Moving to Monetary Union: A Welfare Analysis of Fiscal Policy

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ABSTRACT

This paper compares the welfare effects of fiscal policy under a flexible exchange rate regime and a monetary union in line with the new open economy macroeconomics (NOEM) approach. We show that households in the country where the fiscal expansion takes place are better off under a flexible exchange rate regime than under a monetary union as long as some producers pursue pricing-to-market. In contrast, households in the foreign country derive higher welfare gains under a monetary union. The intuition for this result lies in the combined expenditure switching and terms of trade effects, which favor the domestic country under a flexible exchange rate regime, but are absent in a monetary union. A sensitivity analysis reveals that a higher consumption elasticity of money demand increases the welfare differential between the two exchange rate regimes for both countries.

Keywords: Fiscal Policy, Flexible Exchange Rates, Monetary Union, Pricing-to-Market, Prosper-thy-Neighbor

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1 Introduction

One of the long lasting topics in international macroeconomics is the effectiveness of stabilization policies under alternative exchange rate regimes. Due to the establishment of the European Monetary Union fiscal policy as one of the remaining macroeconomic stabilizers is at the center of the European policy debate. In the traditional Mundell-Fleming framework expansive fiscal policy is more effective under fixed exchange rates because the stimulation of production is not counteracted by an appreciation of the exchange rate. However, recent models of the New Open Economy Macroeconomics (NOEM) approach, that provide microfoundations for money demand, imply in general a depreciation of the exchange rate with the associated positive expenditure switching effects on domestic production.

Using a two-country general equilibrium model in line with the NOEM approach we show that expansive fiscal policy is more effective in terms of output stimulation under flexible exchange rates than in a monetary union. However, an explicit welfare analysis reveals that households are indifferent to the monetary regime when the law of one price holds for all goods and expenditure switching is at its maximum. Contrary to conventional wisdom, the flexible exchange rate regime is most beneficial to consumers in a world of complete pricing-to-market behavior, where the output stimulating effect of fiscal policy is as high as in a monetary union.

Though fiscal policy has been studied in the realm of New Open Economy Macroeconomics, most of the contributions investigate the transmission mechanisms and welfare effects of fiscal policy either under flexible exchange rates or in a fixed exchange rate regime. Up to our knowledge, explicit analytical comparisons of alternative exchange rate regimes have not been provided. In a numerical analysis, Carré and Collard (2003) compare the flexible exchange rate case with a monetary union. While their model gives some guidance on fiscal policy issues and the role of the monetary regime, the major results of their calibration exercise are quite sensitive to the assumed specification of money demand. When money is introduced via a cash-in-advance (CIA) constraint, in which households need cash to purchase consumption and to pay taxes, asymmetric fiscal expansions lead to an appreciation of the exchange rate. Pitterle and Steffen (2004a) and (2004b) derive explicit closed form solutions in a CIA model, thereby highlighting the welfare driving forces of this approach under flexible exchange rates and a monetary union, respectively.

In contrast, asymmetric fiscal expansions generally lead to depreciations of the exchange rate in NOEM models that rely on standard money-in-the-utility concepts. In an innovative study of pricing-to-market behavior under flexible exchange rates Betts and Devereux (2000) identify the positive results of fiscal policy in a two-country general equilibrium model, but do not provide a thorough analysis of the welfare effects of asymmetric fiscal expansions. Corsetti and Pesenti (2001) point to the potential beggar-thy-neighbor property of fiscal expansions under flexible exchange rates. Yet, this result hinges crucially on the assumption that domestic fiscal spending falls exclusively on domestically produced goods. The welfare effects of fiscal policy under fixed exchange rate regimes are in turn investigated by Caselli (2001). As her analysis concentrates on the different welfare implications of symmetric and asymmetric
intervention schemes it does not include a comparison of the results with those obtained under a flexible exchange rate regime.

Building on the framework proposed by Betts and Devereux (2000) we use a NOEM model with money-in-the-utility to analyze the transmission mechanisms and welfare effects of asymmetric fiscal policy under both flexible exchange rates and a monetary union regime. A thorough welfare evaluation under the two regimes allows us to highlight the important role of pricing-to-market for the international distribution of welfare gains that are associated with asymmetric fiscal expansions. It turns out that the monetary regime is irrelevant for the distribution of the welfare gains when pricing-to-market behavior is completely absent. As long as some goods are priced to market, households in the country where expansion originates are always better off under a flexible exchange rate regime than in a monetary union, while the opposite is true for households in the foreign country. The economic mechanism behind these results can be found in a combination of expenditure switching and terms-of-trade effects that are associated with the exchange rate depreciation in the flexible exchange rate regime. Though the positive welfare effect on domestic households from expenditure switching is maximal when the law of one price holds for all goods, they do not benefit from the exchange rate depreciation in this case as the adverse evolution of the terms-of-trade reduces purchasing power significantly. In contrast, a high degree of pricing-to-market implies a positive terms of trade effect for domestic households, which increases the households' welfare together with the lower, but still positive expenditure switching effect. Moving to a monetary union is then detrimental to domestic households as both welfare enhancing effects are absent. Finally, a sensitivity analysis reveals that our results are qualitatively robust to variations of the consumption elasticity of money demand. However, lower values of the consumption elasticity yield smaller welfare differentials of the two monetary regimes.

The paper is organized as follows. Section 2 gives a description of the model under flexible exchange rates while section 3 investigates the monetary union case. Section 4 explores the welfare differentials of the alternative monetary regimes and section 5 concludes.

2 Fiscal Policy under Flexible Exchange Rates

The model setup follows by and large Betts and Devereux (2000) but for a different specification of the utility function. Specifically, labor enters the utility function in a quadratic form, while Betts and Devereux opt for introducing leisure in a logarithmic form. In contrast to Betts and Devereux we assume that households derive utility from government expenditures. Furthermore, we extend the model by carrying out an explicit welfare analysis of fiscal expansions. Finally, the effects of different consumption elasticities of money demand are investigated.

2.1 The Model

We consider a world that consists of two open economies we refer to as home (h) and foreign (f). All foreign variables will be denoted with an asterisk. The countries are populated by
n and 1 − n households, respectively. On the production side, there are n and 1 − n firms that produce a single differentiated good. Home and foreign households interact on the bond market whereas firms trade their goods on the common goods markets. Specifically, we follow Betts and Devereux (2000) and allow for different pricing regimes. A fraction s of firms is able to segment the markets in the two countries, as consumers cannot trade their goods and arbitrage away price differences. Thus, the law of one price need not hold for this kind of goods. We assume that these “pricing-to-market” (PTM) firms set prices in the currency of the consumer. The remaining (1 − s) goods can be traded by consumers so that any price differences in the two countries are precluded. For these goods the law of one price will always hold. As the prices of these goods are set in the currency of the producer, we refer to them as PCP (Producer Currency Pricing) goods.

2.1.1 Households

The description of the model will be carried out in detail for the home country. Most of the equations for the foreign country are completely analogous. We assume that all infinitely long lived households throughout the world have identical preferences. The representative domestic household maximizes his discounted utility given by

$$U = \sum_{t=0}^{\infty} \beta^t \left[ \log c_t + \frac{\gamma}{1-\epsilon} \left( \frac{m_t}{p_t} \right)^{1-\epsilon} + V(g_t) - \frac{\kappa}{2} h^2_t \right],$$

where $\beta \in [0, 1]$ denotes the discount factor. Thus, households derive utility from four different sources. They hold real money balances $m_t/p_t$, which allow them to reduce transaction costs. We integrate these real money balances into the utility function in a general isoelastic form, where the parameter $\epsilon$ determines both the interest elasticity of money demand and the consumption elasticity of money demand. Specifically, the interest elasticity of money demand is given by $-\beta/\epsilon$, while the consumption elasticity of money demand is $1/\epsilon$. For $\epsilon \to 1$ one obtains the special case of a logarithmic formulation. In contrast to the literature we do not assume that government expenditures $g_t$ are purely dissipative. Instead, they affect private utility in an additively separable way via the function $V(g_t)$, where $V$ is assumed to be a twice differentiable convex function, which monotonously increases in $g_t$. Households also gain utility from leisure $1-h_t$. We suppose that the marginal disutility from work increases in $h_t$. Finally, $c_t$ represents a real consumption index, which integrates over a basket of goods produced in the domestic economy - denoted with $h$ - and a basket of goods produced in the foreign economy that are denoted with $f$. Both consumption baskets consist of a fraction $s$ of goods, which are priced to market - denoted with $m$ - and a fraction $(1-s)$ of goods - denoted with $a$ - for which the

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1In many NOEM models real money balances enter the utility function logarithmically. While this assumption simplifies the analysis substantially, it has strong implications for the short run equilibrium and the welfare analysis.

2For an analysis of fiscal policy when private and public consumption are not separable, see Ganelli (2003).
law of one price always holds:

\[ c_t = \left[ \int_0^{s_n} c_t^m(h)^{\theta - 1} dh + \int_0^{n} c_t^a(h)^{\theta - 1} dh \right]^\frac{1}{\theta - 1} \]

The parameter \( \theta > 1 \) denotes the elasticity of substitution between the differentiated goods, with higher values of \( \theta \) implying a better substitutability of the goods.\(^3\) The price index \( p_t \) which corresponds to (2) is obtained by minimizing the household’s nominal expenditure that buys exactly one unit of the consumption index.\(^4\) In deriving the price index one has to account again for the different types of price setting behavior by the domestic and foreign firms. Let \( p_t^m(.) \) be the price of an individual PTM good, while \( p_t^a(.) \) denotes the price of a PCP good. Then, the home country price index is given by

\[ p_t = \left( \int_0^{s_n} p_t^m(h)^{1-\theta} dh + \int_{s_n}^{n} p_t^a(h)^{1-\theta} dh \right)^\frac{1}{1-\theta} + \int_n^{(1-n)s+n} c_t^m(f)^{1-\theta} df + \int_{(1-n)s+n}^1 c_t^a(f)^{1-\theta} df \] (3)

where prices without (with) an asterisk are denoted in home (foreign) currency and \( e_t \) represents the nominal exchange rate.\(^5\) Note from (3), that a pure exchange variation will affect the home country price index only through a change of the domestic price of PCP goods produced in the foreign country. The prices of imported PTM goods are directly set in the domestic currency and are therefore not subject to exchange rate fluctuations. The terms of trade are crucial for the evaluation of welfare in international trade models. We define the domestic terms of trade as follows:

\[ \tau_t = \frac{\Gamma_t}{\Gamma_t^* e_t} \] (4)

where \( \Gamma_t \) and \( \Gamma_t^* \) denote the respective domestic and foreign export price indexes.

Households allocate their consumption expenditures optimally between the differentiated goods. This yields the following domestic per capita demand functions for the different types of goods:

\[ c_t^a(h) = \left( \frac{p_t^a(h)}{p_t} \right)^{-\theta} c_t \]
\[ c_t^a(f) = \left( \frac{e_t p_t^a(f) e_t}{p_t} \right)^{-\theta} c_t \] (5)

\(^3\)We assume here the same cross-country and within-country substitutability of goods. Tille (2001) examines the consequences of different elasticities of substitution within countries and between them.

\(^4\)The consumption-based price index for the case of continuous goods with constant elasticity of substitution is a straightforward extension of the two-good case, which is derived by Obstfeld and Rogoff (1999), p.226ff.

\(^5\)We define the exchange rate in price notation from the perspective of the domestic country.
\[ c_t^m(h) = (\frac{p_t^m(h)}{p_t})^{-\theta} c_t \]
\[ c_t^m(f) = (\frac{p_t^m(f)}{p_t})^{-\theta} c_t \]  

(6)

We assume here, that domestic firms are exclusively owned by domestic households. In every period, households therefore receive the profits of the domestic firms \( \Pi_t \) in addition to their labor income \( w_t h_t \). They also have to pay lump-sum taxes \( p_t T_t \) every period. The budget constraint of the representative household reads

\[ p_t c_t + m_t + R_t f_{t+1} = f_t + m_{t-1} + w_t h_t + \Pi_t - p_t T_t \]  

(7)

where \( f_t \) represents holdings of a nominal one-period bond denominated in home currency and \( R_t \) denotes the bond price, which is the inverse of one plus the nominal interest rate. The nominal bond can be freely traded, leading to an equalization of nominal interest rates in terms of the domestic currency. As it is common in the literature, our timing convention differs for money holdings and bond holdings: Money denoted with \( t \) represents holdings of nominal balances in period \( t \), which will be carried over to period \( t + 1 \). Bonds denoted with \( t + 1 \) have been acquired at the beginning of period \( t \) and mature at the beginning of period \( t + 1 \).

