** (0.0000) | 0.00015** (0.0001) |

TABLE 3. Markov-Switching Fiscal Policy Coefficients Spain, Log-Likelihood 374.6472

Table 1 shows that the active regime has a smaller reaction coefficient of taxes to government expenditures than in the passive regime. Furthermore, the reaction coefficient on debt, in the active regime, is negative and hence shows no sign of debt reduction effort in contrast to the passive regime, where the fiscal policy seems to be more reluctant. Additionally, higher output usually causing inflationary pressure is not held under control but rather stimulated by reducing the real tax further. So the passive regime shows counter-cyclical behavior.

Fiscal policy overall is highly persistent. The probability matrix,

$$P = \begin{bmatrix} 0.9947 & 0.0328 \\ 0.0053 & 0.9672 \end{bmatrix}$$

displays the probabilities of switching from one regime into the other. The top left and bottom right corner thereby show the persistence of the first and second regime respectively.

| | passive Regime | active Regime 2 |
|---------------|-------------------------|-------------------------|
| γ_y^* | 0.0679*** (0.0165) | -0.1118 (0.0277) |
| γ_b^* | 0.0111* (0.0068) | 0.0120 (0.0193) |
| γ_g^* | 0.5164*** (0.0043) | 0.4401*** (0.0129) |
| σ^{*t} | 0.000005*** (0.0000) | 0.000012*** (0.0000) |

TABLE 4. Markov Switching Fiscal Policy Coefficients Euro Area, Log Likelihood 442.687

A similar pattern can be seen when looking at the results for the fiscal policy coefficients in the Euro Area in Table 2. Again the first state can be defined as the

passive regime, with a stronger reaction of taxes towards changes in governmental expenditures. So signaling a larger share of tax financed spending relative to a regime with deficit financing. The coefficients on debt are not significant and neither is the one on the outputgap in the active regime, however the passive regime comes again with pro-cyclical behavior. The transition probabilities show again high persistence in the regimes, especially for passive fiscal behavior:

$$P^* = \begin{bmatrix} 0.9963 & 0.0570 \\ 0.0037 & 0.9430 \end{bmatrix}.$$

Thus being active does not just mean to be mainly debt financing the expenditures but rather to be expansionary in the original sense. By holding back with tax revenues and automatic stabilizers the economy experiences larger output and larger inflationary pressure that is not held back in the first place. While passive fiscal policy tries to hold back large rises in output and price level. However, when output is increasing this definition becomes problematic in the sense that taxes would be higher in active regimes, despite its stimulating purpose. I therefore interpret active fiscal policy as one that holds back on taxes in the current period instead of interpreting it more normally as suggested by these results.

To allow for interacting regime switches across domestic and foreign country, I construct a total of 4 regimes: Active/Active, Passive/Passive, Active/Passive and Passive/Active, where the first denoted the state of the member country and the latter the one of the union. To receive the respective transition probabilities, I build the Kronecker Tensor Product of the two matrices P^F and P^{F*} ,

$$\bar{P}^F = \begin{pmatrix} 0.9910 & 0.0567 & 0.0327 & 0.0019 \\ 0.0037 & 0.9380 & 0.0001 & 0.0309 \\ 0.0053 & 0.0003 & 0.9636 & 0.0551 \\ 1.9e^{-5} & 0.0050 & 0.0036 & 0.9121 \end{pmatrix} \quad (44)$$

where the diagonal displays the persistence of each regime and $p_{i,j}$ gives the probability to go to state i after being in j . From the top left to bottom right it shows the probabilities to stay in the passive/passive, passive/active, active/passive and active active regime for the next period. Households include this probability matrix in their expectations about future states. Thus, an initial active/active mix might be possible despite the assumption of active monetary policy because this state will only last temporarily and so debt will be financed eventually.

