Fiscal Policy and Regional Inflation in a Currency Union

Margarida Duarte*    Alexander L. Wolman†

February 2005

Abstract

This paper investigates the ability of a region participating in a currency union to affect its inflation differential with respect to the union through fiscal policy. We study the interaction between regional fiscal policy and inflation differentials in a two-region general equilibrium model with traded and nontraded goods. We show that a regional fiscal policy that lowers the volatility of the inflation differential can potentially lead to higher volatility of domestic inflation, leaving the volatility of real output roughly unchanged. Moreover, we find that regional tax rules that respond to domestic inflation increase the volatility of real output. These policies, however, leave the volatility of the inflation differential largely unchanged. Our results show that regional fiscal policies can have substantial spill-over effects on the volatility of union-wide and foreign inflation, suggesting the need to study the problem of coordination between regional fiscal authorities and between the central monetary authority and regional fiscal authorities.

Keywords: currency union, inflation differentials, fiscal policy

JEL classification: F33, F02, E62.

*Federal Reserve Bank of Richmond; E-mail address: duarte@andrew.cmu.edu.
†Federal Reserve Bank of Richmond; E-mail address: alexander.wolman@rich.frb.org.
1 Introduction

Regions participating in a currency union delegate monetary policy – the principal tool for controlling their inflation rate – to a central authority. However, currency unions are not typically composed of homogeneous, perfectly integrated regions, and inflation rates vary across regions. The currency union comprising the United States is composed of relatively homogeneous and integrated states and almost no attention is given to inflation differentials across these regions; in fact, state-level consumer price indices are not even constructed. The European Monetary Union, in contrast, is composed of heterogenous and less integrated countries. After a period of strong convergence in inflation rates leading to the adoption of the Euro in 1999, inflation dispersion and inflation differentials increased substantially in the Euro-area after the creation of the currency union.\(^1\) Moreover, domestic inflation rates continue to play an important role in discussions about the economic conditions of individual countries.\(^2\)

Should a region in a currency union wish to exert influence over its own inflation rate – or its inflation differential relative to the rest of the union – it must turn to fiscal policy. When fiscal policy is its only available instrument, can the fiscal authority in a region affect the inflation differential of the region relative to the union? If so, what types of policies are effective, and what consequences do they have for real economic activity?

This paper investigates the ability of a region participating in a currency union to affect its inflation differential with respect to the union through fiscal policy. We study the interaction between regional fiscal policy and inflation differentials in a sticky-price, two-region model with both traded and nontraded goods. There is an exogenous stream of government expenditures, and the regional fiscal authority has access to a labor income tax and lump-sum taxes to finance these expenditures. The model is driven by shocks to government expenditures and to productivity in the traded and nontraded goods sectors.

\(^1\)See Duarte (2003) and Honohan and Lane (2003) for a description of the behavior of inflation dispersion and inflation differentials in the Euro-area.

\(^2\)For instance, Ireland was reprimanded by the European Union’s finance ministers in 2001 for pursuing easy fiscal policy when the inflation rate was high. As another example, Pedro Solbes, then European Commissioner for Economic and Monetary Affairs, stated that for Ireland, “the inflation question, as in Spain, has to be tackled on the national level.” (Irish Times, January 31, 2003, page 51).
In our framework, price (and inflation) differentials arise from movements in the relative price of nontraded goods across countries and from deviations from the law of one price for traded goods. Therefore, the mechanisms behind relative price differentials are independent of the presence of nominal price rigidities in the model. Price stickiness, however, affects the dynamic response of the economy to exogenous shocks and generates time-varying distortions over which monetary and fiscal policies can exert influence.

We study the implications of labor income tax rules that are aimed at influencing the inflation differential of the region. The tax rate is distortionary, and therefore changes in its cyclical behavior alter the behavior of real variables, including the price of the home consumption basket relative to the foreign consumption basket. We find that regional fiscal authorities do have the ability to affect the regional inflation differential. Specifically, by lowering the distortionary tax rate in response to a positive inflation differential (and raising the tax rate in response to a negative inflation differential), a regional fiscal authority can decrease the absolute value of its inflation differential in response to the shocks driving the model. Regional fiscal policy that lowers the volatility of the inflation differential can potentially lead to higher volatility of the domestic inflation rate, but it leaves the volatility of real output largely unchanged. We find that these regional fiscal policies have substantial spill-over effects and lead to higher volatility of union-wide and foreign inflation rates. Moreover, regional tax rules that respond to domestic inflation decrease the volatility of domestic inflation but generate higher domestic real volatility and leave the volatility of the inflation differential largely unchanged. These policies lead to lower volatility of union-wide and foreign inflation rates.