The representative household maximizes his intertemporal utility (1) subject to the budget constraint (7), taking prices and nominal wages as given. The first-order condition with respect to \( f_{t+1} \) yields the standard Euler equation that reveals the household’s desire to smooth consumption:

\[ \beta p_t c_t = R_t p_{t+1} c_{t+1} \]  

(8)

The optimal labor supply decision is characterized by the standard labor-leisure trade off

\[ \kappa h_t = \frac{w_t}{c_t p_t} \]  

(9)

Finally, we get the money demand equation in our Sidrauski (1967) type economy by deriving the first-order condition with respect to \( m_t \)

\[ \frac{m_t^d}{p_t} = \left( \frac{\gamma c_t}{1 - R_t} \right)^{\frac{1}{2}} \]  

(10)

This is the standard optimality condition for money demand arising in money-in-the-utility models. For each household it is optimal to increase his money holdings as long as the marginal utility of consumption is below the marginal utility of real money holdings. Higher consumption levels lead ceteris paribus to an increase in the demand for real balances, as the marginal utility of consumption decreases and additional money holdings become more attractive. An increase in the nominal interest rate raises the opportunity cost of holding non-interest bearing assets and therefore lowers the demand for real balances. Equation (10) also demonstrates that the
sensitivity of the demand for real money holdings to consumption and to nominal interest rates is determined by $\epsilon$. Higher values of $\epsilon$ leave the demand for real balances more insulated from changes in consumption and nominal interest rates.

Optimal behavior of the households implies that they utilize their life-time wealth. From iterating the households budget constraint (7) and ruling out Ponzi-schemes one obtains the transversality condition:

$$\lim_{T \to \infty} \left( \prod_{s=t}^{T} R_s \right) \left( f_{T+1} + \frac{1}{R_T} m_T \right) = 0$$

(11)

### 2.1.2 Government and Central Bank

In every period, the government purchases a bundle of goods $g_t$. We define the public consumption index analogously to the real consumption indices of the households. With Ricardian equivalence holding in this setup, we can abstract from public debt issues and assume that the government’s budget is always balanced. Since we focus here exclusively on fiscal policy, we make the assumption that central banks in both countries leave their money supplies unchanged:

$$m_t^s = m_{t-1}^s = \bar{m}^s$$

(12)

Therefore, the government can not resort to seignorage revenues as a means of financing government expenditures, and the sole financing source are taxes $T_t$. We assume that these are levied on consumers in lump-sum form, such that the government budget constraint simply reads

$$g_t = T_t$$

(13)

Real government expenditures directly translate into tax payments of the consumers.

### 2.1.3 Firms

We assume here that output of PTM and PCP firms is linear in its only production factor labor, which is immobile between countries. Recall that both types of firms sell their goods on the domestic and the foreign market. Total production of each domestic PCP firm ($h \in [s \cdot n, n]$) is given by

$$y_{it}^d(h) = h_{it}^d(h)$$

(14)

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6 A violation of the transversality condition would imply that individuals could either increase life-time utility by simply consuming a portion of the unused wealth or that they would not be able to pay back accumulated debt.

7 Corsetti and Pesenti (2001) and Tille (2001) consider a complete home bias in government consumption. Under this specification, the demand stimulating effects of a fiscal expansion fall exclusively on the domestic economy, and spillover effects on the foreign country are likely to be negative.
Each PCP firm solves the following optimization problem:

\[
\max_{p_{it}(h)} \Pi^a_{it}(h) = p^a_{it}(h)y^a_{it}(h) - w_t h^a_{it}(h)
\]  

subject to

\[
y^a_{it}(h) = \left( \frac{p^a_{it}(h)}{p_t} \right)^{-\theta} n(c_t + g_t) + \left( \frac{p^a_{it}(h)}{e_t p^*_{it}} \right)^{-\theta} (1 - n)(c^*_t + g^*_t)
\]

In contrast to PCP firms, PTM firms \((h \in [0, s \cdot n])\) can discriminate between domestic and foreign markets such that prices for their goods - when expressed in the same currency - might differ in the two countries. Dividing total output of each domestic PTM firm into output sold at home, \(y^m_{it}(h)\), and output sold abroad, \(y^{ms}_{it}(h)\), gives

\[
y^m_{it}(h) + y^{ms}_{it}(h) = h^m_{it}(h)
\]

PTM firms therefore maximize profits by distinguishing explicitly between demand addressed to them by home households and demand by foreign households. For each of the locations of demand they set the profit maximizing price:

\[
\max_{p^m_{it}(h), p^{ms}_{it}(h)} \Pi^m_{it}(h) = p^m_{it}(h)y^m_{it}(h) + e_t p^{ms}_{it}(h)y^{ms}_{it}(h) - w_t h^m_{it}(h)
\]

subject to

\[
y^m_{it}(h) = \left( \frac{p^m_{it}(h)}{p_t} \right)^{-\theta} n(c_t + g_t)
\]

\[
y^{ms}_{it}(h) = \left( \frac{p^{ms}_{it}(h)}{p^*_t} \right)^{-\theta} (1 - n)(c^*_t + g^*_t)
\]

Deriving the optimal price setting rules for both types of firms shows that the optimal price is always given as a markup on nominal production costs:

\[
p^a_{it}(h) = p^m_{it}(h) = e_t p^{ms}_{it}(h) = \frac{\theta}{\theta - 1} w_t
\]

>From equation (18) we see that all domestically produced goods have the same domestic currency price, as long as producers are free to set prices. Since elasticities of demand are the same in both markets, PTM firms will not charge different prices across countries and the law of one price also holds for their goods. Furthermore, all domestic firms face the same marginal production costs, resulting in an equalization of prices for PCP and PTM goods. Thus, when prices are flexible, purchasing power parity always holds and the differentiation between PCP and PTM firms becomes irrelevant. In the light of rigid prices, however, a variation of the nominal exchange rate results in different domestic currency prices of PTM firms.
goods sold at home and abroad. Profits from the sale of PTM goods in the foreign country fluctuate endogenously in this case: A nominal exchange rate appreciation of the domestic currency increases nominal revenues in the domestic currency, while a nominal depreciation lowers nominal revenues.

Note that a better substitutability between the goods, i.e. a higher level of $\theta$ reduces the market power of producers and implies a smaller markup on nominal production costs. Hence, the degree of monopolistic distortion in the economy, which translates into a welfare loss for households, is a decreasing function of $\theta$. In other words, a higher degree of substitutability of the differentiated goods requires a lower consumer price of these goods, which, in turn, leads to a higher equilibrium level of output.

2.2 Positive Analysis of Fiscal Shocks

By now, we have established the structural equations that describe the two model economies. In this section we present the steady state of the model, and the short and long run solution in the presence of nominal rigidities and fiscal shocks. Finally, we derive the output and consumption effects of fiscal policy before proceeding to an explicit welfare analysis.

2.2.1 Steady State

We first derive the analytical solution for the zero growth steady state of the two economies in the absence of macroeconomic disturbances. To obtain a closed-form solution we focus on an initial equilibrium, where government expenditures and initial bond holdings are zero in both countries. The derivation of the steady state equilibrium is necessary as the model here is non-linear and does not yield closed form solutions for general paths of the exogenous variables. In order to analyze the effects of fiscal policy, we therefore consider a log-linear approximation around the initial steady state. At the same time, the steady state exercise yields the flexible price solution of the model. Steady state values of variables will be denoted by bars.

As we consider economies that suffer from monopolistic competition on the goods markets, there is room for shifts in aggregate demand to improve overall welfare. The assumption of zero initial bond holdings implies that output equals consumption in the initial steady state, $\bar{h} = \bar{c}$. Combining the household’s labor-leisure trade off (9) and the optimal price-setting rule (18) of firms yields:

$$\bar{h} = \bar{h}^* = \left(\frac{\theta - 1}{\theta \kappa}\right)^\frac{1}{2} = \bar{c} = \bar{c}^*$$  \hfill (19)

As can be seen from equation (19), steady state production is inefficiently low in the decentralized equilibrium. When deciding on his optimal labor supply, the individual household does not consider the additional profits that arise economy wide from a marginal increase of his labor effort. From the perspective of an individual firm, it is clear, that there is no incentive to decrease the own price, as the firm cannot capture the entire benefits from the resulting
increase in aggregate demand. A social planner, however, could coordinate the behavior of households and firms in a way that goods prices equal marginal costs of production and output reaches its first-best level. Note that the higher the elasticity of substitution between goods, the closer is the economy to the competitive equilibrium. For the later welfare based evaluation of fiscal policy it is important to keep in mind that a higher consumption level that comes at the price of less leisure is, in principal, welfare enhancing.

As purchasing power parity holds in the steady state, we can derive the steady state exchange rate by combining the money market clearing conditions in both countries:

\[ \bar{e} = \bar{m}^s \left( \bar{c}^s \right)^{\frac{1}{\epsilon}} \]  

(20)

The steady state level of the exchange rate only depends on relative money supplies and the international consumption ratio. Intuitively, higher relative money supply entails a lower relative price of the domestic currency, i.e. a weaker currency.

### 2.2.2 Long Run Equilibrium

We now consider the case where producers have to fix the price of their goods before the occurrence of shocks and may fully adjust the good price in the next period. We opt for exogenous nominal rigidities as we are interested in analytical solutions of the model, that suffice to illustrate the main implications of fiscal policy in a two country world. Under this assumption, the economies reach the new steady state in \( t + 1 \) (long run), if a shock occurs in period \( t \) (short run). Before we get into the analytical solution process, note that the two periods may be solved almost independently. The essential link between the two periods are nominal bond holdings, that have been accumulated in the short run. The following set of equations describes the structural equations in the long run. Imposing symmetry on the firms the system can be stated in per capita terms.

#### MONEY MARKETS

\[ \frac{m^s_{t+1}}{p_{t+1}} = \left( \frac{\gamma c_{t+1}}{1 - R_{t+1}} \right)^{\frac{1}{\epsilon}} \]  

(21)

\[ \frac{m^s*_{t+1}}{p^*_{t+1}} = \left( \frac{\gamma c^*_t}{1 - R^*_{t+1} \frac{e^*_{t+2}}{e_{t+1}}} \right)^{\frac{1}{\epsilon}} \]  

(22)

Equations (21) and (22) state the long run money market equilibria, where money supply has to equal money demand, \( m^s_{t+1} = m^d_{t+1} \). Remember that \( p_{t+1} \) and \( p^*_{t+1} \) denote the respective domestic and foreign consumer price indexes.

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8Models that endogenize price rigidities via explicit price adjustment costs like Hairault and Portier (1993) and Carré and Collard (2003) or use Calvo (1983) style price determination as in Kollmann (2001a, 2001b) yield better empirical fits. Though these approaches are richer in structure they hamper the finding of analytical solutions.
Current accounts

\[ p_{t+1}(c_{t+1} + g_{t+1}) + R_{t+1}f_{t+2} = p^h_{t+1}y_{t+1} + f_{t+1} \]  
(23)

\[ p^*_t(c^*_t + g^*_t) + \frac{R_{t+1}}{e_{t+1}}f^*_t = p^*_t y^*_t + \frac{f^*_t}{e_{t+1}} \]  
(24)

The current account identities are given by equations (23) and (24). The respective left hand side sums up per capita nominal expenditure for private consumption, government purchases and bonds. On the respective right hand side, per capita revenues and maturing bonds add up to total per capita income. The production levels of the representative domestic and foreign firms are given by \( y_{t+1} \) and \( y^*_t \), whereas \( p^h_{t+1} \) and \( p^*_t \) are the corresponding goods prices denoted in the respective producer’s currency.

Goods markets

\[ y_{t+1} = \left( \frac{p^h_{t+1}}{p_{t+1}} \right)^{-\theta} n(c_{t+1} + g_{t+1}) + \left( \frac{p^h_{t+1}}{p^*_t e_{t+1}} \right)^{-\theta} (1 - n)(c^*_t + g^*_t) \]  
(25)

Equations (25) and (26) describe the long run goods markets. The distinction between PTM and PCP goods becomes obsolete when prices are free to adjust, see equation (18). The production of a representative producer depends on overall domestic and foreign demand and the relative good price in the respective market.

