Fiscal Policy and Trade in a Currency Union[1]

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Abstract

This paper explores the transmission channels of fiscal policy and its impact on trade flows within a currency union. An *interest rate channel* implies a 'Taylor-type' response of a central bank to inflation in core. A terms of trade channel implies factors that directly affect the relative prices between the core and periphery. In case of a core government spending, an interest rate channel dominates the terms of trade channel. It leads to to an import from the periphery to the core. On the contrary, a reduction in distortionary tax in the core reverses the direction of trade. The former policy 'jump starts' the periphery whereas the later creates a 'beggar-thy-neighbor' effect.

JEL *Classification*: E42, E62, E63, F41, F45

Keywords: fiscal policy, currency union, transmission, New-Keynesian models, business cycles

Introduction

In this paper, we examine the *transmission of fiscal policy within the European Union, on trade flows and welfare*. We build upon the open economy model of Christiano et al.(2011) (henceforth CER)[2] extending it to a currency union and examine a government spending in core and its impact on periphery. A government spending shock in core leads to a reduction in output in the periphery, given a Taylor rule for the union. We arrive at identical results with a negative tax shock in the core. However, the direction of trade is different in both these policies. While the former allows for greater imports from the core, the later creates conditions for exports form the core to the periphery.

These two types of fiscal policy measures work primarily through two distinct channels. Consider an 'interest rate channel' to begin with. A spending shock in the core implies a shift in aggregate demand. This shift causes a core inflation and an increase in interest rate set by the central bank. This reaction causes a fall in consumption in the core and hence a decline in output. This channel can be called the interest rate channel because it is a result of the Taylor-type activism by the central bank. This largely drives results by changing the direction of trade and hence composition of output within a monetary union. The extent of reaction is dependent upon the contribution of inflation in the core economy in overall inflation in the currency union.

On the other hand, an analysis of a negative tax shock in the core implies a movement along the aggregate demand. Such a shock also alters the slope of the core aggregate demand curve. It implies a rise in core private demand. The improvement in terms of trade for the core also implies a periphery rise in demand. This causes a rise in inflation and implies an adjustment of composition within the Eurozone. This channels can be called the terms of trade channel.

The distinction in terms of these channels is the starting point of the change in composition. In the interest rate channel, an inflation caused by government demand causes the terms of trade re-adjustment; whereas in terms of trade channel, an improvement in terms of trade by reduction of taxes in core causes further imported inflation. For our baseline model, we thus show this duality of taxes and spending operating through separate channels. However, in determining the direction of trade within the model, we calibrate it to German, Spain, Italy and French trade data from the Eurostat.

We find that the results are primarily driven by three model parameters and could explain a significant proportion of the intra EU trade between these two countries. Firstly, depending upon the degree of openness of the core, the interest rate channel would imply greater or lesser imports. Greater the index of openness, greater is the possibility of substituting for expensive domestic goods with imported goods. This implies that crowding out is not complete and inflation takes greater time to get under control. A gradual steady state convergence from above for core and below from periphery along with trade flows from the periphery to core would take place. On the contrary, if a favorable tax shock implies a terms of trade channel, then greater the degree of openness from the periphery, greater the exports from the core to the periphery.

[2] These models in general are extensions to the RBC models in various settings – Gali and Monacelli, 2005 to a small open economy, Altig et al., 2011 to heterogeneous capital within the RBC model, Christiano et al., 2005 to evaluate of monetary shocks in a new Keynesian model.

Secondly, the magnitude of trade flows in either of the channel depends upon the relative population weights associated with consumption and output. The effect of population in both channels is similar, and we are only alluring to magnitudes for this parameter. Thirdly, the elasticity of substitution between domestic and foreign goods also plays an important role in driving the trade flows between the two countries. In the interest rate channel, the rise in core inflation on account of a spending increase would imply that domestic marginal cost is greater. This leads to a higher producer priced domestic consumption good. In equilibrium, optimal allocation between domestic and foreign goods gets affected. Greater the elasticity substitution, greater is the substitution effect. On an aggregate, and over time, there is an income effect which postpones going back to the steady state. The lag is about ten quarters in the interest rate channel.

In what follows, we shall explore these mechanisms and contrast the results from ones in the literature. Section 2 presents a literature review. Section 3 provides our extension of the CER framework. Section 4 discusses the calibration and conducts policy experiments. Section 5 estimates the model and seeks empirical validity. Section 6 discusses the plausibility and points to the limitations. Section 7 concludes.