Early research on currency unions, dating back to Mundell (1961), concerns the optimal composition of a currency area. In modern dynamic equilibrium models, it has been difficult to find conditions under which it is optimal for a region to delegate its monetary policy.\(^3\) Therefore, models of currency unions typically assume its existence. Altissimo, Benigno, and Rodriguez-Palenzuela (2004) study the role of structural differences across countries and different shocks in generating relative price differentials in a two-region model of a currency union.\(^3\)

\(^3\)Corsetti and Pesenti (2004) and Devereux and Engel (2003) are notable exceptions.
currency union.\textsuperscript{4} Canzoneri, Cumby, and Diba (2005) build a rich partial equilibrium model of a currency union and study the interaction between the common monetary policy and regional fiscal policies for regions characterized by different relative sizes and debt positions. In our paper, we use a general equilibrium model of a currency union to study how regional fiscal policy affects regional inflation differentials.\textsuperscript{5}

The paper proceeds as follows. In section 2 we present the model and section 3 describes the calibration. Section 4 is devoted to developing a basic understanding of the model; we describe the channels which lead to inflation rate differences across countries, and discuss the dynamic responses of the economy to productivity and government spending shocks. Section 5 contains our main results on the implications of using regional fiscal policy to affect regional inflation or the inflation differential with respect to the union. In section 7 we conclude.

\section{The Model}

We consider a currency union composed by two equally-sized regions, denoted home and foreign, that share the same currency. A central monetary authority issues the currency and conducts monetary policy. Each region has a fiscal authority that is responsible for fiscal policy in the region.

We assume that the two regions share the same structure. There are two sectors of production in each region, the traded and nontraded sectors. In each sector there are two types of firms, retailers and intermediate goods producers. Retailers produce final composite goods from intermediate varieties and can adjust prices costlessly.\textsuperscript{6} A continuum of intermediate goods firms produce traded and nontraded varieties using labor, which is immobile across regions. These firms have market power and set prices in a staggered fashion. Given the

\textsuperscript{4}There is an empirical literature documenting regional variation in inflation rates within currency unions. Cecchetti, Mark, and Sonora (2002), Parsley and Wei (1996), and Rogers (2001) study price level convergence, and Canova and Pappa (2003) study the effects of fiscal shocks on price dispersion.

\textsuperscript{5}Bergin (2000) and Sims (1999) consider the implications of the fiscal theory of the price level for a monetary union. We focus on monetary and fiscal policy regimes in which there is a unique equilibrium. Nonetheless, the particular form of a region’s fiscal policy rule affects the equilibrium behavior of inflation.

\textsuperscript{6}The retail sector could be eliminated from the model. We include it in order to simplify the presentation of the model.
price adjustment scheme, these firms choose an optimal price when they do adjust.

Each region is populated by a continuum of identical households of measure one. Households in each region supply labor to domestic firms and consume a traded composite good and a nontraded composite good. Households also demand real balances, which are an argument in their utility function. We assume that international asset markets are complete by allowing consumers to trade internationally a complete set of state-contingent nominal claims.

In what follows, we describe only the economy of the home region. An analogous description applies to the foreign region. The subscript $f$ for foreign (or $h$ for home) denotes the country of origin of a good, whereas the superscript $\ast$ denotes a variable of the foreign region.

2.1 Households

Households derive utility from consumption of a composite good ($c_t$), leisure ($1 - l_t$), and from the liquidity services of holding money ($\frac{M_t}{P_t}$). Households maximize the expected discounted value of the utility flow,

$$U_0 = E_0 \left[ \sum_{t=0}^{\infty} \beta^t u \left( c_t, 1 - l_t, \frac{M_t}{P_t} \right) \right],$$

where $E_0$ denotes the mathematical expectation conditional on information available in period $t = 0$, $\beta \in (0, 1)$ is the discount rate, and $u$ is the momentary utility function, assumed to be concave and twice continuously differentiable.

2.1.1 The Composition of Consumption, Demands, and the Price Index

The composite consumption good $c_t$ is an aggregate of traded and nontraded composite goods ($c_{T,t}$ and $c_{N,t}$) as follows:

$$c_t = \left[ \omega^\frac{\rho - 1}{\rho} c_{T,t} + (1 - \omega)^\frac{\rho - 1}{\rho} c_{N,t} \right]^\frac{1}{\rho}.$$

(2)
The elasticity of substitution between the traded and nontraded good is $\rho$, and $\omega$ determines the agent’s bias towards the tradable good.

We use the common currency as the numeraire. Let $P_T$, and $P_{N,t}$ denote the prices of the traded and nontraded composite goods in the home region. Given the consumer’s demand for the composite consumption good, the demand for the traded and nontraded goods can be determined by solving a cost minimization problem. The resulting demand functions are given by

$$c_{T,t} = \omega \left( \frac{P_t}{P_{T,t}} \right)^\rho c_t,$$

and

$$c_{N,t} = (1 - \omega) \left( \frac{P_t}{P_{N,t}} \right)^\rho c_t.$$  

Substituting these demands into the consumption aggregator (2) yields the price index for the consumption good, $P_t$:

$$P_t = \left[ \omega P_{T,t}^\rho + (1 - \omega) P_{N,t}^\rho \right]^{\frac{1}{1-\rho}}.$$  

2.1.2 The Budget Constraint

The representative consumer in the home region holds currency $M_t$ issued by the central monetary authority and trades a complete set of state-contingent nominal bonds with the consumer in the foreign region. We denote the price at date $t$ when the state of the world is $s_t$ of a bond paying one unit of currency at date $t+1$ if the state of the world is $s_{t+1}$ by $Q(s_{t+1}|s_t)$ and we denote the number of these bonds purchased by home households at date $t$ by $D(s_{t+1})$.