When assuming regime switching monetary policy as well we also receive two states that can be easily classified by inflationary targeting and a rather reluctant behavior. The results for the European central bank can be derived from Table 3. With a coefficient α_π larger than one the first regime is characterized by strong

inflation targeting . This indicates that nominal interest rate increases more than one on one when inflation rises and so the real interest rate in the union rises to reduce the price level. The passive Regime is rather reluctant and less focused on

| | active Regime | passive Regime |
|--------------|--------------------|----------------------|
| α_π | 1.0537 (0.0616) | -0.1785 (0.0054) |
| α_y | 0.3115 (0.1259) | -0.2233 (0.0060) |
| σ^r | 2.4912 (1.3772) | 0.000618 (0.0003) |

TABLE 5. Markov Switching Monetary Policy Coefficients Euro Area, Log-Likelihood -92.6495

maintaining price stability. Especially during recessionary times this is a common tool to help stimulate present consumption by increasing the costs of saving. However, the transition probabilities as well as the duration of latter regime shows that the active, inflationary targeting is the prevailing behavior over most of the horizon.

$$P^M = \begin{bmatrix} 0.9954 & 0.2500 \\ 0.0046 & 0.7500 \end{bmatrix}.$$

For my analysis throughout the model, I use the results for the first monetary regime, denoting the ECB as staying in an active state with inflation targeting.

7. Results

7.0.1. Domestic Fiscal Stimulus. While fiscal independence is reduced when becoming part of a monetary union, individual country stimulus packages are still part of the instrumental repertoire. Thus, the following analysis will focus on the effect of a temporary increase of ε_t^g , a shock to governments consumption for home produced goods only. Since government spending on union level is not affected, the foreign coefficient on government spending does not play a role but only whether its response is pro- or countercyclical. So multipliers vary with the respective domestic regime but differ only slightly with changes in the foreign fiscal state.

The Impulse Response Functions of Figure 15 in the Appendix show the responses towards a domestic fiscal policy shock when both fiscal policies are switching, assuming that the state mix lasts throughout all periods. Since Spain has a rather small s , with around 10% of EMU wide GDP, monetary policy will not react with an one on one rise in the interest rate towards changes in Spain's inflation. Instead the real interest rate will be perceived negative, yielding intertemporal substitution of consumption towards the current period. With greater intertemporal elasticity of substitution this effect increases and affects multipliers positively. On the other side tax rates need to rise eventually in both regimes to finance government spending.

These create negative wealth effects as well as distortions, reducing consumption while passive regimes hit the forward looking households worse today. This effect exceeds the benefit through higher gross return from work. Labor demand keeps increasing more than labor supply, since P_t^H slightly exceeds P_t , but the large tax rate especially in a passive regime still reduces its net return. Thus fiscal stimulus crowds out private consumption. Due to low trade interdependence there is barely any price level spillover, creating a large gap of prices and competitiveness. Equation (43) explains why foreign consumption comes quicker back to normal compared to domestic demand. Overall the effects on the foreign world are negligible due to low λ and λ^* .

To define the final effect of government stimulus on output and consumption I use the standard impact multiplier, calibrated to display everything in percentages of output.

$$\text{Impact Multiplier: } \frac{\sum_{t=0}^k \Delta Y_{t+k}}{\sum_{t=0}^k \Delta G_{t+k}} \quad \text{and} \quad \frac{\sum_{t=0}^k \Delta C_{t+k}}{\sum_{t=0}^k \Delta G_{t+k}} \quad (45)$$

where the multiplier is a cumulative sum over k periods.

It becomes clear that the high taxation in the passive state causes greater losses in both output and consumption multiplier. The first is small and negative due to the higher price of their most required goods, the negative wealth effect and dominance of the distortions. The impact multiplier on output is positive but declines over time as well. Due to limited price level spillover there are large differences in the real exchange rates, decreasing consumption and output further over time. The results I found are consistent with empirical literature as shown in Burriel et al. (2010).

| Regime Mix | 1 quarter | 1 year | 3 years | 5 years |
|------------|-----------|--------|---------|---------|
| P/P | 0.7514 | 0.5434 | 0.2897 | 0.1993 |
| P/A | 0.7510 | 0.5424 | 0.2876 | 0.1967 |
| A/P | 0.8121 | 0.6591 | 0.4745 | 0.4145 |
| A/A | 0.8121 | 0.6588 | 0.4736 | 0.4132 |

TABLE 6. Output Multipliers

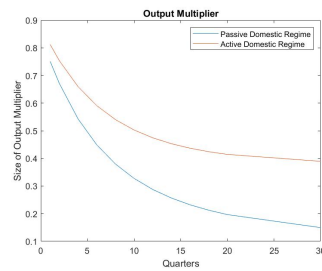


FIGURE 3. Output Multiplier over Time

The longer the horizon of the multipliers the more it matters to have active domestic fiscal policy in the first place. Intensive pressure on domestic inflation solely leads to a strong decline in the marginal rate of intertemporal substitution by increasing expected inflation as well. Thus, together with negative interest rates it causes demand to decline long after the shock.