Euler equations

\[ \beta p_{t+1} c_{t+1} = R_{t+1} p_{t+2} c_{t+2} \]  
(27)

\[ \beta p^*_t c^*_t = R_{t+1} \frac{e_{t+2}}{e_{t+1}} p^*_t c_{t+2} \]  
(28)

The Euler equations (21) and (22) stem from the optimization problem of the respective households.

Labor markets

\[ \kappa h_{t+1} = \frac{\theta - 1}{\theta} \frac{p^h_{t+1}}{p_{t+1} c_{t+1}} \]  
(29)

\[ \kappa h^*_t = \frac{\theta - 1}{\theta} \frac{p^*_t}{p^*_t c^*_t} \]  
(30)

The long run labor market conditions (29) and (30) close the model. Here, the labor leisure trade off stated in equation (9) is combined with the pricing rule of the firm, see (18), thereby eliminating the equilibrium nominal wage \( w_{t+1} \).

In order to derive analytical solutions, the non-linear model is linearized around the pre-
shock steady state discussed in section 2.2.1. Steady state deviations of a variable $x$ are denoted by $\tilde{x} = \frac{dx}{\bar{x}}$, where $\bar{x}$ represents the steady state value of $x$. It is possible to derive closed form solutions for the individual variables using the fact that any variable may be expressed as a function of the respective world aggregate and its international differential. For any domestic variable $x$, its deviation is given by $\tilde{x} = \tilde{x}^w + (1 - n)(\tilde{x} - \tilde{x}^*)$ while for its foreign counterpart $\tilde{x}^* = \tilde{x}^w - n(\tilde{x} - \tilde{x}^*)$ holds.

The difference of the log-linear long run money markets gives us the fundamental relation between the long run exchange rate and the international consumption differential:

$$\tilde{e}_{t+1} = -\frac{1}{\epsilon}(\tilde{c}_{t+1} - \tilde{c}^*_{t+1})$$

(31)

In the absence of monetary policy shocks, a negative consumption differential implies a depreciation of the long run exchange rate. As always in money-in-the-utility models, it is only the consumption level that matters for money demand, while total production or absorption is not considered. The nominal exchange rate, which can be interpreted as the relative price of domestic money, therefore only hinges on relative domestic consumption. Furthermore, interest rates do not affect the exchange rate due to real interest rate equalization in the long run. The exchange rate $\tilde{e}_{t+1}$ arises in equation (31) when replacing the difference of the domestic and foreign long run price levels that follow from the definition of the domestic price index (3), its foreign counterpart and symmetry of the producers:

$$\tilde{p}_{t+1} = n\tilde{p}^h_{t+1} + (1 - n)\tilde{p}^f_{t+1} \quad \tilde{p}^*_t = (1 - n)\tilde{p}^{f*}_{t+1} + n\tilde{p}^{h*}_{t+1}$$

(32)

Since the law of one price holds in the long run, taking differences of the price indexes yields the standard purchasing power parity condition:

$$\tilde{p}_{t+1} - \tilde{p}^*_t = \tilde{e}_{t+1}$$

(33)

Table 1 shows the log-linear differences of the long run current accounts, goods markets and labor markets where $\tilde{\tau}_{t+1} = \tilde{p}^h_{t+1} - \tilde{p}^f_{t+1}$ denotes the long run terms of trade. In the derivation we make use of the bond market clearing condition, $n \cdot f_{t+1} = -(1 - n) \cdot f^*_t$, and the steady state property of long run bond holdings implying $f_{t+1} = f_{t+2}$.

9See Aoki (1985) for a detailed discussion of the solution method.

10The log-linear terms of trade follow from equation 4. A positive $\tilde{\tau}_{t+1}$ implies an improvement of the domestic terms of trade.
The difference of the long run current accounts can be interpreted as follows. The first two components on the left-hand side describe the international differential of absorption, the bond term represents the permanent interest payments or income that stem from possible current account imbalances in the short run. On the right hand side, we see the total income differential that is comprised by the real production differential and the terms of trade. Worsening long run terms of trade reduce the purchasing power of real production while an improvement has a positive impact.

The long run goods markets differential gives some intuition for the evolution of the long run production differential. A deterioration of the terms of trade implies a rise in domestic relative production due to the associated expenditure switching: Domestic products become more attractive due to a lower relative price. Note that the degree of international substitutability $\theta$, that is attached to the terms of trade $\tilde{\tau}_{t+1}$, governs the size of demand deviations stemming from relative price changes.

Finally, the international labor market differential clarifies the link between the long run production differential, the consumption differential, and relative price changes (indicated by the terms of trade $\tilde{\tau}_{t+1}$). A positive production differential goes along with a negative consumption differential because of the labor leisure trade off of the respective households where high marginal utility of consumption is matched by high marginal utility of leisure. Again, the terms of trade correct for price differentials as the domestic (foreign) real wage, that is relevant for the domestic (foreign) households’ working effort decision, depends on the domestic (foreign) producer price and on the overall domestic (foreign) consumer price level.

The long run “real side” of the model summarized in table 1 is a system of three equations with four endogenous variables, i.e. consumption differential, output differential, bond holdings and terms-of-trade. We solve the system of equations simultaneously in order to derive semi-reduced expressions for the consumption and output differential:

$$
\tilde{c}_{t+1} - \tilde{c}^*_t = \frac{1 + \theta}{2\theta} \cdot \frac{(1 - \beta)df_{t+1}}{pe^w(1 - n)} - \frac{1 + \theta}{2\theta} \cdot \frac{dg_{t+1} - dg^*_t}{e^w}
$$

(34)
\[ \tilde{y}_{t+1} - \tilde{y}^{*}_{t+1} = -\frac{\theta}{1 + \theta}(\tilde{c}_{t+1} - \tilde{c}^{*}_{t+1}) \]  

The long run consumption differential depends on bond holdings and on the government expenditure differential. Negative bond holdings imply permanent interest rate payments and hence a negative wealth effect. In the long run flexible price equilibrium households then tend to reduce consumption and to raise effort. A positive government expenditure differential reduces the consumption differential because a greater share of the tax burden that is implied by the overall demand boost falls on domestic households. The mirroring property of the output differential is due to the long run labor leisure trade off.

Note that equation (34) provides the necessary link of the long run and short run of the model. In the sequel, we describe the short run equilibrium, where we also derive semi-reduced form equations. A closed form solution of the model results when endogenous bond holdings are eliminated from the two sets of equations.

### 2.2.3 Short Run Equilibrium

We now turn to the analysis of the short run equilibrium, in which nominal prices are preset and cannot be changed within the period. In the case of PCP goods, prices are fixed in the respective home currency of the selling firm. An unanticipated variation of the nominal exchange rate therefore alters the consumer prices of these goods in the respective foreign country. For this type of goods the law of one price holds even when prices are rigid. On the other hand, the prices of PTM goods are assumed to be fixed in the local currency of the buyer, such that an unexpected exchange rate movement does not affect consumer prices of these goods. Instead, the returns per unit of PTM firms from sales abroad fluctuate in response to exchange rate movements. A depreciation of their home currency leads to an increase in revenues, while an appreciation causes a decrease. Hence, in the event of unanticipated exchange rate variations, the law of one price does not hold for PTM goods.

Optimal price setting behavior of the firms implies that prices are fixed at a level above marginal costs of production. Therefore, it is profitable for a firm to increase production if it faces additional demand due to an unanticipated shock. Production thus becomes entirely demand determined in the short run as long as marginal revenues are not below marginal costs of production. Since the output level is solely determined on the goods markets and nominal wages adjust to meet the required labor supply, the standard labor market clearing conditions do not bind. The following set of equations characterizes the short run equilibrium in per capita terms:

**Money markets**

\[ \frac{m^s_t}{p_t} = \frac{m^d_t}{p_t} = \left( \frac{\gamma c_t}{1 - R_t} \right)^\frac{1}{\epsilon} \]  

(36)
\[
\frac{m_t^{ss}}{p_t^s} = \frac{m_t^{ds}}{p_t^s} = \left( \frac{\gamma c_t^s}{1 - R_t \frac{e_{t+1}}{e_t}} \right)^{\frac{1}{\tau}}
\] (37)

Current accounts

\[
p_t (c_t + g_t) + R_t f_{t+1} = (1 - s)p_t^q y_t^q + s(p_t^{mh} y_t^{mh} + e_t p_t^{mhs} y_t^{mhs})
\] (38)

\[
p_t^s (c_t^s + g_t^s) + \frac{R_t}{e_t} f_{t+1}^s = (1 - s)p_t^{as} y_t^{as} + s(p_t^{mf} y_t^{mf} + \frac{p_t^{mf}}{e_t} y_t^{mf})
\] (39)

Goods markets

\[
y_t^a = \left( \frac{p_t^a}{p_t} \right)^{-\theta} n(c_t + g_t) + \left( \frac{p_t^a}{e_t} p_t^* \right)^{-\theta} (1 - n)(c_t^* + g_t^*)
\] (40)

\[
y_t^{as} = \left( \frac{p_t^{as}}{e_t} p_t^* \right)^{-\theta} n(c_t + g_t) + \left( \frac{p_t^{as}}{p_t} \right)^{-\theta} (1 - n)(c_t^* + g_t^*)
\] (41)

\[
y_t^{mh} = \left( \frac{p_t^{mh}}{p_t} \right)^{-\theta} n(c_t + g_t)
\] (42)

\[
y_t^{mhs} = \left( \frac{p_t^{mhs}}{p_t^*} \right)^{-\theta} (1 - n)(c_t^* + g_t^*)
\] (43)

\[
y_t^{mf} = \left( \frac{p_t^{mf}}{p_t} \right)^{-\theta} n(c_t + g_t)
\] (44)

\[
y_t^{mfs} = \left( \frac{p_t^{mfs}}{p_t^*} \right)^{-\theta} (1 - n)(c_t^* + g_t^*)
\] (45)

Euler equations

\[
\beta p_t c_t = R_t p_{t+1} c_{t+1}
\] (46)

\[
\beta p_t^* c_t^* = R_t \frac{e_{t+1}}{e_t} p_{t+1}^* c_{t+1}^*
\] (47)

While the money market equilibrium conditions and the Euler equations resemble those of the long run system, the possibility of pricing-to-market behavior leads to a modification of the current accounts and the goods markets. As for the current accounts, we have to consider the above mentioned effect that a nominal exchange rate variation changes the unit revenues of PTM firms that stem from their sales abroad while unit returns of PCP producers are unaffected. In the case of PTM producers, we denote demand stemming from the foreign country with an asterisk while \( h \) and \( f \) point to the origin of production. For instance, \( p_t^{mh} y_t^{mh} \) represents the revenues of a domestic PTM firm stemming from sales in the foreign market denoted in the foreign currency. The goods markets relate the respective production levels of
the firms to domestic and foreign demand. We explicitly distinguish between PCP and PTM firms in both countries.

For given long run values, linearized versions of equations (36)-(47), together with the linearized short run price indexes, allow us to derive an analytical solution of the effects of fiscal policy. In the light of sticky prices, it is the response of the nominal exchange rate that governs the changes in the international competitiveness of firms and that decides upon the reaction of the terms of trade. For both aspects, the degree of pricing-to-market behavior plays a vital role. The short run nominal exchange rate thus turns out to be the major transmission channel of asymmetric fiscal policy and is crucial for the welfare evaluation which is the focus of the paper.