Literature Review

Our paper is in the intersection of fiscal policy transmission and its impact on trade flows within a currency union. There is extensive discussion on the impact of government spending multipliers in a New Keynesian model[3]. In reading through the surging discussion of fiscal multipliers[4] in currency union[5], a discussion of either the magnitude or the impact of a government spending is forthcoming. The resurgence of a debate on fiscal policy is timely and there exists disagreement[6]. Christiano et al. (2011) undertakes simple exercises and distinguishes the results of a government expenditure in a new-classical model without price stickiness. The contrast upon adding Keynesian price rigidity divides the discussion on magnitudes.

On the contrary there is a critique from a growing empirical literature that the size difference has to be identified[7] in order to establish results which are model independent. Empirical estimation from continuing changes in spending, monitoring policy announcements and evaluating identification from policy news shocks[8] have also gained traction. In fact, Blanchard and Leigh (2013) evaluates the size of multipliers by explicitly accounting for growth forecast errors. Caggiano et al. (2015) explores such measurement errors on account of linerization of solution functions adopted to evaluate these models.

On the contrary, the literature on taxation talks more about the timing of taxation (Ramey, 2011b) and anticipation of fiscal policies. Christoffel et al. (2008) constructs a large scale model to examine the impacts of distortionary taxation and estimates the model. But the crucial channel of taxation is not explicitly discussed in the case of a monetary union. Further, taxes are also

[3] Woodford (2011) and Ramey (2011a) etc.
[4] Ramey (2011a),Christiano et al. (2011), Woodford (2011)
[5] Farhi and Werning (2012), Blanchard et al. (2016), Coenen et al. (2012),Flotho (2015)
[6] Perotti (2007): argues that there is disagreement on the 'basic theoretical effects of fiscal policy and on the interpretation of the existing empirical literature.'
[7] Auerbach and Gorodnichenko (2012)
[8] Schmitt-Grohe and Uribe, 2012

examined as automatic stabilizers[9] albeit in a setting where the effect of tax is not obvious as in the case of Non-Ricardian consumers. There is a parallel literature on identification of tax shocks[10] that deal with identification of these issues in a reduced form manner.

We try and look at the expenditure and taxation literature in conjunction to examine the issues of trade flows[11]. There are a few who have looked at the conjoint effect – Drautzburg and Uhlig (2015) combine the models of spending in presence of a distortionary taxation[12]. However, it is important to distinguish between the literature which jointly analyses taxation and spending with what we are trying to do. In extending the literature to a currency union, we are able to examine the effects of these policies together by examining trade within the union. This implies that we can hold constant the impact of exchange rate volatility, which does not affect the intra union trade in any direct manner.

Also, by invoking the two channels of transmission[13], we are able to explicitly comment on the direction of trade. This adds to the existing literature on transmission and extends it to the currency union[14]. The gaps in direction of trade as sourced from changes in fiscal policy would be addressed. The next section provides a medium scale DSGE model to explore these issues.

A New Keynesian Model

In the model, each economy specializes in the production of one type of good traded across borders. The model currency union consists of two countries, called D (Home/Domestic) and F (Foreign)[15]. It is populated with a continuum of agents of unit mass, where the population in the segment $[0, n)$ belongs to country D and the population in the segment $(n, 1]$ belongs to country F. Each country specializes in one type of tradable good, with measure equal to population size. Variables with asterix superscript $(*)$ would represent foreign economy.

Household's Problem

The household's problem in our economy is a simplified version of Christiano et. al. (2011) where $i \in [\,0, n)$ for the home economy. We will represent all the shock processes as $\nu_{var,t}$, all weightage as μ_{var}, and all intertemporal constant elasticities as σ_{var}. The preference structure of the representative household can be summarized by the following set of characterizations:

$$U\left(X_{it}, N_{it}, \frac{M_{it}}{P}, G_t\right) == \left[\frac{1}{1-\sigma_c}(X_{it} - \mu_c\, \nu_{ct})^{1-\sigma_c} - \frac{\mu_n N_{it}^{1+\sigma_n} \nu_{nt}}{1+\sigma_n} + \mu_m \ln\frac{M_{it}}{P_t} + \frac{\mu_g G_t^{1-\sigma_g}}{1-\sigma_g}\right]$$

[9] McKay and Reis (2016)
[10] Riera-Crichton et al. (2016)
[11] Farhi et al., 2014 argue that they can have devaluations of the manner discussed via exchange rate changes even in a monetary union iff the fiscal policies act in a manner to tilt the price ratios. This is partly the idea with which I started thinking about fiscal imbalances in currency union. The mechanism by which I thought the devaluations to take place was by export subsidies, and they also discuss in part these measures.
[12] Other authors who have worked on the intersection of these two types of policies are - Uhlig (2010), Stahler and Thomas (2012)
[13] "An important feature influencing the effects of fiscal policy in our model is the inclusion of ''rule of thumb'' households who consume all of their after-tax income as in Erceg et al. (2006); ample micro- and macro-evidence suggests that such non-Ricardian consumption behavior is a key transmission channel for fiscal policy." Erceg and Linde, 2013. We do not invoke rule of thumb consumers for examining transmission.
[14] See - Corsetti et al. (2010), Corsetti and Pesenti (2005), Cwik et al. (2011)
[15] The usual small country models are of limited use in pursuing international transmission of policies. Obstfeld & Rogoff (1995).