| Regime Mix | 1 quarter | 1 year | 3 years | 5 years |
|------------|-----------|---------|---------|---------|
| P/P | -0.0179 | -0.0247 | -0.0331 | -0.0361 |
| P/A | -0.0179 | -0.0248 | -0.0331 | -0.0362 |
| A/P | -0.0148 | -0.0198 | -0.0258 | -0.0278 |
| A/A | -0.0148 | -0.0198 | -0.0258 | -0.0278 |

TABLE 7. Consumption Multipliers.

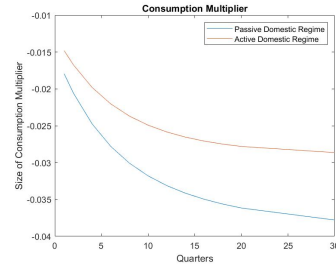


FIGURE 4. Consumption Multiplier over Time

Overall domestic fiscal stimulus is not effective in open, incomplete markets, when taxes are distortionary and trade is low. Even more so price frictions decrease multipliers further over time, postponing price adaptations. However, consumption benefits from low interest rates and cheap foreign goods, which improves with higher substitutability. Since under low trade interdependence, foreign policy hardly matters for a domestic fiscal stimulus. The best regime mix, however, can still be considered to be active/passive, where prices are raised less in domestic and more in the foreign country, relative to their opposing regimes.

7.0.2. Union Wide Fiscal Stimulus. Within a monetary union economic shocks are most often shared among the members since business cycles have a strong co-movement. Due to high trade interactions and a common currency, deviations in one country quickly spill over to partner countries. Thus, stabilization mechanisms are in many times done on union level. In the previous analysis the regime of foreign fiscal policy had no effect other than the reaction on output through γ_g^* . With a rise in ε_t^{gU} public demand for both goods increases and both regimes matter for the choice of financing these expenditures. The difference between γ_g is rather small in this example such that the difference between the multipliers is not great, especially not when there is only low trade interactions between the countries.

Figure 16 in the Appendix displays the IRFs towards a union wide shock and shows that now foreign as well as domestic taxes are responding according to their respective regime. In contrast to before, the demand shock across the union increases not just the price level for domestic but also foreign goods. This shock causes monetary policy to react and increase interest rates further such that households will substitute their consumption towards future periods, but also minimize price differentials and changes in the marginal rate of intertemporal substitution. Consequently, there is an upward movement in consumption and output multiplier over time. Due to active monetary policy and higher costs for domestic and foreign goods, consumption reduces overall compared to the previous analysis. Output, on the other side, benefits through improvements in the terms of trade. Therefore under the active/passive policy there are lower distortions and wealth effect for households with large home bias, while

firms receive higher foreign demand due to improvements in their competitiveness.

| Regime Mix | 1 quarter | 1 year | 3 years | 5 years |
|------------|-----------|--------|---------|---------|
| P/P | 0.6997 | 0.7006 | 0.6975 | 0.6921 |
| P/A | 0.6915 | 0.6777 | 0.6533 | 0.6367 |
| A/P | 0.7639 | 0.8262 | 0.9049 | 0.9344 |
| A/A | 0.7559 | 0.8035 | 0.8609 | 0.8795 |

TABLE 8. Output Multipliers after a rise in ε_t^{gU}

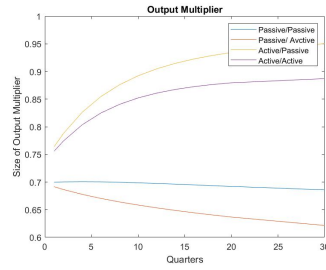


FIGURE 5. Output Multiplier over Time

The impact of fiscal stimulus on output has the highest effect among the four different policies.. Now the domestic country benefits from foreign price increases through the union wide demand shock. Active domestic and passive foreign behavior improves the terms of trade most by increasing foreign and lowering domestic prices. This lets the demand for home goods rise through better competitiveness. However, consumption still declines due to high tax burden. Additionally households now face high interest rates and overall expensive products, since both price levels are directly affected. In the previous analysis home prices became larger than the aggregate CPI. With a union wide shock the price level of domestic goods especially under active behavior is now lower than the aggregate CPI. Since marginal costs are displayed by $w_t - t_H$ and t_H becomes negative, they are increasing, causing labor demand to decline. Leaving labor supply constant, wages drop in both regime mixes with active domestic government. This causes further losses in the consumption multiplier.