Linearizing the overall short run price indexes for both countries gives

\[ \tilde{p}_t = (1 - n)(1 - s)\tilde{e}_t \quad \text{and} \quad \tilde{p}_t^* = -n(1 - s)\tilde{e}_t. \] (48)

Pricing-to-market limits the pass-through of nominal exchange rate movements on price levels in times of sticky prices. In the case of full PTM, consumer prices in both countries are entirely insulated from exchange rate movements, implying that both price indexes are fixed on their pre-shock levels. Combining differences of linearized price indexes and linearized money market clearing conditions, yields

\[ (1 - s)\tilde{e}_t = \tilde{m}_t - \tilde{m}_t^* - \frac{1}{\epsilon}(\tilde{e}_t - \tilde{e}_t^*) - \frac{1}{\epsilon \tilde{r}}(\tilde{e}_t - \tilde{e}_{t+1}) \] (49)

As money supplies are assumed to be constant in both countries, \( \tilde{m}_t - \tilde{m}_t^* \) drops out of this equation. Using the long run equilibrium exchange rate (31) and the difference of the linearized versions of the short run Euler equations (46) and (47), gives the short run response of the nominal exchange rate depending only on the short run consumption differential:

\[ ((1 - s)\epsilon^2\tilde{r} + \epsilon - s)\tilde{e}_t = -(\epsilon\tilde{r} + 1)(\tilde{c}_t - \tilde{c}_t^*) \] (50)

This exchange rate equation stems from the monetary part of the model, in which a negative consumption differential acts towards a depreciation of the exchange rate. Note that a higher degree of pricing-to-market leads to a more pronounced reaction of the exchange rate. This is a direct consequence of the effect mentioned above that pricing-to-market limits the pass through of nominal exchange rate movements on price levels: To generate a certain differential between \( \tilde{p}_t \) and \( \tilde{p}_t^* \) a stronger exchange rate reaction is necessary if a higher share of the consumer goods prices is insulated from exchange rate movements.

Instead of eliminating the long run exchange rate response from equation (49) it is also possible to derive the relation between the short and long run exchange rate which determines the international nominal interest rate differential.\(^{11}\) The latter is in turn important for the economic intuition behind the international transmission of fiscal policy. Eliminating the short

---

\(^{11}\)Remember that the internationally traded nominal bond is denominated in domestic currency. Therefore, the foreign nominal interest rate has to be corrected for a possible over- or undershooting of the exchange rate.
run consumption differential yields:

$$\frac{\tilde{e}_{t}}{\epsilon_{t+1}} = \frac{\epsilon + \frac{\beta}{1 - \beta}}{\epsilon + \frac{\beta}{1 - \beta} + (1 - \epsilon)s} \geq 1$$ (51)

As a rule, expansive fiscal policy generates overshooting of the nominal exchange rate. For the special cases of \(s = 0\) and \(\epsilon = 1\) the short run exchange rate response does not differ from the long run exchange rate response.\(^{12}\)

Turning now to the real part of the model, we can derive a second short run exchange rate equation based on the current accounts and the goods market clearing equations. Take differences of the linearized versions of (38) and (39) and replace the individual output differentials via the linearized versions of (40) to (45), to arrive at

$$((1 - s)(\theta - 1) + s)\tilde{e}_{t} = \tilde{e}_{t} - \tilde{e}_{t}^{*} + \frac{\beta df_{t}}{pcw(1 - n)} + \frac{dg_{t} - dg_{t}^{*}}{cw}$$ (52)

Holding \(f_{t}\) and \(dg_{t} - dg_{t}^{*}\) constant, a negative consumption differential is here associated with an exchange rate appreciation. In the case of PCP goods, the appreciation leads to a shift of world demand towards the foreign country, that translates into higher relative income of foreigners. For PTM goods, relative consumer prices in both countries remain unchanged, but, at given production levels, the home currency earnings of home firms decline, while the foreign currency earnings of foreign firms increase. All in all, relative lower domestic consumption expenditures are matched by a fall in home households’ relative income. The same reasoning applies for debt accumulation and a negative government expenditure differential. Of course, a positive government expenditure differential acts towards a depreciation of the nominal exchange rate and the above argumentation is reversed.

Combining the two exchange rate equations 50 and (52) and eliminating the endogenous bond holdings via the long run consumption differential yields

$$\tilde{e}_{t} = \frac{\frac{dg_{t} - dg_{t}^{*}}{cw} + \frac{1}{r} \frac{dg_{t+1} - dg_{t+1}^{*}}{cw}}{(1 - s)(\theta - 1) + s + \frac{2s}{(1 + \theta)r} + \frac{(1 - s)\epsilon^{2}r + (1 - s - s)\frac{2\theta + r + \theta r}{1 + \theta}(\epsilon r + 1)}{r}}$$ (53)

As \(\epsilon \geq 1\), \(\theta > 1\), and \(0 \leq s \leq 1\), equation (53) shows that an unanticipated positive shock to domestic government spending will always lead to a nominal depreciation of the exchange rate.\(^{13}\) To provide an intuition for the depreciation, we step back to the domestic and foreign money markets (36) and (37). As the tax burden of the fiscal expansion falls exclusively on

\(^{12}\)Pricing-to-market is not a necessary condition for exchange rate overshooting. It also occurs in NOEM models that allow for a home bias in consumption, see Warnock (2003) and Pitterle and Steffen (2004b).

\(^{13}\)We show in a companion paper Pitterle and Steffen (2004b) that fiscal expansions yield an appreciation of the exchange rate when money is introduced via a cash-in-advance constraint where households need cash for consumption good purchases and taxes.
domestic households, the short consumption differential \((\tilde{e}_t - \tilde{e}_t^*)\) turns out to be negative.\(^{14}\) With money supply unchanged, the money market equilibria can be restored via changes in the respective price levels, changes in the nominal bond price, or exchange rate overshooting, \(\epsilon_{t+1}^{e_t} \). An adjustment via the nominal bond price is not possible, as a rise or reduction of the equilibrium value affects both money markets in a symmetric way. As pointed out earlier, deviations of consumer price levels in the respective markets stem exclusively from exchange rate movements. In general, a rise of the domestic price level, \(p_t\), calls for an exchange rate depreciation, as import prices of PCP goods tend to rise. On the other hand, foreign import prices will decrease thereby lowering the foreign price level. The second viable channel of adjustment is an overshooting of the exchange rate, as this phenomenon allows for a nominal interest rate differential. In a world with PTM and PCP producers, i.e. \(0 < s < 1\), money market equilibrium is restored via both channels. If all producers price to market, i.e. \(s = 1\), consumer prices are unchanged and adjustment is achieved only via exchange rate overshooting. In the absence of pricing-to-market, exchange rate overshooting is precluded, see equation (51), and equilibrium is exclusively restored via price level changes. A permanent fiscal expansion has a stronger impact on the exchange rate movement than a pure temporary shock because consumption differential is smaller in the latter case.

We now conduct a comparative statics analysis for the degree of pricing to market and for the consumption elasticity of money demand. The derivative of \(\tilde{e}_t\) with respect to \(s\) is positive as long as

\[
\theta^2 - 1 + 2(\epsilon - 1) \epsilon \theta + \tilde{r} \epsilon (\theta + 1)(\theta + \epsilon - 2) > 0
\]

For the assumed parameter space, \(\epsilon \geq 1, \theta > 1\), this condition always holds. Thus, a higher fraction of PTM producers amplifies the depreciation of the nominal exchange rate. Since consumer prices of PTM goods are not subject to exchange rate movements, the depreciation has to be greater in order to achieve an equal change in the overall price level.

The derivative of \(\tilde{e}_t\) with respect to \(\epsilon\) is negative as long as

\[
(1 + \tilde{r}((1 - s) \epsilon (2 + \tilde{r} \epsilon) + s)(\tilde{r} + \theta (2 + \tilde{r})) > 0
\]

which also holds for the assumed parameter space. A lower consumption elasticity of money demand reduces the exchange rate response. If due to the tax burden of fiscal policy domestic consumption is reduced, the required rise of the price level is relatively small for a high value of \(\epsilon\). The link between consumption and money demand is then weakened.

### 2.2.4 Consumption and Output Responses

So far, we have derived the implications of an unanticipated domestic fiscal expansion for the short run exchange rate, which provides a convenient basis for the calculation of the responses of the remaining home and foreign variables. From now on, we simplify the exposition of

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\(^{14}\)The explicit solutions for domestic and foreign consumption will be derived in section 2.2.4.
the model by setting foreign government expenditure in every period to zero, \( dg^* = 0 \). We describe the positive results of the analysis in a twofold manner. While stating the analytical solutions in a semi-reduced form, i.e. depending on the exchange rate response, we also provide a numerical simulation of the model. In the next section, these positive results are evaluated by the utility function of the households so as to provide a thorough policy analysis in welfare terms.

We first derive the responses of the short and long run world variables. It is important to stress that the pricing behavior of firms does not affect the responses of world aggregates. Short and long run average prices, that govern world real balances and the average real interest rate, do not depend on the degree of pricing to market. As a consequence, neither world consumption nor world production hinge on the assumption about the pricing behavior of the firms. Table 2 states the world effects of a domestic fiscal expansion. A temporary shock only stimulates short run world production. Except for \( \epsilon = 1 \), a permanent shock always leads to a crowding out of both short and long run private consumption thereby limiting output stimulation. By combining the responses of the different world aggregates with the respective differentials we can now determine the evolution of consumption and production in both countries. The short run responses of domestic and foreign consumption are given by

\[
\tilde{c}_t = \tilde{c}_t^w + (1 - n)(\tilde{c}_t - \tilde{c}_t^*)
= -\frac{n(\epsilon - 1)}{2 \epsilon (1 + \bar{r})} \frac{dg_{t+1}}{\bar{c}_w} - \frac{(1 - n)[(1 - s) \epsilon^2 \bar{r} + \epsilon - s]}{1 + \epsilon \bar{r}} \tilde{e}_t
\]

(54)

and

\[
\tilde{c}_t^* = \tilde{c}_t^w - n(\tilde{c}_t - \tilde{c}_t^*)
= -\frac{n(\epsilon - 1)}{2 \epsilon (1 + \bar{r})} \frac{dg_{t+1}}{\bar{c}_w} + \frac{n[(1 - s) \epsilon^2 \bar{r} + \epsilon - s]}{1 + \epsilon \bar{r}} \tilde{e}_t
\]

(55)

where \( \tilde{e}_t \) is given by (53). Intuitively, relative domestic consumption declines due to the tax burden of a domestic fiscal expansion that falls exclusively on domestic households. According to (54) and (55), we can decompose the responses of home and foreign consumption into a symmetric world effect and an asymmetric price effect stemming from the exchange rate.

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Table 2: World aggregates depending on \( \epsilon \)

<table>
<thead>
<tr>
<th></th>
<th>( \tilde{c}_t^w )</th>
<th>( \tilde{y}_t^w )</th>
<th>( \tilde{c}_{t+1}^w )</th>
<th>( \tilde{y}_{t+1}^w )</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( -\frac{n(\epsilon - 1)}{2 \epsilon (1 + \bar{r})} \frac{dg_{t+1}}{\bar{c}_w} )</td>
<td>( -\frac{n(\epsilon - 1)}{2 \epsilon (1 + \bar{r})} \frac{dg_{t+1}}{\bar{c}_w} + n \frac{dg_t}{\bar{c}_w} )</td>
<td>( -\frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} )</td>
<td>( \frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} )</td>
</tr>
</tbody>
</table>

---

where \( \tilde{e}_t \) is given by (53). Intuitively, relative domestic consumption declines due to the tax burden of a domestic fiscal expansion that falls exclusively on domestic households. According to (54) and (55), we can decompose the responses of home and foreign consumption into a symmetric world effect and an asymmetric price effect stemming from the exchange rate.
response. Without pricing-to-market, i.e. \( s = 0 \), the depreciation causes an increase of the domestic consumer price level and a fall of the foreign consumer price level. By the money market equilibrium conditions, the lower (higher) level of real balances of domestic (foreign) households implies a decrease (increase) of domestic (foreign) consumption. For complete pricing-to-market, i.e. \( s = 1 \), consumer price levels in both countries are unaffected, yet the overshooting of the exchange rate leads to a relatively lower nominal interest rate in the domestic economy. Money market equilibrium again requires a fall in relative domestic consumption. In the polar case of full pricing-to-market and a unit consumption elasticity of money demand, the money market equilibrium conditions lead to the extreme case of symmetric consumption responses following asymmetric fiscal policy.

In order to assess the overall effects on short run consumption we resort to a numerical simulation of the model. We consider a one percent permanent increase in domestic government expenditure. For simplicity, the two countries are assumed to be of the same size, i.e. \( n = 0.5 \). The remaining parameters of the model are taken from the literature, specifically we follow Sutherland (1996) in assuming an elasticity of substitution between individual goods of \( \theta = 6 \) and a discount factor \( \beta = 0.95 \), that implies an annual real rate of return of \( \bar{r} \approx 0.05 \). In our benchmark case, we set \( \epsilon = 9 \), which yields an interest elasticity of money demand of \( \frac{-\beta}{\epsilon} \approx -0.1 \). While this choice of \( \epsilon \) matches the empirical consensus on very low interest elasticities, see e.g. Mankiw and Summers (1986), the implied consumption elasticity is below the values reported in the empirical literature on money demand. We will discuss the sensitivity of the model to the choice of \( \epsilon \) in section 2.3 in more detail. In figure 8(a), see appendix A, domestic and foreign short run consumption are graphed against the degree of PTM. A domestic fiscal expansion reduces domestic consumption while foreign consumption is raised regardless of the degree of pricing-to-market.