The restrictions on the elasticity of substitution parameters are standard[16]. In addition there are two types of shocks embedded within the utility function: (a) ν_{ct} is a taste and preference shock and (b) ν_{nt} is a labor supply shock. Note that both of these shocks are common to the households in the domestic economy. To complete the preference characterization, we would need the following dis-aggregation for the index of consumption and subsequent consumer price index.

$$X_{it} = C_{it} - hC_{t-1}$$

$$X_{it} = \left[(1-\omega)^{\frac{1}{\epsilon_l}} C_{Dit}^{\frac{\epsilon_l - 1}{\epsilon_l}} + \omega^{\frac{1}{\epsilon_l}} C_{Mit}^{\frac{\epsilon_l - 1}{\epsilon_l}}\right]^{\frac{\epsilon_l}{\epsilon_l - 1}}$$

$$P_t = \left[(1-\omega)\left(P_{Dt}(1+\tau_{Dt})\right)^{1-\epsilon_l} + \omega\left(P_{Mt}(1+\tau_{Mt})\right)^{1-\epsilon_l}\right]^{\frac{1}{1-\epsilon_l}}$$

$$C_{Dit} = (1-\omega)\left[\frac{P_{Dt}(1+\tau_{Dt})}{P_t}\right]^{-\epsilon_l} X_{it}$$

$$C_{Mit} = \omega\left[\frac{P_{Mt}(1+\tau_{Mt})}{P_t}\right]^{-\epsilon_l} X_{it}$$

The above expressions complete the preference characterization for our representative household. There are two key parameters that determine the allocation of consumption between domestic and foreign final goods firms and in turn determine the aggregate consumption behavior of the domestic economy. This can be seen by looking at the aggregate domestic consumption for the home economy as follows.

$$C_{Dt} = \frac{(1-\omega)X_t}{(1+\tau_{Dt})^{\epsilon_l}}\left[(1-\omega)(1+\tau_{Dt})^{1-\epsilon_l} + \omega(1+\tau_{Mt})^{1-\epsilon_l}\tau_t^{1-\epsilon_l}\right]^{\frac{\epsilon_l}{1-\epsilon_l}}$$

$$C_{Mt} = \frac{(\omega)X_t}{(1+\tau_{Mt})^{\epsilon_l}}\left[(1-\omega)(1+\tau_{Dt})^{1-\epsilon_l} + \omega(1+\tau_{Mt})^{1-\epsilon_l}\tau_t^{1-\epsilon_l}\right]^{\frac{\epsilon_l}{1-\epsilon_l}}$$

Domestic consumption from the model: Notice that the domestic consumption in a symmetric equilibrium implies only ω, ϵ_l determine the proportion of domestic and foreign consumption. We will explore the sensitivity of the solution to these parameters in later sections. In addition to the parameters, the proportion of domestic and to imported consumption also depends upon the terms of trade as represented by τ_t and the difference between domestic and imported taxes levied by the government. It is important to not that the distortionary taxes will directly affect the proportion of domestic to foreign consumption and could act as if there was a currency devaluation in a currency union (Farhi et al., 2014.).

In addition to the optimal aggregate consumption, the household exercise also provides with the following optimality conditions:

$$\nu_{\beta t}\lambda_{1t}^R = \beta\nu_{\beta t+1}(1+i_t^{cu})\lambda_{1t+1}^R(1+\pi_t)^{-1}$$

[16] For example $\sigma_c > 0$ which is intra-temporal elasticity of substitution of habit-adjusted consumption across the two varieties.

where $\lambda_{1t}^R = (X_t - \mu_c \nu_{ct})^{-\sigma_c}$. This expression connects the current consumption to future consumptions adjusted for inflation and interest rates. The following equations are consumption-leisure first order conditions at country level, international risk sharing, investment with adjustment cost and future capital first order conditions respectively.

$$\mu_n N_t \nu_{nt} = \lambda_{1t}^R w_t{}^{17}(1 - \tau_{nt})$$
$$\lambda_{1t}^R(1 + \pi_t) = \lambda_{1t}^{*R}(1 + \pi_t^*)$$
$$\lambda_{1t}^R = \left\{\lambda_{2t}\left[1 - \nu_{it}\left(1 - \frac{\kappa}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)\right)^2 + \frac{\nu_{it} I_t}{I_{t-1}}\kappa\left(\frac{I_t}{I_{t-1}} - 1\right)\right] + \left[\beta E_t \nu_{\beta t+1}\lambda_{2t+1}\kappa\left(\frac{I_{t+1}}{I_t} - 1\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right]\right\}$$
$$\lambda_{2t} = \beta E_t\left(\frac{\nu_{\beta t+1}}{\nu_{\beta t}}\right)[R_{t+1}^R \lambda_{1t+1}^R(1 - \tau_{kt+1}) + \lambda_{2t+1}(1 - \delta)]$$

These first order conditions are obtained after forcing market clearing and balanced budgets for government with specified exogenous processes.