| Regime Mix | 1 quarter | 1 year | 3 years | 5 years |
|------------|-----------|---------|---------|---------|
| P/P | -0.0838 | -0.0839 | -0.0843 | -0.0847 |
| P/A | -0.0827 | -0.0832 | -0.0841 | -0.0847 |
| A/P | -0.0805 | -0.0785 | -0.0762 | -0.0754 |
| A/A | -0.0793 | -0.0778 | -0.0759 | -0.0753 |

TABLE 9. Consumption Multipliers.

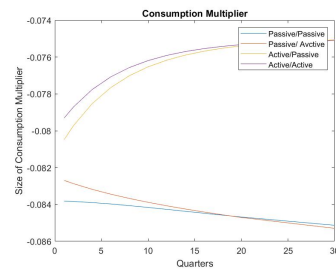


FIGURE 6. Consumption Multiplier over Time

Higher interest rates due to the assumption of inflation targeting increase consumption multipliers over time through intertemporal substitution towards future periods. Also now that the real exchange rate is positive between countries, it benefits consumption in future periods.

Small countries firms benefit through improved terms of trade and higher export. Households on the other side loose the option to substitute cheaper products, receive lower net wages and face higher interest rates. The consumption multiplier is initially higher under an active/active regime, until the agents benefit from improved terms of trade. Otherwise it stays optimal to behave active within a passive union.

7.0.3. Union Fiscal Stimulus excluding member. Countries such as Spain seem to suffer from large crowding out through fiscal stimulus. Loss in terms of trade decrease external demand and make domestic households substitute towards imports. Thus, next I want to analyze the effect of a public demand shock to foreign products only and whether the improvements in competitiveness crowds in private consumption. Figure 8 displays the domestic responses towards a 1% government spending shock on the foreign county. Even when only the foreign country increases their public spending, domestic consumption declines. Since domestic goods will become relatively cheaper, P_t^H to be now lower than aggregate CPI. Thus the nominal wage will be perceived higher for the households and labor supply lets the real wage decline. Since firms cannot adapt right away, marginal costs stay higher than intended decreasing wage and private consumption. Output rises, as soon as terms of trade are improved and consumers substitute towards cheaper domestic products. Despite a small loss in consumption in the longer run output can be raised without any expenditures.