Combining short run world production and its international differential gives the response of short run production in both countries:

\[
\tilde{y}_t = -\frac{n(\epsilon - 1)}{2\epsilon(1 + \bar{r})} \frac{dg_{t+1}}{c^{wo}} + n \frac{dg_t}{c^{wo}} + \theta(1 - s)(1 - n) \tilde{e}_t
\]

\[
\tilde{y}^*_t = -\frac{n(\epsilon - 1)}{2\epsilon(1 + \bar{r})} \frac{dg_{t+1}}{c^{wo}} + n \frac{dg_t}{c^{wo}} - \theta(1 - s) n \tilde{e}_t
\]

The evolution of short run production is depicted in figure 8(b). Equations (56) and (57) illustrate that short run production is completely demand driven. Initially, both the reduction of world private consumption and the increase in world government expenditures fall symmetrically on both countries. The depreciation of the exchange rate, however, gives rise to an expenditure switching effect. As domestic PCP goods become relatively cheaper for consumers located in the foreign country and foreign PCP goods relatively more expensive for domestic consumers, world demand is redirected towards domestic firms. In the short run, domestic output thus always exceeds foreign output. The magnitude of the expenditure switching effect hinges both on the fraction of PCP firms and on the degree of substitutability between the
goods.

When analyzing the long run equilibrium, we have stressed the role of bond holdings as the essential link between the short and the long run. Hence, before turning to the long run responses of consumption and production, we determine the reaction of the trade balance:

$$\frac{df_{t+1}}{\bar{p} c_w} = - \frac{(1 - n) 2\theta(1 + \bar{r}) \epsilon(1 + \bar{r}s + \bar{r}\epsilon(1 - s))}{(1 + \theta) \bar{r}(1 + \bar{r}\epsilon)} \tilde{e}_t + \frac{(1 - n)(1 + \bar{r})}{\bar{r}} \frac{dg_{t+1}}{\bar{c}_w} \quad (58)$$

Equation (58) shows that in the case of a temporary fiscal expansion in the trade balance always deteriorates, as domestic individuals finance part of their short run consumption by selling bonds to foreigners. With permanently higher government expenditures in the domestic country, the situation is more complicated. The depreciation of the nominal exchange rate is stronger and amplifies the negative response of bond holdings. However, the second term on the right-hand side of equation (58) reveals the fact that the need of consumption smoothing of domestic households is lower than with a temporary government spending shock, which leads to a weaker reaction of the trade balance. In our benchmark case, which is depicted in figure 8(d), the effect on the trade balance is negative for all possible values of $s$.

The long run responses of domestic and foreign consumption are given by

$$\tilde{c}_{t+1} = -\frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} - \frac{(1 - n)[(1 - s) \epsilon^2 \bar{r} + \epsilon + s\bar{r}\epsilon]}{1 + \epsilon \bar{r}} \tilde{e}_t \quad (59)$$

$$\tilde{c}_{t+1}^* = -\frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} + \frac{n[(1 - s) \epsilon^2 \bar{r} + \epsilon + s\bar{r}\epsilon]}{1 + \epsilon \bar{r}} \tilde{e}_t \quad (60)$$

Even in the case of a temporary shock domestic households reduce long run consumption, as they have to pay interests on bonds that have been accumulated in the short run. In the foreign country, long run consumption is generally higher than in the steady state, see figure 9(b). A higher share of PTM producers raises foreign long run consumption, as the positive wealth effect on foreign households, that is implied by the trade balance response, becomes stronger.

Finally, we can calculate long run production in both countries by combining the long run output differential with the world aggregate:

$$\tilde{y}_{t+1} = \frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} + \frac{(1 - n) \theta [(1 - s) \epsilon^2 \bar{r} + \epsilon + s\bar{r}\epsilon]}{(1 + \theta)(1 + \epsilon \bar{r})} \tilde{e}_t \quad (61)$$

$$\tilde{y}_{t+1}^* = \frac{n}{2} \frac{dg_{t+1}}{\bar{c}_w} - \frac{n \theta [(1 - s) \epsilon^2 \bar{r} + \epsilon + s\bar{r}\epsilon]}{(1 + \theta)(1 + \epsilon \bar{r})} \tilde{e}_t \quad (62)$$

Figures 9(c) and 9(d) show the evolution of domestic and foreign production. In the long run, domestic households face a negative wealth effect. In the case of a permanent shock, they are confronted with both a higher tax burden and interest payments to foreigners. According to their labor leisure trade off they respond by increasing their labor supply. Domestic production
is therefore always higher in the long run than in the initial steady state. In the foreign country, the permanent interest income has a negative effect on labor supply and hence production. If the fiscal shock is permanent, however, foreign producers also face higher demand for their products due to the stimulation of world demand. This is reflected by the first term on the left hand side of equation (62). Note that the second term also comprises an expenditure switching effect that stems from higher relative foreign wages. All in all, the effects on foreign production are almost offsetting.

2.3 Welfare Analysis

As our model is based on explicitly optimizing agents, the welfare analysis of fiscal policy does not rely on ad hoc welfare criteria like in Mundell-Fleming-type models, but on the specified utility function of the representative households. For tractability, we first derive the welfare implications of a domestic fiscal expansion for a utility function where real balances enter in a logarithmic formulation, that is \( \epsilon = 1 \). Later on, we check for the robustness of the results allowing for higher values of \( \epsilon \) so as to match empirical estimates of the interest elasticity of money demand.

2.3.1 Welfare Effects in the \( \epsilon = 1 \) Case

When real balances enter the utility function logarithmically, the positive analysis is greatly simplified. Table 3 states the equilibrium values of consumption and output in the short and long run as well as the trade balance response and the short run exchange rate. As for output stimulation, domestic fiscal policy has full impact on short run world output with \( \epsilon = 1 \) no matter if the expansion is temporary or permanent. This follows from the fact that short run world consumption is not crowded out at all. Since output is suboptimally low due to monopolistic distortions, short run world welfare is likely to be improved. In the long run, world output and consumption are only affected if the fiscal expansion is permanent. Then, only half of a permanent fiscal expansion translates into additional output while world consumption is subdued. Hence, the expansive effects are substantially lower in the long run, when the fiscal expansion is anticipated and prices are free to adjust.

As it is standard in the literature of NOEM models with money-in-the-utility, we focus on the real components of utility as the monetary component is likely to be small.\(^{15}\) Furthermore we follow Tille (2001) in assuming that government expenditure yields the same utility as steady state consumption at the margin, i.e. \( V'(g_t) = (\bar{c})^{-1} = (\bar{c}^w)^{-1} \). If government expenditure is purely dissipative as e.g. in Betts and Devereux (2000), the tax-induced negative welfare effect on domestic households would always dominate the welfare effects of pricing-to-market, that are at the focus of the analysis. Although our approach is a polar case, it simply scales the results without loss of information because government expenditures enter the utility function additively. The welfare results for the foreign country are independent of this specification.

---

\(^{15}\)See for instance Obstfeld and Rogoff (1995).
Table 3: Positive Analysis for $\epsilon = 1$

$\tilde{c}_t^w = 0 \quad \tilde{h}_t^w = n \cdot \frac{dg}{c_w}$

$\tilde{c}_{t+1}^w = -\frac{n}{2} \frac{dg_{t+1}}{c_w} \quad \tilde{h}_{t+1}^w = \frac{n}{2} \frac{dg_{t+1}}{c_w}$

$\tilde{c}_t = -(1 - n)(1 - s) \tilde{e}_t \quad \tilde{c}_t^* = n(1 - s) \tilde{e}_t$

$\tilde{y}_t = n \frac{dg}{c_w} + \theta(1 - n)(1 - s) \tilde{e}_t \quad \tilde{y}_t^* = n \frac{dg}{c_w} - \theta n(1 - s) \tilde{e}_t$

$\tilde{c}_{t+1} = -\frac{n}{2} \frac{dg_{t+1}}{c_w} - (1 - n) \tilde{e}_t \quad \tilde{c}_{t+1}^* = -\frac{n}{2} \frac{dg_{t+1}}{c_w} + n \tilde{e}_t$

$\tilde{y}_{t+1} = n \frac{dg_{t+1}}{c_w} + \frac{(1 - n)\theta}{1 + \theta} \tilde{e}_t \quad \tilde{y}_{t+1}^* = n \frac{dg_{t+1}}{c_w} - n \frac{\theta}{1 + \theta} \tilde{e}_t$

$\frac{df_{t+1}}{pc^{cw}} = -\frac{(1 - n)(1 + \bar{r})}{\bar{r}} \left( \frac{2\theta}{1 + \theta} \tilde{e}_t - \frac{dg_{t+1}}{c_w} \right) \quad \tilde{e}_t = \frac{\bar{r}(1 + \theta) \frac{dg}{c_w} + (1 + \theta) \frac{dg_{t+1}}{c_w}}{\bar{r} \left( (1 - s)\theta^2 + \theta + s \right) + 2\theta}$

Totally differentiating the household’s utility function (1) yields for any period $t$:

\[ dU_t^{Flex} = \frac{dU_{t+1}^{Flex}}{\bar{r}} \frac{1}{dU_{t+1}^{Flex}} \]

where we made use of the steady state value of output given by equation (19).\textsuperscript{16} It is important to note that the degree of monopolistic competition, that is represented by the elasticity of substitution of goods ($\theta$), decide upon the relative weight of leisure in the process of utility evaluation. Intuitively, a low substitutability of the differentiated goods implies a low steady state output level and hence a low marginal disutility of labor. At the same time, marginal utility of consumption will be high. As the new steady state is reached in period $t + 1$, the long run solution of the model is also valid for the subsequent periods. Discounted overall welfare can then be stated as:

\[ d\Omega_t^{Flex} = dU_t^{Flex} + \frac{1}{\bar{r}} dU_{t+1}^{Flex} \]

We now turn to the question, how a domestic fiscal expansion affects domestic and foreign welfare, and how welfare is accrued to the respective periods. Using the definition of

\textsuperscript{16}Models where leisure enters the utility function in the form $\eta \log(1 - h_t)$ yield exactly the same total utility differential.
welfare (63) and replacing the respective home and foreign short run output and consumption
responses, we derive

$$dU_t^{\text{Flex}} = -\frac{n(\theta - 1)}{\theta} \cdot \frac{dg_t}{c_w} - (1 - n)(1 - s) \theta \tilde{e}_t + \frac{dg_t}{c_w}$$

(65)

and

$$dU_t^{*\text{Flex}} = -\frac{n(\theta - 1)}{\theta} \cdot \frac{dg_t}{c_w} + n (1 - s) \theta \tilde{e}_t$$

(66)

where the exchange rate response is given in table 3. We may decompose the short run
welfare effects into symmetric and asymmetric components. For given prices, the increase
in aggregate world demand translates into equally higher production in both countries. The
first term on the respective right-hand-side of equations (65) and (66) reflects the negative
welfare effects of higher labor effort. The negative (positive) impact on domestic (foreign)
welfare of the respective consumption and expenditure switching effects are captured by the
exchange rate terms of the above equations. In general, the depreciation of the exchange
rate $\tilde{e}_t$ induces expenditure switching towards domestic goods. At the same time, domestic
(foreign) consumption is reduced (raised) in order to restore money market equilibrium as
explained above. For $s = 1$, neither expenditure switching occurs nor do domestic and foreign
consumption deviate from their steady state values. Finally, domestic government expenditure
$\frac{dg_t}{c_w}$ has a direct positive effect on domestic welfare. Aggregating the competing effects gives
the evolution of short run welfare which is depicted in figure 1(a). Due to the switching effects
domestic (foreign) welfare is a positive (negative) function of $s$. Thus, the pricing behavior of
firms decides upon the short run distribution of welfare. In the absence of switching effects,
the domestic country is better off than the foreign country. For values of $s$ below 0.7, the
distribution of welfare is reversed.