Firms Behavior

We have two types of firms in the model economy - (a) Intermediate Firms and (b) Final Firms. The 'intermediate firms', 'unimaginatively' so named, produce intermediate goods which are neither tradable nor directly consumable. So they are internal to the home country. On the other hand, the 'final' firms produce final consumable and tradables and interact with consumers both home and abroad. The advantage of doing so is two fold - (a) we can break the factor market dynamics and isolate it in the intermediate goods firm and (b) we can focus on trade in goods from a perfectly competitive perspective yet having price stickiness in the model. We proceed by looking at the final firms' profit maximization problem.

Final Goods Firms Problem

Consider the representative k^{th} firm's problem, where for the home country $k \in [0, n)$. Consumers both domestic and abroad consume this commodity[18]. The production function is a CES aggregator of a continuum of intermediate goods firms $j \in [0, 1]$ and the elasticity of substitution between these firms represented by $\epsilon_j > 1$[19]. The production function of the k^{th} firm is as follows:

$$Y_{kt} = \left(\int_{j=0}^{1} Y_{jt}^{\frac{\epsilon_j - 1}{\epsilon_j}} dj\right)^{\frac{\epsilon_j}{\epsilon_j - 1}}$$

[17] Real wages $w_t = \frac{W_t}{P_t}$

[18] Thus this commodity acts as a final consumption good as well as a good which can be traded across countries. The structure is isomorphic in foreign countries. We can think of this as comprehensive weighted commodity bundle which is being accounted for in our GDP.

[19] Thus this commodity acts as a final consumption good as well as a good which can be traded across countries. The structure is isomorphic in foreign countries. We can think of this as comprehensive weighted commodity bundle which is being accounted for in our GDP.

This is a standard final good problem[20]. From the final goods problem, we can obtain the following expressions for economy wide variables. We get an expression for domestic inflation, consumer price inflation as well as their linkage with terms of trade. Note that the key parameters of the model show up once again along with an additional parameter, namely the Calvo price parameter ξ. This takes us the the optimal actions by these monopolistic intermediate firms.

$$(1+\pi_{Dt})^{1-\epsilon_j} = \left[\xi(1+\pi_D)^{1-\epsilon_j} + (1-\xi)\left(1+\pi_{Dt}^{opt}\right)^{1-\epsilon_j}\right]$$

$$\tau_t = \frac{1+\pi_{Dt}^*}{(1+\pi_{Dt})}\tau_{t-1}$$

$$(1+\pi_t)^{1-\epsilon_l} = \left[\frac{(1-\omega)(1+\tau_{Dt})^{1-\epsilon_l} + \omega(1+\tau_{Mt})^{1-\epsilon_l}\tau_t^{1-\epsilon_l}}{(1-\omega)(1+\tau_{Dt-1})^{1-\epsilon_l} + \omega(1+\tau_{Mt-1})^{1-\epsilon_l}\tau_{t-1}^{1-\epsilon_l}}\right](1+\pi_{Dt})^{1-\epsilon_l}$$

Intermediate Goods Firms' Problem

The $j \in [0,1]$ representative intermediate firms interact in factor markets which are perfectly competitive. They hire labor supplied by households and borrow capital from households. In return, they provide competitive wages and rent for labor and capital respectively. Given the level of productivity[21], they produce the 'non-tradable' intermediate goods using the familiar Cobb-Douglas production function. Further, we assume constant returns to scale in production.

Given the simplified exposition of our intermediate firm production the basic idea of this sector is to generate price persistence and act in the factor markets. Their price setting problem implies the following difference equation for evolution of price dispersion in the domestic economy.

$$P_{\sigma t} = (1-\tau_{YDt})^{\epsilon_j}\left\{(1-\xi)\left[\frac{1+\pi_{Dt}^{opt}}{1+\pi_{Dt}}\right]^{-\epsilon_j} + \xi\left[\frac{1+\pi_{Dt}}{1+\pi_D}\right]^{\epsilon_j} P_{\sigma t-1}\right\}$$

In addition, the standard Calvo problem given our production structure leads to the following marginal cost expression in our medium sized DSGE model:

$$mc_{1t}^R = \frac{1}{\nu_{pt}}\left(\frac{N_t}{K_t}\right)^{\alpha}\left(\frac{w_t}{1-\alpha}\right)$$