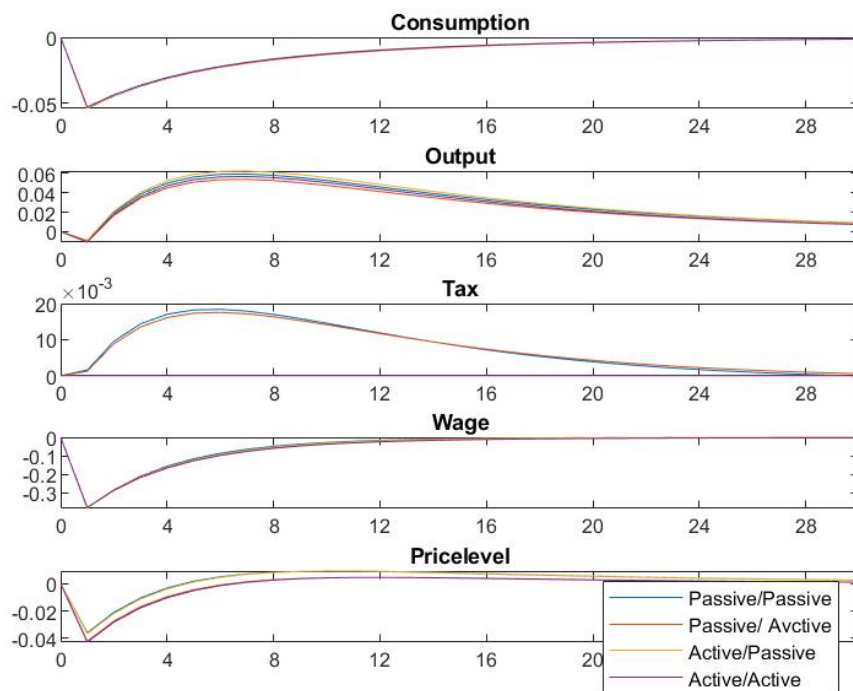


FIGURE 7. IRF to a Fiscal Stimulus shock ε_t^{g*}

Since even for trade intensive countries government stimulus is not effective, under distortionary taxes, the most efficient outcome for a country is achieved when every member except itself raises spending. The multiplier raises quickly above one, since no expenses are made. The largest outcome is achieved whenever foreign policy behaves passive during their spending shock. As a consequence no country has an initiative to increase fiscal stimulus but rather wait till other countries increase government spending. Much larger output at costs of a lower private consumption for no costs

might be preferred over previous results. This leads to a overall reluctant behavior and in the end no stimulus across the union. Further analysis for strategic behavior of the different members should follow in future research.

7.1. Trade Intensive Countries

While the previous analysis focused on a small country with low trade dependence like Spain. I now analyze the effect of fiscal stimulus on trade intensive countries such as Germany. According to Eurostat (2021) German exports account up to about 23% of total intra-Euro Area exports, while simultaneously showing a small home bias of only 60%. Due to high interactions with the union, changes in economic variables quickly spill over. Furthermore the country itself has higher economic weight ($s = 0.2886$) such that monetary policy adapts quicker. A government spending shock, increases the price level of domestic goods raising CPI but also the aggregate foreign inflation through trade. The monetary authority (ECB) will respond with higher interest rates, causing intertemporal substitution of private consumption reduce today's multiplier. On the other side households benefit from their large share of cheaper import products, but are more hurt when these prices increase as well under a union wide fiscal stimulus.

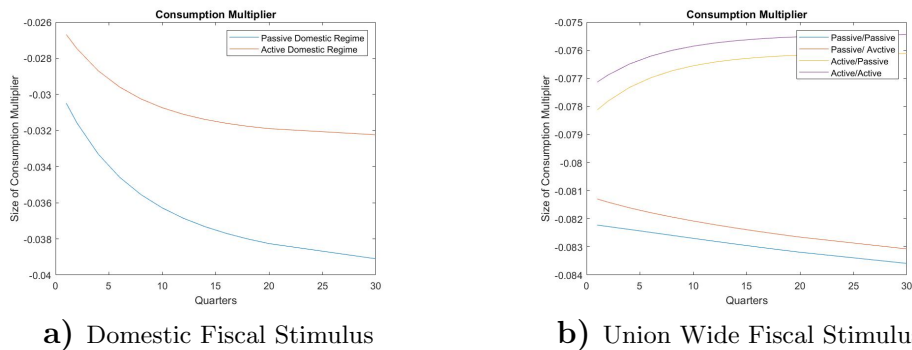


FIGURE 8. Consumption Multiplier

Due to high trade dependence, high competitiveness is throughout more important for the consumers than cheap products. While in small countries, the active/active mix is preferred by consumers initially, since it yields cheaper foreign products. Now in contrast to before the active/passive mix is preferred in all periods. The greater the export share of a country the more consumers benefit through the terms of trade benefit on production and labor demand. The curvature is less than in Figure (7), since the international real exchange rate stays rather constant due to price level spillover.

The output multiplier is reduced drastically as a response to a domestic demand shock. Now high trade dependency increases the need for high competitiveness and low relative prices. When there is a union wide fiscal stimulus, output benefits from larger

export demand, since foreign price levels become higher. For large trade intensive countries it is clearly best to look for a union wide solution instead, since otherwise the loss in competitiveness is too great and exports are highly crowded out.