Analogously, we can calculate long run domestic and foreign welfare:

$$dU_{t+1}^{\text{Flex}} = -\frac{n(2\theta - 1)}{2\theta} \cdot \frac{dg_{t+1}}{c_w} - \frac{2\theta (1 - n)}{\theta + 1} \tilde{e}_t + \frac{dg_{t+1}}{c_w}$$

(67)

$$dU_{t+1}^{*\text{Flex}} = -\frac{n(2\theta - 1)}{2\theta} \cdot \frac{dg_{t+1}}{c_w} + \frac{2\theta n}{\theta + 1} \tilde{e}_t$$

(68)

In the case of a temporary expansion ($\frac{dg_{t+1}}{c_w} = 0$) domestic households suffer a welfare loss
while foreign households are better off. The driving force for this result is the reaction of the
trade balance given in table 3. With unit consumption elasticity of money demand and
temporary shocks, the trade balance always deteriorates which implies a negative wealth effect
on domestic households via permanent interest payments.

In general, a permanent domestic fiscal expansion improves long run welfare in both coun-
tries, see figure 1(b). This is mainly a consequence of the demand stimulating effect of long
run government expenditures. However, the evolution of long run welfare also depends on the
trade balance which is governed by the degree of pricing-to-market. The numerical illustra-
Figure 1: Welfare effects of a permanent shock, $\epsilon = 1$
tion given in figure 2 reveals that the trade balance is in general positive except for very high fractions of PTM producers.\textsuperscript{17} Take the case of $s = 1$: Short run domestic consumption is then unchanged and domestic production rises by $\frac{n dg_t}{c_w}$. As the real tax burden amounts to $\frac{dg_t}{c_w}$, domestic households are in the need of issuing bonds – hence the deficit.\textsuperscript{18} A decreasing share of PTM producers raises domestic production in real and nominal terms via expenditure switching. At the same time, nominal consumption expenditure remains unchanged as price and quantity effects of the exchange rate depreciation are exactly offsetting. Therefore, with lower values of $s$ the domestic country runs a trade balance surplus which translates into a long run welfare gain of domestic households.

With the evolution of short and long run welfare at hand, we can now calculate the overall welfare results of fiscal shocks in both countries. It is important to stress that from an overall perspective, it is only the net present value of production in terms of consumption that matters for welfare. For instance, a strong increase in short run production may yield a strong short run welfare loss. However, if the higher short run income translates into high bond holdings, long run welfare will be improved via the associated wealth effect and compensates the short run welfare loss. Using (65) - (68) and the short run exchange rate response, we can derive closed form solutions for the full impact of both permanent and temporary fiscal expansions on domestic and foreign welfare. With $dg_t = dg_{t+1} = dg_{p}$, the overall welfare impact of a permanent expansion reads

$$d\Omega^{Flex}_{t} = n \left( \frac{1 + 2 \bar{r}}{2 \bar{r} \theta} \right) \frac{dg_{p}}{c_w} + (1 - n) \left( \frac{s(1 + \bar{r})(1 + \theta)}{\bar{r}((1 - s)\theta^2 + \bar{r} + s) + 2\theta} \right) \frac{dg_{p}}{c_w}$$

\textsuperscript{17}The trade balance effect is unambiguously negative in our benchmark case, where $\epsilon = 9$.
\textsuperscript{18}As a second order effect, the depreciation of the exchange rate raises nominal income from exports whereby the financing gap is smoothed.

![Figure 2: Effect of $s \in [0, 1]$ on the trade balance.](image-url)
\[ d\Omega_t^{\text{Flex}} = n \left( \frac{1 + 2 \bar{r}}{2 \bar{r} \theta} \right) \frac{dg_p}{c_w} - n \left( \frac{s(1 + \bar{r})(1 + \theta)}{\bar{r}(1 - s)s^2 + \theta + s + 2\theta} \right) \frac{dg_p}{c_w} \]  

(70)

The overall effect of a domestic fiscal expansion on domestic welfare is unambiguously positive. This result hinges essentially on our assumption of full utility enhancing government expenditure. Once fiscal spending yields less marginal utility than consumption, i.e. \( V'(g_t) < (\bar{c})^{-1} = (\bar{c}_w)^{-1} \), a domestic fiscal expansion is less beneficial – or even detrimental – for domestic households. The first term on the right-hand side of equation (69) is equivalent to the overall world welfare increase. This effect, which falls symmetrically on both countries, reflects the short and long run demand stimulation of fiscal policy. Furthermore, equation (69) displays the positive impact of short run price movements on domestic welfare, which depends crucially on the degree of pricing-to-market. In the foreign country, the positive world effect is dampened by the negative price effect. However, according to figure 1(c) there is always a welfare gain for the foreign households when \( \epsilon = 1 \).

While the world welfare effect is independent of the pricing behavior of firms, the price effects vary significantly with the degree of pricing-to-market. For \( s = 0 \), the price effects disappear and the welfare gains of a domestic expansion are entirely symmetric. The higher the share of PTM producers \( s \), the more asymmetric is the distribution of welfare gains: Domestic households enjoy higher utility at the expense of foreigners. We identify two effects as the driving forces of the international distribution of welfare both of them stemming from the short run depreciation of the exchange rate: an expenditure switching effect and a terms-of-trade effect.

Recall that the depreciation of the exchange rate increases the competitiveness of domestic firms and stimulates production in the domestic country. From our above reasoning, the monopolistic distortion is then abated and there is a positive welfare impulse on domestic households. For \( s = 0 \), the expenditure switching effect is at its maximum, while it vanishes with complete pricing-to-market. At the same time, however, the purchasing power of additional production varies with the evolution of the terms of trade, which we derive by linearizing equation (4):

\[ \tilde{\tau}_t = (2s - 1) \tilde{c}_t \]  

(71)

Against the backdrop of an exchange rate depreciation and rigid prices, the domestic terms of trade deteriorate as long as \( s < 0.5 \) and improve for \( s > 0.5 \). To give some intuition for this result, consider the two polar cases \( s = 0 \) and \( s = 1 \). Without pricing-to-market, domestic households face higher import prices, while export prices in domestic currency remain unchanged. In the opposite case of full pricing-to-market, domestic import prices are unchanged whereas export prices rise. While the expenditure switching effect decides upon the production structure, the terms of trade determine the consumption possibilities arising from additional output.
Combining both effects, we can give a comprehensive analysis of the role of pricing-to-market for overall welfare. With $s = 0$, the strong expenditure switching effect, which is positive for the domestic country and negative for the foreign country, is exactly offset by the evolution of the terms of trade, that favors the foreign country. The overall welfare effect is then independent of the short term change in relative prices. Hence, an asymmetric fiscal expansion has symmetric effects on welfare in the two countries when the law of one price holds for all goods. With $s = 0.5$, the terms-of-trade are unchanged and expenditure switching is lower but still positive for the domestic country. Therefore, the price effect has a positive (negative) impact on domestic (foreign) welfare. With $s = 1$, expenditure switching disappears as relative prices are unchanged. However, the terms-of-trade work strongly in favor of the domestic households. In a world of complete pricing-to-market, there is a very asymmetric distribution of welfare gains following a domestic fiscal expansion. Table 4 summarizes the competing effects on overall welfare.

Table 4: Effects on overall welfare

<table>
<thead>
<tr>
<th></th>
<th>$s = 0$</th>
<th>$s = 0.5$</th>
<th>$s = 1$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>domestic</td>
<td>foreign</td>
<td>domestic</td>
</tr>
<tr>
<td>expenditure switching</td>
<td>++</td>
<td>--</td>
<td>+</td>
</tr>
<tr>
<td>terms-of-trade</td>
<td>--</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>demand stimulus</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>total</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
</tbody>
</table>

Our reasoning demonstrates that an expansion of production, that stems from expenditure switching, is associated with a negative evolution of welfare as it goes hand in hand with a deterioration of the terms of trade. Even though the monopolistic distortion renders output stimulation per se beneficial, policy makers have to account for possible adverse purchasing power effects.

We also investigated the effects of a temporary domestic fiscal expansion on overall welfare both analytically and numerically. Temporary domestic expansions lead to lower overall welfare increases in both countries, because of the lack of a long run overall demand stimulation. The qualitative effects of pricing-to-market on relative welfare are the same as in the case of a permanent shock, however quantitatively less important.
2.3.2 Robustness of the Results

So far, we have concentrated on the analysis of a simplified version of the two-country model by setting $\epsilon = 1$. While the major transmission mechanisms and welfare effects are already highlighted by the simple model, it is still necessary to check for the robustness of the results. When real money balances are integrated into an additively separable utility function in an isoelastic way, the parameter $\epsilon$ affects at the same time the interest elasticity of money demand, which is here given by $-\frac{\beta}{\epsilon}$, and the consumption elasticity of money demand, here $\frac{1}{\epsilon}$. Assuming $\epsilon = 1$ thus implies a unit consumption elasticity and an interest elasticity close to -1. Empirical studies, however, suggest that the consumption elasticity of money demand is much higher in absolute values than the interest elasticity. Estimates of the consumption elasticity vary from 0.27 reported in Lieberman (1980) to 1 in Mankiw and Summers (1986). In contrast, the estimated values of the interest elasticity range from $-0.39$, reported by Chari, Kehoe, and McGrattan (2002) in their well known calibration exercise, to $-0.05$, reported by Mankiw and Summers (1986). As Mulligan and Sala-i-Martin (1997) point out, the interest elasticity of money demand is not a stable function over time, but tends to be much lower in times of low nominal interest rates than in times of high nominal interest rates.

Against the background of these empirical estimates, the case of $\epsilon = 1$ can be regarded as an upper limit of the consumption elasticity of money demand, but it implies a much too high absolute value of the interest elasticity. Therefore, we now allow for values of $\epsilon$ larger than one and analyze the consequences of this choice for our model results. Specifically, we will consider the cases $\epsilon = 9$ and $\epsilon = 2.5$. In our benchmark simulation we have set $\epsilon = 9$, thereby matching the consensus estimate of the interest elasticity. As pointed out earlier, this bears the consequence of a too low consumption elasticity of money demand. In order to resolve the intrinsic trade-off when choosing $\epsilon$, we also analyze the $\epsilon = 2.5$ case. This yields an interest elasticity at the higher bound of the empirical estimates and a consumption elasticity at the lower bound.

Figure 3 depicts the effects of $\epsilon$ on overall welfare in the domestic and foreign country, respectively. Higher values of $\epsilon$ always reduce domestic welfare. In the foreign country, welfare is increased except for very low levels of $s$. The economic intuition for these results lies exclusively in the short run dynamics of the model. In the long run, the monetary components of the model are separated from the real adjustment process due to flexible prices. Hence, world aggregates of consumption and output do not depend on $\epsilon$. Even though the long run international differentials of consumption and output are functions of $\epsilon$, this is only due to short run current account imbalances. As the latter are irrelevant for the overall welfare effects of fiscal policy, because they only determine the intertemporal utility pattern, we can focus exclusively on the short run effects.

---

19 Chari, Kehoe, and McGrattan (1997) manage to generate both high volatility and persistence of nominal and real exchange rates by setting the consumption elasticity of money demand to the low level reported by Lieberman (1980).
20 This result can be validated by setting $f_{t+1} = 0$ in the long run system. The differences of consumption and output then only depend on government expenditure and $\theta$. 

28
Above we identified three welfare driving forces in the short run: a world demand stimulus, an expenditure switching effect and a terms-of-trade effect. The latter effects depend crucially on the magnitude of the exchange rate depreciation. In our exchange rate analysis we have shown that a higher $\epsilon$ implies a lower depreciation which dampens both the expenditure switching and the terms-of-trade effect. Independently of the degree of pricing-to-market, the stimulation of world demand is decreasing in $\epsilon$ which has a negative impact on overall welfare in both countries. As outlined above, the two price effects do depend on the pricing behavior of firms. Therefore, we carry out the analysis for the two polar cases $s = 0$ and $s = 1$.\footnote{In the synopsis at the end of the paragraph we also include the $s = 0.5$ case, that rules out terms-of-trade effects.} Recall that for $s = 0$, the expenditure switching effect is strongly positive (negative) for the domestic (foreign) country while the terms-of-trade effect is negative (positive) for the domestic (foreign) country. For $s = 1$, there is no expenditure switching and the terms-of-trade effect is positive (negative) for the domestic (foreign) country. The dampening effect of higher values of $\epsilon$ on the exchange rate depreciation implies overall welfare effects on the respective countries with a reversed sign. Table 5 gives the sign of the three effects on overall welfare when moving from a low to a high value of $\epsilon$.