In addition, we can also show that the inflation of Calvo lucky firms is connected with the domestic inflation as follows:

$$\left(1+\pi_{Dt}^{opt}\right) = \frac{\epsilon_j}{\epsilon_j - 1}\frac{f_t}{g_t}\,(1+\pi_{Dt})$$

$$f_t = \frac{F_t}{P_{Dt}^{\epsilon_j}} = \nu_{\beta t}\lambda_{1t}^R(1-\tau_{YDt})^{\epsilon_j} mc_{1t}^R Y_{Dt} + E_t\xi\beta\left(\frac{1+\pi_{Dt+1}}{1+\pi_D}\right)^{\epsilon_j} f_{t+1}$$

$$g_t = \frac{G_t}{P_{Dt}^{1-\epsilon_j}} = \nu_{\beta t}\lambda_{1t}^R(1-\tau_{YDt})^{\epsilon_j} Y_{Dt} + E_t\xi\beta\left(\frac{1+\pi_{Dt+1}}{1+\pi_D}\right)^{\epsilon_j - 1} g_{t+1}$$

[20] Details are provided in the appendix.

[21] All the j intermediate firms have identical productivity level. The productivity for all these firms vary over time in exactly the same manner.

Policy Setting in the Model

Note that the solution functions arrived at in the previous sections are obtain on the basis of market clearing imposed on labor, capital, government bonds and internationally traded state contingent securities in the model. The baseline of the model imposes the condition that government consumption of imported goods is zero, such that the results are not sensitive to the proportion of government spending in the model. The government budget is of the nature that lumpsum taxes provide for the budget balance and we do not include the debt dynamics of the domestic and foreign governments.

We model the fiscal policy by assuming that lump sum taxes adjust in order to balance the flow budget constraint of the government[22].

$$P_t G_t + (1 + i_t^{cu}) B_{Gt} = \tau_{Dt} P_{Dt} C_{Dt} + \tau_{Mt} P_{Mt} C_{Mt} + \tau_{kt} R_t K_t + \tau_{Nt} W_t N_t + B_{Gt+1} + \tau_{yt} + \tau_{YDt} P_{Dt} Y_{Dt}$$

Thus the government spends on consumption of both domestic and foreign goods, and buys back bonds and gives interest. To finance this spending, the government levies taxes on domestic consumption τ_{Dt}, foreign consumption τ_{Mt}, rental income τ_{kt}, wages on the consumerτ_{Nt}. The government also finances its expenditure by floating one period government bonds[23]. In addition, government levies an output tax τ_{YDt} (specific tax) on the final goods firms and a lump sum tax τ_{yt} on the consumers. The government spending follows optimal allocation problem as in the case of households, within domestic and foreign goods[24].

We model monetary policy as in Christiano et.al. (2011) accounting for the possibility that the nominal interest for the currency union as a whole respond to output gap and inflation deviations from steady state[25].

$$i_t^{cu} = \max\left\{0, \phi_{y_{gap}}(1-\rho_i) y_{gap,t}^{cu} + \phi_\pi (1-\rho_i)\pi_t^{cu} + \rho_i i_{t-1}^{cu} + \nu_{mt}\right\}$$

Closing the Model

A goods market equilibrium implies the following population adjusted equality[26] where the variables appear in per capita terms.

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[22] *Limitations in Fiscal policy*: (a) We do not model the fiscal policy in which government solves a Ramsey problem, by choosing optimal level of taxation to maximize social welfare (Ljungqvist and Sargent, 2000). The gains in doing so might be clearer in a welfare comparison. (b) We also do not allow richer debt dynamics since we assume that in equilibrium debt holding by the households is zero. Hence any expenditure increases or income decreases are purely financed by a lump sum tax.

[23] We will not consider the impact of bonds, and in equilibrium bond holdings will be zero.

[24] Details of expenditure and tax processes are provided in the appendix.

[25] Essentially we are modelling the nominal interest rate (main refinance options, fixed rate tender) which is the Euro equivalent of Federal Funds Rate. "The **deposit facility** rate is one of the three interest rates the ECB sets every six weeks as part of its monetary policy. *The rate defines the interest banks receive for depositing money with the central bank overnight*. Since June 2014, this rate has been negative. There are two other key interest rates: the rate for our **main refinancing operations (MROs)** and the **rate on the marginal lending facility**. The MRO rate defines the cost at *which banks can borrow from the central bank for a period of one week*. If banks need money overnight, they can borrow from the marginal lending facility at a higher rate." (ECB website)