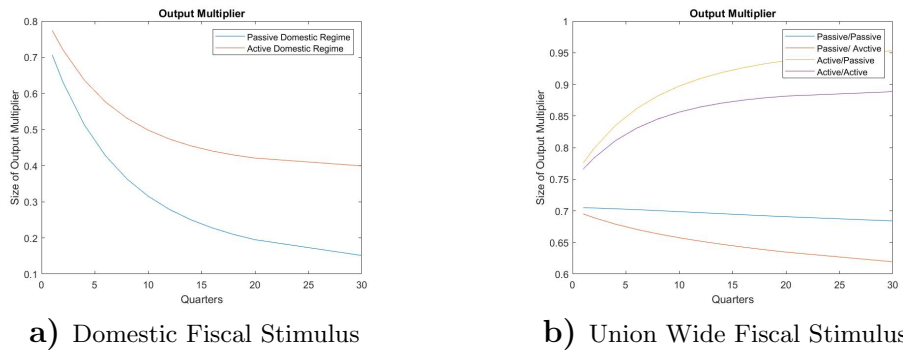


FIGURE 9. Output Multiplier

The overall difference between regime mixes and the preference for the Active/Passive Regime mix increases with higher λ and λ^* . Foreign Policy becomes more important for countries that enjoy great trade relations. When all countries, small and large prefer an Active/Passive regime mix, the final outcome cannot be the best solution for all members. Since then countries will behave active throughout, yielding an active/active overall regime mix. For one this will yield the second best option, but second it will cause the overall debt burden within the union to rise quickly.

7.2. Non Switching Policy Functions

Arguing for Markov Switching regimes for fiscal policy behavior yields the opportunity to analyze the importance of the financing decision on economic stimulus. For comparison in the following I estimate the effect of non switching fiscal policy on multipliers. For that I first evaluate the responses of taxes towards changes in government spending, output and debt using a standard linear regression. Table 8

| | Spain | Euro Area |
|------------|------------------------|------------------------|
| γ_y | 0.4377*** (0.0218) | 0.1561*** (0.0218) |
| γ_b | 0.0505*** (0.0035) | 0.0376*** (0.0035) |
| γ_g | 0.4835*** (0.0022) | 0.4875*** (0.0022) |
| σ^t | 0.00001*** (0.0000) | 0.00003*** (0.0000) |

TABLE 10. Non-Switching Fiscal Policy Coefficients , Log-Likelihood 320.0473

displays the resulting coefficients for both the union and Spain as an example for a EU member state. All are highly statistically significant and lie mostly between the active and passive regime results. However, automatic stabilizers react stronger in

this setting. The coefficient for Spain increases to 0.4377, while it was around half that size in the passive regime and non significant for the active regime. The union shows a similar picture.

Thus, the resulting multipliers for both regimes are significantly lower especially for output. More precisely, implying a non switching environment leads to negative multipliers after around 5 quarters when there is a country individual spending shock. This, however, is not supported by the data. In fact output multipliers are found to be positive and below one.

| | 1 quarter | 1 year | 3 years | 5 years |
|--|-----------|---------|---------|---------|
| Output Multiplier (Shock to G_t) | 0.2822 | 0.0782 | -0.0546 | -0.1221 |
| Output Multiplier (Shock to G_t^U) | 0.6909 | 0.6830 | 0.6593 | 0.64110 |
| Consumption Multiplier (Shock to G_t) | -0.0330 | -0.0398 | -0.0446 | -0.0471 |
| Consumption Multiplier (Shock to G_t^U) | -0.0876 | -0.0894 | -0.0939 | 0.0977 |

TABLE 11. Multiplier with non switching fiscal policies

Only a union wide fiscal stimulus leads to credible results regarding the impact on a members GDP. With little below 0.7 it shows a smaller effect than in the switching setting. However, the difference between the multipliers in both types of shocks is much greater. The need to find a union wide solution becomes even greater than before. Consumption Multipliers are again negative and have a similar size as before. The union wide shock leads to a larger crowding out of private consumption due to the the additional increase in foreign goods prices. Overall the results seem to be more realistic than the multipliers for output.

In conclusion, assuming time varying fiscal policy behavior is not only supported by the data but furthermore proves to yield more reliable results with regard to the multipliers. Governments financing decision matters and proves to be an indicator for behavioral changes over time. With an inflexible monetary sector fiscal policy determines the price level and so drives economic multipliers. Finding the ideal environment for the largest multipliers is an important task to guarantee fiscal efficiency.

8. Conclusion

My results show that an active fiscal policy within a passive behaving union leads to the largest multipliers. Furthermore, while the effect on consumption declines, the output multiplier reaches close to one if government stimulus is done on a union-wide level. Although it is based on the NK framework, my model suggests negative multipliers for consumption and positive ones for output throughout. The latter increases with activeness, trade intensity, and size of the domain. Thus, the most significant effects are reached when a union-wide shock hits a trade-intensive country

while being in an active state. Private consumption, on the other side, suffers from crowding out through fiscal demand and subsequent rises in the price level worsens when the solution is found on a union level. Overall the inclusion of transition probabilities cannot compensate for the loss in Ricardian equivalence created by distortionary income taxation.