As a rule, the effects on expenditure switching and the terms of trade are offsetting for $s = 0$. Hence, the negative demand stimulation effect makes both countries worse off. For $s = 1$, the domestic country suffers from both a negative demand stimulation effect and a negative effect stemming from lower terms of trade. In the foreign country the dampened exchange rate movement alleviates the negative terms-of-trade effect. The resulting positive effect on foreign overall welfare dominates the negative effect from lower demand stimulation.

![Figure 3: Overall utilities, permanent shock (MIU)](image)
Finally, an robustness check for a temporary domestic fiscal expansion yields the same results for the domestic country. However, in the foreign country higher values of $\epsilon$ are then always beneficial independently of the pricing behavior of firms. This results from the fact that the demand stimulating effect of fiscal policy is independent of $\epsilon$ when the expansion is temporary.

3 Fiscal Policy in a Monetary Union

This section analyzes the transmission mechanisms of fiscal policy when the two countries engage in a monetary union. The countries thereby give up monetary sovereignty in favor of a supranational central bank. The abandonment of the flexible exchange rate regime implies different international transmission mechanisms of asymmetric fiscal shocks. With nominal rigidities on the goods markets, relative prices are temporarily unchanged. Therefore, neither expenditure switching nor terms of trade effects occur in the short run. In this respect, our model is closely related to Caselli (2001), who investigates fiscal policy under fixed exchange rates, but in a different institutional setting. In her analysis of a bilateral exchange rate peg, the two countries maintain monetary sovereignty and cooperate to fix the bilateral exchange rate while keeping the world money stock unchanged. As a consequence, the role of seignorage is quite different under the two exchange rate regimes: In a monetary union model, seignorage does simply not occur if the central bank keeps the money supply constant. Under a bilateral exchange rate peg one central bank expands money supply (positive transfers to households) so as to match money demand, while its foreign counterpart has to embark on a restrictive monetary strategy (negative transfers to households).
The framework used in our analysis is basically the one described in the previous section 2, but for an institutional change of the money markets and the introduction of a common currency. For brevity, the description of the model focuses on the innovative elements of the monetary union case relative to the flexible exchange rate version. As for the producers, the distinction between PTM and PCP producers is irrelevant because both types of producers set prices in the common currency. Therefore, the law of one price holds for both types of goods and purchasing power parity obtains.

3.1 An Independent Central Bank

In a monetary union with an independent central bank, money market equilibrium requires

\[ m_t^w = n \cdot m_t^d + (1 - n) \cdot m_t^{d*} \]  

(72)

with the central bank’s world money supply \( m_t^w \) and the respective domestic and foreign per capita money demand \( m_t^d \) and \( m_t^{d*} \), all of which are denominated in the common currency. Since our focus is on fiscal policy, we assume that the central bank pursues a passive monetary policy. Specifically, money supply remains unchanged, i.e. \( m_t^w = m_{t-1}^w \). This assumption does not alter the implications of fiscal policy because shocks to real government expenditures and money supply shocks are additive in our model. Equation (72) implies that money supply cannot be controlled separately for the individual countries.

3.2 Positive Analysis of Fiscal Shocks

In section 2, the solution vehicle of the model has been the short run exchange rate response. In a monetary union setting, it is also useful to express the variables of interest first in a semi-reduced form. The exchange rate being absent, we opt for stating the model solution in terms of nominal bond holdings, which link the short run solution of the model to the long run. The steady state of the monetary union version of the model resembles the flexible exchange rate case, but for some differences in the definition of the nominal variables. From steady state money market clearing follows \( \bar{m}_t^w = \bar{m}_t^d = \bar{m}_t^{d*} \). Furthermore, prices do not differ in the two countries, hence \( \bar{p}(h) = \bar{p}(f) = \bar{p} \), where \( \bar{p} \) denotes the price level in the two countries.

3.2.1 Long Run Equilibrium

The long run solution of the monetary union model differs from the flexible exchange rate version only on the monetary side of the model. Long run money market equilibrium now requires that world money supply match the weighted sum of the respective national money demands

\[ m_{t+1}^w = n \left( \frac{\gamma c_{t+1}}{1 - R_{t+1}} \right)^{\frac{1}{c}} \cdot p_{t+1} + (1 - n) \left( \frac{\gamma c^{*}_{t+1}}{1 - R_{t+1}} \right)^{\frac{1}{c}} \cdot p_{t+1}^t. \]  

(73)
As the union-wide money supply is fixed, a variation of domestic money demand has to be matched by a diametrical change in foreign money demand. A change in the bond price $R_{t+1}$ or a change in the union-wide price level $p_{t+1}$ affects money demand symmetrically in both countries. Differing long run consumption profiles in the two countries, thus, always imply an adjustment of the regional distribution of money demand. This can be seen most clearly by taking differences of the linearized money demand equations:

$$\tilde{m}_{t+1}^d - \tilde{m}_{t+1}^{d*} = \frac{1}{\epsilon} (\tilde{c}_{t+1} - \tilde{c}_{t+1}^*)$$

(74)

Again, it is the consumption elasticity of money demand $\frac{1}{\epsilon}$ that determines how long run consumption differentials translate into variations of the regional money demand structure. The long run semi-reduced consumption and production differentials under the flexible exchange rate regime given by equations (34) and (34) still hold in a monetary union because the real side of the model is independent of the monetary regime with flexible prices.

### 3.2.2 Short Run Equilibrium

In contrast to the flexible exchange rate case, consumer prices are now entirely fixed in the short run, i.e. $\tilde{p}_t = \tilde{p}^h_t = \tilde{p}^f_t = 0$. As a consequence, the adjustment process to a fiscal shock is radically different because relative short run prices do not change. Some insights can already be gained from the international differences of the linearized equilibrium equations. The money demand difference is given by

$$ (\tilde{m}_t^d - \tilde{m}_t^{d*}) = \frac{1}{\epsilon} (\tilde{c}_t - \tilde{c}_t^*) $$

(75)

As in the long run, the international money demand differential is exclusively driven by the consumption differential. The goods market and current account differences read

$$ \tilde{y}_t - \tilde{y}_t^* = 0 $$

(76)

$$ \tilde{c}_t - \tilde{c}_t^* = \left( \tilde{y}_t - \tilde{y}_t^* \right) - \frac{dq_t - dq_t^*}{\tilde{c}^w} - \frac{\beta d f_{t+1}}{\tilde{p}^{c^w} (1 - n)} $$

(77)

With relative prices fixed, world demand falls symmetrically on domestic and foreign producers, hence the zero production differential. As for the current accounts, relative domestic consumption is reduced by a positive government expenditure differential. However, domestic households may increase relative consumption by accumulating debt in the short run. The difference of the respective Euler equations yields

$$ \tilde{c}_t - \tilde{c}_t^* = \tilde{c}_{t+1} - \tilde{c}_{t+1}^* $$

(78)

In a monetary union, the short and long run consumption differentials are of the same size, as real interest rate differentials are ruled out.
So far we have derived the short and long run consumption and production differentials in a semi-reduced form. To get the full impact of fiscal shocks on output and production we now calculate the short run trade balance response. using the Euler equation differential (78) and plugging in the short and long run consumption differentials yields

\[
\frac{df_{t+1}}{pc^w} = -(1 - n)(1 + \bar{r}) \left( \frac{2\bar{r} - \theta}{\bar{r} - \theta \bar{r} + 2\theta} \frac{dg_t - dg^*_t}{\bar{c}^w} + \frac{1 + \theta}{\bar{r} + \theta \bar{r} + 2\theta} \frac{dg_{t+1} - dg_{t+1}^*}{\bar{c}^w} \right) \tag{79}
\]

We focus again on an asymmetric fiscal expansion, where \( dg_\geq 0 \) and \( dg^*_t = 0 \). The short run government expenditure differential then has a negative effect on the domestic trade balance, whereas the long run differential, that only arises when fiscal policy shocks are permanent, acts towards an improvement. Temporary fiscal shocks thus lead to a strong negative response of the trade balance. Anticipating the higher future income, domestic households - which exclusively bear the tax burden associated with the fiscal expansion - increase their short run consumption level considerably by selling bonds to foreign households. In the case of a permanent fiscal expansion domestic households face a similar income situation in the short and long run, such that consumption smoothing is less relevant. However, as \( \theta > 1 \), we see from (79) that permanent shocks also prompt domestic households to run a short run trade balance deficit.

### 3.2.3 Consumption and Output Responses

We now turn to the question, how fiscal policy affects the consumption paths in the two countries, and whether production is stimulated in a monetary union. Having established the semi-reduced differentials of consumption and output, and the reduced form of the trade balance, we now provide closed form solutions for the respective individual variables.

The world aggregates of consumption and output turn out to be independent of the exchange rate regime. Short run domestic consumption then reads

\[
\tilde{c}_t = \tilde{c}_t^w + (1 - n)(\tilde{c}_t - \tilde{c}_t^*) = \frac{n(\epsilon - 1)}{2\epsilon(1 + \bar{r})} \frac{dg_{t+1}}{\tilde{c}^w} - \frac{(1 - n)(1 + \theta)}{\bar{r} + \theta \bar{r} + 2\theta} \left( \frac{\bar{r} dg_t}{\tilde{c}^w} + \frac{dg_{t+1}}{\tilde{c}^w} \right) \tag{80}
\]

where we made use of the trade balance response given by equation (79). In the short run, domestic consumption is always lower than in the initial steady state, no matter if the fiscal expansion is temporary or permanent. However, equation (80) also reveals that domestic consumption is only partially crowded out by the fiscal expansion\(^ {22} \). As debt financing is much stronger for a temporary shock, short run domestic consumption is higher than in the case of a permanent expansion.

\(^ {22} \)In the case of a temporary shock this can directly be seen from (80) by setting \( \frac{dg_{t+1}}{\tilde{c}^w} = 0 \). For a permanent shock, the limited crowding out effect can be shown by setting \( \frac{dg_t}{\tilde{c}^w} = \frac{dg_{t+1}}{\til{c}^w} \) and simplifying the resulting expression.

33
The short run response of foreign consumption is given by

\[
\tilde{c}_t^* = \tilde{c}_t^w - n(\tilde{c}_t - \tilde{c}_t^*) \\
= - \frac{n(\epsilon - 1)}{2 \epsilon(1 + \bar{r})} \frac{dg_{t+1}}{c^w} + \frac{n(1 + \theta)}{\bar{r} + \theta \bar{r} + 2\theta} \left( \tilde{r} \frac{dg_t}{c^w} + \frac{dg_{t+1}}{c^w} \right)
\]

Both a temporary and a permanent fiscal expansion lead to a short run increase of foreign consumption. Though foreign households forgo present consumption by acquiring bonds from domestic households, they still raise consumption above the steady state level due to the strong expansion of overall demand. The latter translates into equally higher production in both countries:

\[
\tilde{y}_t = \tilde{y}_t^w = - \frac{n(\epsilon - 1)}{2 \epsilon(1 + \bar{r})} \frac{dg_{t+1}}{c^w} + n \frac{dg_t}{c^w}
\]

Hence, a domestic fiscal expansion always has an output stimulating effect on both countries. Permanent fiscal expansions, however, have a substantially lower impact on output, as short production is entirely demand driven. Following the above reasoning on consumption, households increase consumption less because of the anticipated permanent nature of the shock.

We derive the solution for domestic and foreign long run consumption using the long run consumption differential and the trade balance response given by equation (79):

\[
\tilde{c}_{t+1} = - \frac{n}{2} \frac{dg_{t+1}}{c^w} - \frac{(1 - n)(1 + \theta)}{\bar{r} + \theta \bar{r} + 2\theta} \left( \tilde{r} \frac{dg_t}{c^w} + \frac{dg_{t+1}}{c^w} \right) 
\]

\[
\tilde{c}_{t+1}^* = - \frac{n}{2} \frac{dg_{t+1}}{c^w} + \frac{n(1 + \theta)}{\bar{r} + \theta \bar{r} + 2\theta} \left( \tilde{r} \frac{dg_t}{c^w} + \frac{dg_{t+1}}{c^w} \right)
\]

While domestic consumption is unambiguously reduced in the long run, foreign households consume more because they enjoy a positive income effect from bonds and a positive effect from the long run demand expansion when the shock is permanent.