[26] Equilibrium in money market, internationally traded securities and government bonds: *Assumption (1)*: We can assume that in equilibrium, there are no government bonds, internationally traded securities or money holdings ($M_t = 0, B_{Gt} = 0, B_t = 0$). *Assumption (2)*: We can also allow for the case that at the aggregate these markets clear, implying that $M_t = M_{t-1}; B_{Gt}(1 + i_t^{cu}) = B_{GT+1}; B_t = Q_{t+1} B_{t+1}$. This implies that on an aggregate, for the home economy, the money demand equals the money supply, even

$$Y_{Dt} = C_{Dt} + I_t + G_{Dt} + \frac{1-n}{n}(C^*_{Mt} + G^*_{Mt})$$

Substituting optimal consumption for both private and government gives us the aggregate demand[27] for the home country. A similar expression is available for the foreign country. If we assume that the trade is balanced for both private and government agents, then we can write the following equalities $\omega n = \omega^*(1-n)$ and $\omega_g n = \omega^*_g(1-n)$[28].

$$Y_{Dt} = \left(\frac{P_{Dt}}{P_t}\right)^{-\epsilon_l}\left[(1-\omega)\,(1+\tau_{Dt})^{-\epsilon_l}X_t + \frac{1-n}{n}\,\omega^*(1+\tau^*_{Mt})^{-\epsilon_l}\left(\frac{P_t}{P^*_t}\right)^{-\epsilon_l}X^*_t\right]$$
$$+\left(\frac{P_{Dt}}{P_t}\right)^{-\epsilon_g}\left[\left(1-\omega_g\right)(1+\tau_{Dt})^{-\epsilon_g}G_t + \frac{1-n}{n}\,\omega^*_g(1+\tau^*_{Mt})^{-\epsilon_g}\left(\frac{P_t}{P^*_t}\right)^{-\epsilon_g}G^*_t\right] + I_t$$

The following variables then define the equilibrium of the two country model in our case. As is usually obtained in a limiting case, we cannot directly obtain an expression for the New-Keynesian IS and the expectations augmented Phillips curve. Implicit expressions for the currency union will allow us to arrive at an expression for total output of the currency union and population weighted inflation in our case. We are also keeping the taxes separate so that a systemized reduction is not automatic in our case.

We follow a symmetric equilibrium for the two countries with difference in fiscal policies, degree of openness and population proportions[29].

$$\left\{\begin{array}{c}\lambda^R_{1t};\ \lambda_{2t};mc^R_{1t};\ \pi_t;\pi_{Dt};\ \pi^{opt}_{Dt};P_{\sigma t};f_t;g_t;\ X_t;C_t;N_t;w_t;\ I_t;R^R_t;K_t;\ Y_{Dt};C_{Dt};C_{Mt};\\ G_t;G_{Mt};\ G_{Dt};\ \tau_{kt};\ \tau_{Dt};\ \tau_{Mt};\ \tau_{nt};\tau_{YDt};\\ \nu_{mt};\ \nu_{\beta t};\ \nu_{nt};\ \nu_{ct};\ \nu_{it};\ \nu_{pt}\end{array}\right\}$$

We solve for the equilibrium by perturbation around the steady state. Our solution strategy follows Sims, E. and Wolff, J. (2016) and Christiano et al. (2005) adopted for the two country open economy. We differ from Blanchard et al. (2016) by including distortionary fiscal policies which allow us to exploit two different channels of fiscal policy transmission by focusing on two types of fiscal policies. We add the terms of trade channel and analyses the direction and magnitude of trade. We solve for the differences between the domestic and the foreign economies according to the following calibrations.

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though some households might be holding more than others in adjacent periods. Similar analogies for the other two assets. The second assumption is less restrictive than the first and hence we shall adopt that to begin with.

[27] Investment is assumed to be carried on using domestic goods, even though Erceg and Linde (2013) have also discussed a case otherwise.

[28] Blanchard et. al. (2016) assume this in order to simplify the exposition. In their baseline, the government doesn't import any consumption goods, in which case, $\omega_g = 0$. This can also be seen as a limiting case, but we do not invoke any arguments on the basis of government expenditure directly affecting demand for foreign goods. Further, there is no way to reduce the expression to arrive at the accounting identity $Y = C + I + G$ since there is no relationship between government spending between the two countries and they are modeled as exogenous. In the case of an optimizing Ramsey problem, that might not be the case.

[29] We can always allow for different shock processes in order to identify the origin of country specific shocks, but our focus is to arrive at differences in trade emanating from differences in fiscal policy. Empirically this would amount to specifying shock processes which are independent of the past as well as cross equation restrictions which help isolate the effect of fiscal policy.