As in Debrun et al. (2021), two direct implications from the output multipliers effects are that a currency union may lead to higher debt and a demand externality. The higher debt comes through the individual superiority of active regimes. If everyone strives to maximize efficacy, debt levels across the monetary union will be high. The central bank will then react on a union-wide level and remains inactive. Thus, costs of lower interest rates and a possible high union-wide future inflation are carried by all members, while the country itself faces the loss through high taxes in a passive regime. The demand externality comes from large trades across members of a currency union. Since countries gain the highest benefit relative to costs when there is a foreign demand shock, each country will wait for others to be active so that the union-wide stimulus will be too low. That is, although stimulus packages need to be financed on the country level, each country benefits mostly through spillover effects. My results validate both aforementioned externalities. I showed that multipliers increase when a country is more active, but the union is passive. However, this would imply a second-best solution in which all members are active, and debt levels increase drastically across the union. In addition, multipliers from a stimulus are less than one for the country of origin. However, they generate an increase in foreign output at no cost, leading to free riding and low stabilization mechanisms within a currency union.

With the centralization of the monetary authority, fiscal dominance is an important aspect in stabilization efforts. Simultaneously, governments need to maintain sustainable in their expenses. The Stability and Growth Pact as well as the Maastricht Treaty restrict fiscal authorities, to prevent scenarios following the debt externality. However, the fact that they are not imposed by a supra-national organization makes possible penalties less credible. Another option to increase effectiveness for struggling countries is to impose a certain regime upon them or solely on their trade partners. Even passive countries can then benefit from a higher multiplier, when others are even more passive. Overall, the model shows that fiscal stimulus is best done on union level. Thus, a coordinated fiscal policy for a currency union would benefit all members in times of recovery. An example for that was the European Economic Recovery Plan in 2008, launched by the European Commission.

This paper contributes to the literature on multipliers regarding the issues through countries' sovereignty and a centralized monetary policy. Further research could add

empirical investigations of multipliers within a currency union when fiscal authorities are switching across time.

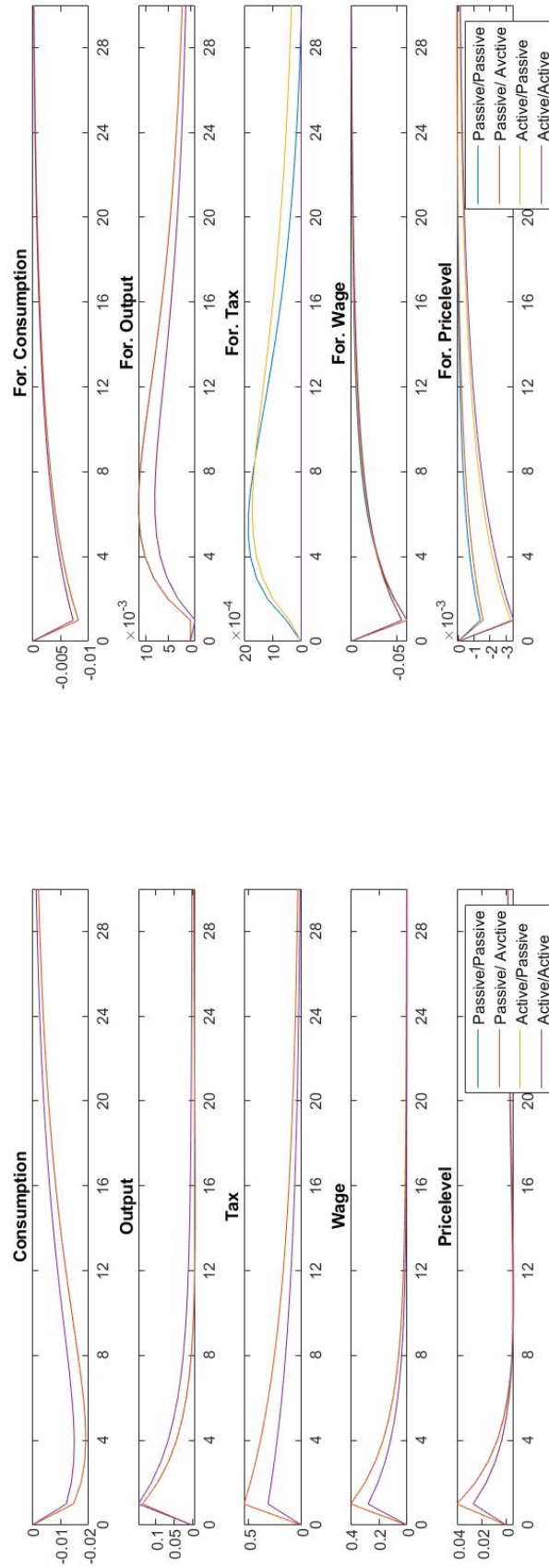
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APPENDIX