Finally, we calculate the responses of long run production in both countries:

\[
\tilde{y}_{t+1} = \frac{n}{2} \frac{dg_{t+1}}{c^w} + \frac{(1 - n)(1 + \theta)}{\bar{r} + \theta \bar{r} + 2\theta} \left( \tilde{r} \frac{dg_t}{c^w} + \frac{dg_{t+1}}{c^w} \right) 
\]

\[
\tilde{y}_{t+1}^* = \frac{n}{2} \frac{dg_{t+1}}{c^w} - \frac{n\theta}{\bar{r} + \theta \bar{r} + 2\theta} \left( \tilde{r} \frac{dg_t}{c^w} + \frac{dg_{t+1}}{c^w} \right)
\]

In the domestic economy, households work more than in the initial steady state. This results from both the necessity to generate trade balance surpluses in order to pay the interests on the accumulated debt and from higher world demand. Foreign households, in contrast, reduce their working time as the positive interest effect outweighs the effect stemming from an increase of world demand.
3.3 Welfare Analysis

We now turn to a welfare evaluation of the positive results in the previous section. Using the semi-reduced forms of the short run consumption and output differentials yields the evolution of short run utility in both countries:

\[ dU_t^{MU} = \frac{1}{\theta} \tilde{h}_t^w - \frac{df_{t+1}}{\bar{p} \bar{c}_w (1 + \bar{r})} \]  

(87)

\[ dU_t^*^{MU} = \frac{1}{\theta} \tilde{h}_t^w + \frac{n df_{t+1}}{\bar{p} \bar{c}_w (1 + \bar{r})(1 - n)} \]  

(88)

The first term on the right-hand side of equations (87) and (88) reveals the beneficial effect of world output stimulation which falls symmetrically on both countries. The magnitude of this welfare gain is governed by the elasticity of substitution \( \theta \): Higher values of \( \theta \) imply a lower monopolistic distortion and are thus associated with lower welfare gains. Moreover, the rise in world production, see table 2, depends on the persistence of the fiscal expansion and the consumption elasticity of money demand. As explained in section 2.2.4 the stimulation of output is maximal if either the shock is temporary or in the special case of a unit consumption elasticity, i.e. \( \epsilon = 1 \). The second term on the right-hand side of equations (87) and (88) drives a wedge between domestic and foreign utility. While domestic households sell bonds in order to finance additional consumption, foreigners are willing to give up short run consumption possibilities in exchange for future income.

The evolution of long run utility in the two countries is given by

\[ dU_{t+1}^{MU} = \frac{1}{\theta} \tilde{h}_{t+1}^w + \frac{\bar{r} df_{t+1}}{\bar{p} \bar{c}_w (1 + \bar{r})} \]  

(89)

\[ dU_{t+1}^*^{MU} = \frac{1}{\theta} \tilde{h}_{t+1}^w - \frac{n \bar{r} df_{t+1}}{\bar{p} \bar{c}_w (1 + \bar{r})(1 - n)} \]  

(90)

World production increases in the long run only in the case of a permanent fiscal expansion. The resulting welfare gains are again equally shared by domestic and foreign households. In contrast to short run utility, the consumption elasticity of money demand has no impact on the magnitude of the welfare gains. The utility effects of bond holdings now mirror those of the short run: Domestic households face a utility loss as they have to pay interests on debt accumulated in the short run, whereas foreign households benefit from additional consumption possibilities. Summing up short and long run utility in both countries we get

\[ d\Omega_t^{MU} = d\Omega_t^*^{MU} = \frac{1}{\theta} \left( \tilde{h}_t^w + \frac{1}{\bar{r}} \tilde{h}_{t+1}^w \right) \]  

(91)

In a monetary union, an asymmetric fiscal expansion has a positive impact on overall welfare in both countries. The welfare gains, that arise from output stimulation and the resulting abatement of the monopolistic distortion on the goods markets, are equally shared by domestic
and foreign households. Moreover, overall welfare depends positively on the consumption elasticity of money demand, i.e. it decreases with $\epsilon$. The effect of $\epsilon$ on overall utility is depicted in figure 4, where we maintain the parameter choice of section 2. While the pattern of bond holdings determines the intertemporal utility profile, it does not enter overall welfare. The optimal bond holding decision of households is characterized by the trade-off between present and future consumption possibilities. Foreign households are only willing to finance domestic short run consumption if they are entirely compensated via permanent interest income in the future. The net present value of bonds in terms of welfare is therefore zero. All in all, an asymmetric fiscal expansion is always prosper-thy-neighbor in a monetary union, while the welfare effect on domestic households is also positive due to the welfare enhancing effects of government expenditures.

4 Comparison of Exchange Rate Regimes

Based on the results of the previous sections we now compare the welfare effects of fiscal policy under the two alternative exchange rate regimes. Thereby we shed light on the decisive role of the pricing behavior of firms for the welfare evaluation of a transition to a monetary union. Before turning to the comparison of domestic and foreign short run welfare under the two exchange rate regimes, we restate the short run utility responses under flexible exchange rates in a semi-reduced form:

$$dU_t^{Flex} = \frac{1}{\theta} \tilde{h}_t^{w} - \frac{df_t^{Flex}}{\tilde{p}c^{w}(1 + \bar{r})} + s(1 - n)\tilde{e}_t$$

(92)
\[ dU^*_{t+1}^{\text{Flex}} = \frac{1}{\theta} \hat{h}^w_{t+1} + \frac{n dF_{t+1}^{\text{Flex}}}{\bar{p}c^w(1 + \bar{r})(1 - n)} - s \hat{c}_t \] (93)

As in the monetary union case, output stimulation is welfare enhancing for both countries, whereas the trade in bonds leads to higher domestic and lower foreign short run utility. However, it is important to point out that bond holdings in the flexible exchange rate case differ from those under a monetary union. Moreover, the exchange rate depreciation redirects short run utility from the foreign to the domestic economy.

In order to obtain the welfare effects of a transition from a flexible exchange rate system to a monetary union, we define the domestic welfare differential

\[ dU^*_t = dU^*_{t}^{MU} - dU^*_{t}^{Flex} \] (94)

with an analogous expression for the foreign country. Using short run utilities stated in equations (87) and (92) and the foreign counterparts (88) and (93) we arrive at

\[ dU^*_t = -\frac{df_{t+1}^{MU} - df_{t+1}^{Flex}}{\bar{p}c^w(1 + \bar{r})} + (1 - n)s\hat{e}_t \] (95)

\[ dU^*_t = n \frac{(df_{t+1}^{MU} - df_{t+1}^{Flex})}{\bar{p}c^w(1 - n)(1 + \bar{r})} + ns\hat{e}_t \] (96)

As the world output stimulation is independent of the monetary regime the respective terms cancel out when taking differences. Thus, the short run welfare differential only depends on the difference in bond holdings and on the exchange rate effect under flexible exchange rates. Figures 5(a) and 5(b) give the numerical results of the short run utility differential in the respective countries for different values of \( \epsilon \) and a permanent fiscal expansion. The domestic utility differential is in general positive except for high degrees of pricing-to-market. For \( s = 0 \), a transition to a monetary union implies that domestic households do not suffer anymore from the negative terms-of-trade effect under flexible exchange rates. Moreover, expenditure switching raises relative production and hence labor effort under flexible exchange rates which translates into a short run welfare loss. With complete pricing-to-market, i.e. \( s = 1 \), the positive terms-of-trade effect under flexible exchange rates vanishes in a monetary union, hence the negative short run welfare differential. The evolution of the foreign short run welfare differential mirrors the effects on the domestic economy as expenditure switching and terms-of-trade effects work in the opposite direction.

Turning to the long run welfare effects, the semi-reduced forms of long run utility under flexible exchange rates read

\[ dU^*_{t+1}^{\text{Flex}} = \frac{1}{\theta} \hat{h}_{t+1}^{w} + \frac{\bar{r}df_{t+1}^{Flex}}{\bar{p}c^w(1 + \bar{r})} \] (97)

\[ dU^*_{t+1}^{\text{Flex}} = \frac{1}{\theta} \hat{h}_{t+1}^{w} - \frac{n \bar{r}df_{t+1}^{Flex}}{\bar{p}c^w(1 + \bar{r})(1 - n)} \] (98)
Using long run utilities stated in equations (89) and (97) and the foreign counterparts (90) and (98) we arrive at

\[ dU_{t+1}^{\Delta} = \frac{dF_{t+1}^{MU} - dF_{t+1}^{Flex}}{\bar{p}\bar{c}w(1 + \bar{r})} \]  

\[ dU_{t+1}^{*\Delta} = -n(dF_{t+1}^{MU} - dF_{t+1}^{Flex}) \frac{\bar{p}\bar{c}w(1 - n)(1 + \bar{r})}{\bar{p}\bar{c}w(1 + \bar{r})} \]  

For both countries, long run welfare under the two exchange rate regimes only differs due to a possibly different reaction of the trade balance. Figures 6(a) and 6(b) depict the long run utility differential in the respective countries. In the case of complete pricing-to-market, the trade balance response is identical under a monetary union and a flexible exchange rate, such that there is no long run difference of the two systems in terms of welfare. This follows from the lack of expenditure switching under both monetary regimes. For values of s below unity, the differential of bond holdings \( dF_{t+1}^{MU} - dF_{t+1}^{Flex} \) is always negative. Due to expenditure switching, domestic production is higher under flexible exchange rates and thus domestic households resort less to debt when smoothing consumption. As a consequence, domestic households are in the long run better off under a flexible exchange rate regime than in a monetary union, while the opposite is true for foreign households.

As explained above, the pattern of bond holdings only determines the intertemporal utility structure, but has no impact on the net present value of welfare in the two countries. Combining the short and long run welfare differentials, we can therefore express the overall welfare differential only depending on the short run exchange rate response in the flexible exchange
Figures 7(a) and 7(b) illustrate the overall utility differential in the respective countries. From (101) we conclude that a domestic fiscal expansion is more beneficial to domestic households under flexible exchange rates than in a monetary union as long as some of the firms follow pricing-to-market behavior. A higher share of PTM producers makes a monetary union less attractive for domestic households. Though expenditure switching is then reduced under flexible exchange rates, domestic households benefit substantially from improved terms-of-trade. For households in the foreign country a transition to a monetary union is welfare improving against the background of a fiscal expansion abroad, because the combined adverse expenditure switching and terms-of-trade effects are then absent.

As outlined above, lower consumption elasticities of money demand yield a weaker depreciation of the exchange rate. As a consequence, the welfare differentials in both countries are much smaller in the case of $\epsilon = 9$ than for a unit elasticity of money demand.

The explicit welfare analysis of fiscal policy has revealed that output stimulation is only welfare enhancing as long as it stems from overall demand stimulation. When production is stimulated by changes in relative prices, overall welfare deteriorates due to purchasing power losses.
Conclusion

In this paper we analyzed the effects of an asymmetric fiscal expansion under alternative monetary regimes. A comparison of the welfare results of the flexible exchange rate case with those in a monetary union reveals that the two monetary regimes provide exactly the same distribution of the associated welfare gains when pricing-to-market behavior is completely absent. In all other cases, domestic households are better off under the flexible exchange rate regime than under a monetary union. The basic economic mechanism behind these results can be found in a combination of expenditure switching and terms-of-trade effects that are associated with the exchange rate depreciation in the flexible exchange rate regime. Although the assumption of monopolistically distorted goods markets renders output stimulation per se beneficial, welfare of domestic households is at its maximum level when there is no output stimulating expenditure switching at all. This is due to the fact that the purchasing power of domestic households is then very high.

A straightforward extension of the model would be the inclusion of a home bias in government purchases as proposed by Corsetti and Pesenti (2001). Fiscal expansions may then become a beggar-thy-neighbor policy. Moreover, an empirical investigation of pricing to market against the backdrop of fiscal policy concerns may yield further insights into the relevance of different pricing behaviors for the optimal monetary regime. These issues are beyond the scope of this paper and are left for future research.

Figure 7: Overall utility differentials
A Numerical Simulation, Permanent Fiscal Expansion

Figure 8: Permanent Fiscal Expansion, $\epsilon = 9$
Figure 9: Permanent Fiscal Expansion, $\epsilon = 9$
References