Theoretical Moments and Baseline Calibration

We calibrate the model for quarterly data from Eurostat for Germany and France as the core economies and Italy and Spain as the peripheral economies. We assume symmetric calibration except for the degree of openness. We do not invoke the results on government spending on imported goods. The results get stronger upon invoking these aspects of the issue. The following calibration is in line with the literature starting from Smets and Wouters (2003) estimation. \\

Parameters	μ_c	κ	g_y	n	ω_c	ϵ_g	ϵ_c	β	h	α
Calibration	0.001	0.005	0.230	0.33	0.3	1.1	1.1	0.99	0.8	0.33

The remaining parameters are composite and are arrived at according to the equilibrium relations stated in the appendix.

Government Spending and Trade Flows: The Interest Rate Channel

The impact of a government spending on the core is via an inflationary channel. It operates via a shift in core aggregate demand and hence a currency union aggregate demand. This raises output over and above the steady state which calls for a rise in interest rate. This is the interest rate channel as was discussed above. The fact that a government spending causes inflation and hence in normal times crowds out consumption leads to inflationary pressures. As a reaction to the rising demand, the central bank acts upon the deviation form steady state. It is to be noted that the magnitude of spending has to be sizable in order for the central bank to react to such deviations. This feature is a currency union aspect of the issue and hence the population weights associated with the component output becomes important.

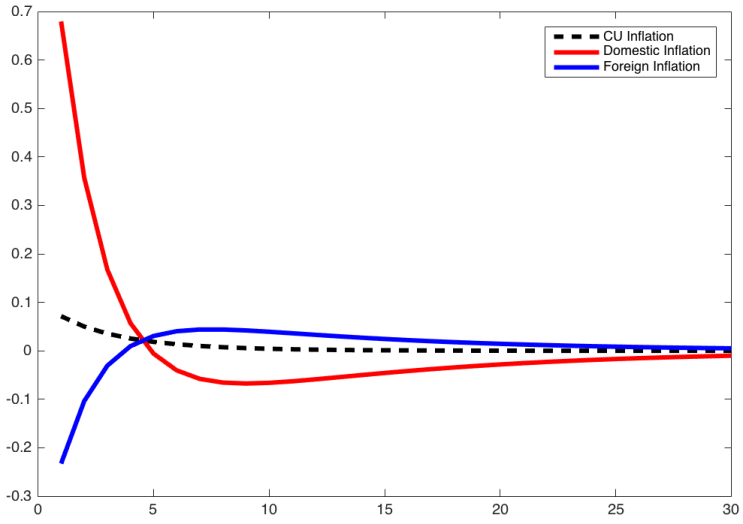

Figure 1:Inflation: Baseline

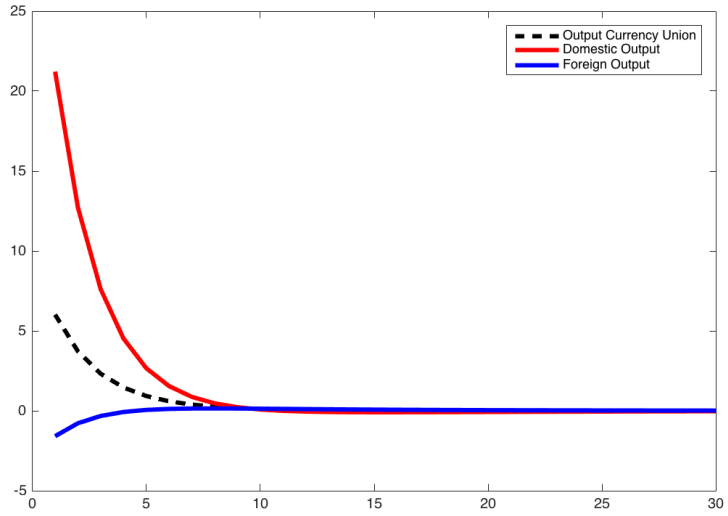

Figure 2: Output Baseline

The fact that the spending increase leads to inflation which causes a gradual worsening of relative prices, and hence leads to a revival of output in the periphery. This is the imports by the core from the periphery. Implicitly, the price inflationary pressures cause the foreign goods to be cheaper. And hence after five quarters there is a visible revival on the periphery. The important issue which we are highlighting is two fold (a) the immediate consequence of government spending increase is an interest rate increase. This is different from the case of taxation, where a reduction of taxation directly impacts terms of trade. In the case of government spending, terms of trade impact is only eventual. (b) The second issue is the degree of openness of core also drives the magnitude of exports from the periphery to the core. We will come back to this later[30].

Tax Reduction and Trade Flows: The Terms of Trade Channel

On the contrary, when examining the impact of a negative tax shock[31] on domestic economy, we have argued about the relative dominance of the terms of trade channel. The idea is that a reduction in distortionary tax implies a direct reduction in domestic prices as compared to foreign good prices. This causes a pivot of the aggregate demand curve in the home country. Part of this price change implies a substitution effect on the part of domestic consumers along with second round income effects. However, the terms of trade change also implies that for foreign consumers, imported goods are cheaper as compared to domestically produced goods. An import implies that domestic output reduces below steady state.