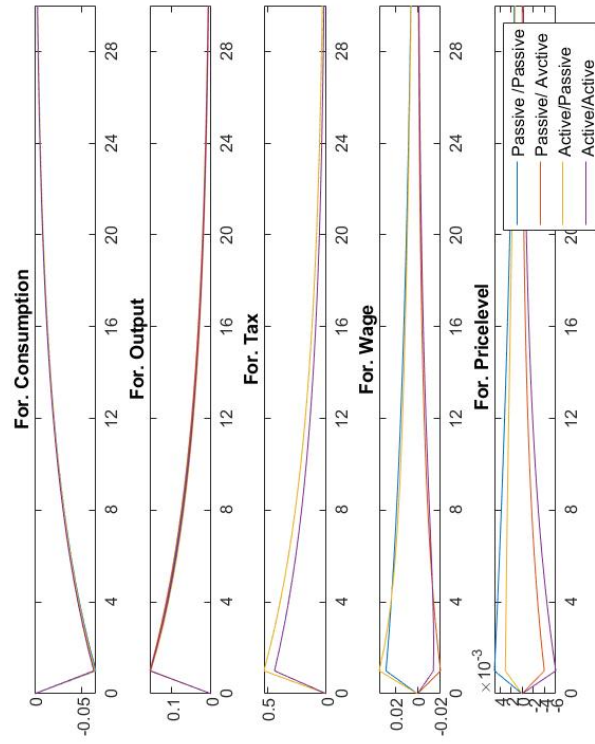
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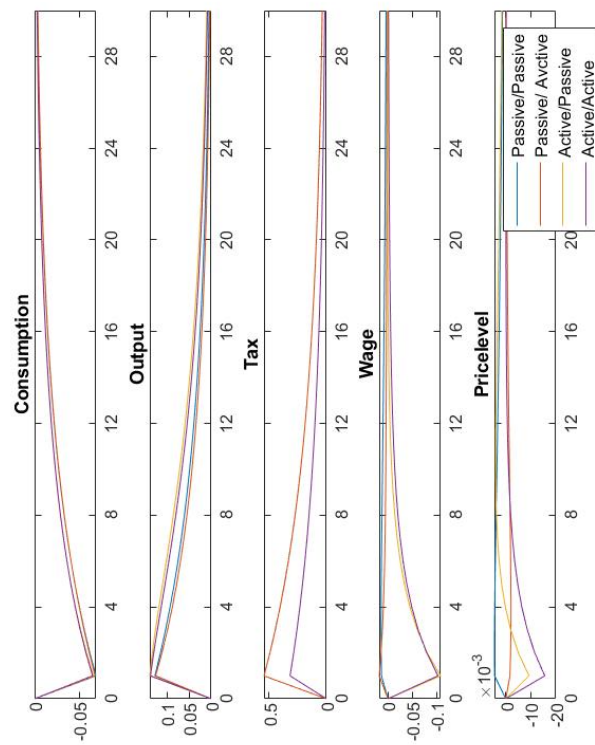
a) Domestic IRFs to a 1% Fiscal Policy Shock

b) Foreign IRFs to a 1% Fiscal Policy Shock

FIGURE .10. IRF for a Domestic Fiscal Stimulus under low trade, $\gamma_b = 0$.



b) Foreign IRFs



a) Domestic IRFs

FIGURE .11. IRF to a 1 St. Dev. Union Wide Government Spending Shock