[30] We have not been able to incorporate direction of trade simulations from the model due to paucity of time, but intend to revise it in the next iteration.

[31] a reduction in sales tax in the core.

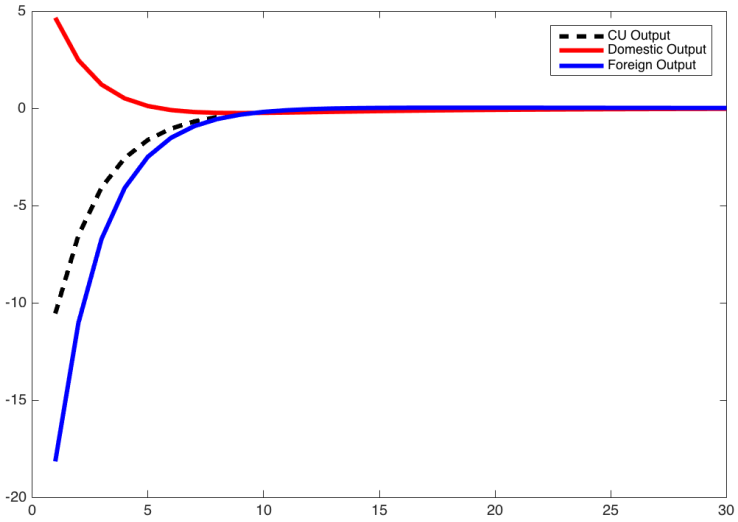

Figure 3: Output Gap: Baseline

The magnitudes of these changes are not computed exactly however the direction implies the dominance of terms of trade creating the dominant effect. It is certainly the case that both the channels work with both these policies, but our preliminary analysis points to the fact that a distortionary tax of the form discussed by us hinges upon more of the terms of trade channels. The subsequent export from the core to the periphery also has an interesting policy parallel. This is indicative of a Beggar-Thy-Neighbor, and in our case, this is a direct result of the fiscal policy.

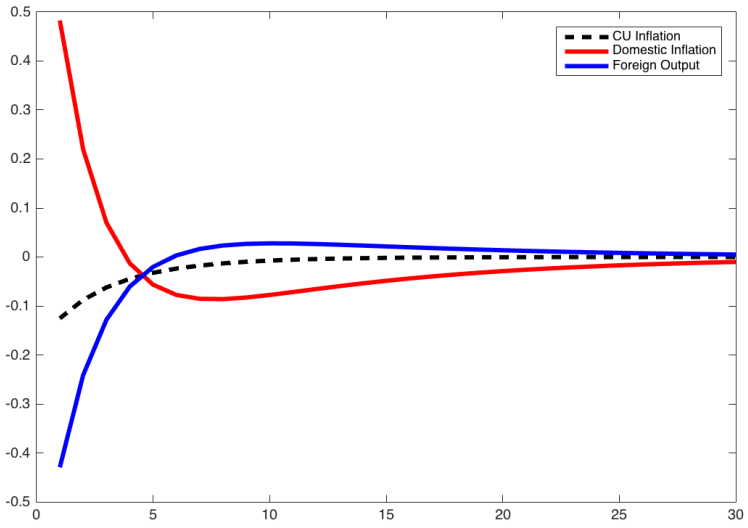

Figure 4: Inflation Baseline

Conclusion

In conclusion, (a) there are at least two channels of transmission of fiscal policy in currency union. (b) depending upon the instrument of fiscal activity, the magnitudes of the channels vary and (c) hence with it varies the directions of trade. It is obvious that there is a welfare implication which has to be worked out in all detail. It is also important that the limitations of the present work must be mentioned out rightly. (i) We would like to dissect the total magnitudes to explicitly bring out the directions of trade. (ii) We would like to estimate the complete model before

completely analyzing the magnitudes. (iii) We would like to also work with a second order perturbation in order to adequately capture the welfare aspects, which have to be extended soon enough. (iv) We do not deal with government debt and government bonds in equilibrium are zero in our baseline simulation.

Keeping in mind the direction of work, it is at best safe to say that the nature of fiscal policy and the direction of trade are interesting facets, and this paper is an ongoing attempt to explore the transmission channels further.

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Analytical Points

- Tax shocks might be slightly *back loaded* in forcing trade flows whereas government spending might be more *front loaded*
- *Trade creation versus trade diversion* on account of fiscal tinkering with the terms of trade
- Fiscal devolution type impact of taxes which causes 'beggar thy neighbor'. So bringing in that literature to bear on the issue of trade.