The intertemporal budget constraint of the household, expressed in currency units, is given by

$$P_t c_t + M_t + \sum_{s_{t+1}} Q(s_{t+1}|s_t) D(s_{t+1}) (6)$$

$$\leq (1 - \tau_t) P_t w_l + M_{t-1} + D(s_t) + \Pi_t + T_t,$$

where $\Pi_t$ represents profits of domestic firms (assumed to be owned by the domestic con-
sumer), \((1 - \tau_t) P_t w_t l_t\) represents after-tax nominal labor earnings, and \(T_t\) represents lump-sum transfers from the local government.

The consumer chooses sequences for consumption \(c_t\), labor \(l_t\), state-contingent bonds \(D(s_{t+1})\), and money holdings \(M_t\), in order to maximize the expected discounted utility (1) subject to the budget constraint (6).

### 2.2 The Regional Fiscal Authority

The fiscal authority in the home region taxes labor income at the rate \(\tau_t\), and receives seigniorage revenues \(Z_t\) from the central monetary authority. These revenues are spent on public consumption \(g_t\) and lump-sum transfers to consumers \(T_t\).  

7 8 The government has the same preferences as the consumer for traded and nontraded composite goods. Therefore, the price of each unit of public consumption is \(P_t\) and, given a level of government consumption \(g_t\), government demands for the traded and nontraded composite goods are given by expressions analogous to the individual consumption demands (3) and (4). The budget constraint of the government in the home region is thus given by

\[
\tau_t P_t w_t l_t + Z_t = P_t g_t + T_t. \tag{7}
\]

We are interested in studying the role of both regional fiscal policy shocks and systematic fiscal policy in affecting inflation differentials across regions. Fiscal policy shocks can be associated with either taxation or spending, and likewise systematic fiscal policy can be associated with either taxation or spending. We follow much of the literature in assuming that the ratio of government spending to output follows an exogenous stochastic process, whereas the labor income tax rate is either constant or determined by a feedback rule that

---

7 Public consumption does not yield utility to households in our model.

8 We abstract from government debt in our model. When the sequence of distortionary taxes \(\{\tau_t\}_{t=0}^{\infty}\) is held constant, financing changes in government spending through lump-sum transfers is equivalent to debt financing. In the absence of lump-sum transfers, however, allowing the government to issue debt necessarily affects the sequence of distortionary taxes and, hence, the equilibrium response to any given shock. It also requires imposing a feedback rule for \(\tau_t\) to ensure stationarity of government debt. In the absence of consensus estimates on fiscal policy rules that allow for government debt, we choose to allow for lump-sum transfers and abstract from government debt. See Mitchell, Sault, and Wallis (2000) for a study of different rules used in the literature. See Johnson (2001) for a criticism of the arbitrariness of the approach taken by much of the literature.
incorporates responses to endogenous variables.

The share of total public consumption in output, \( g/y \), is given by

\[
\left( \frac{g}{y} \right)_t = c_g + \rho_g \left( \frac{g}{y} \right)_{t-1} + \varepsilon_{g,t},
\]

where \(|\rho_g| < 1\) and \(\varepsilon_{g,t} \sim N(0, \sigma_g)\). The tax rate \(\tau_t\) on labor income is determined by the feedback rule

\[
\tau_t = \tau + \alpha_{\tau,\pi} (\pi_t - \pi^U_t),
\]

where \(\pi_t\) and \(\pi^U_t\) denote, respectively, home and union-wide inflation (to be defined below). In this specification of the feedback rule we allow for a response of the labor income tax rate to the inflation differential of the region with respect to the union-wide level. This tax response is meant to capture the idea that, in a currency union, fiscal policy is the only instrument by which a local government can affect the inflation rate of the region.

2.3 Firms

There are two sectors of production in each region: traded \(T\) and nontraded \(N\). In each sector, intermediate goods firms produce a continuum of differentiated varieties and retail firms produce a final composite good. In the traded sector, the final good is a composite of traded home and foreign intermediate inputs and the final nontraded good. In the nontraded sector, the final good is a composite of domestic nontraded intermediate inputs.

2.3.1 Retailers

We start by describing the problem of retailers in each sector. Producers of the final nontraded good combine a continuum of intermediate nontraded varieties, \(y_{N,t}(i), i \in [0, 1]\), to produce the composite good \(y_{N,t}\). These firms are perfect competitors and each period choose inputs \(y_{N,t}(i)\) and output \(y_{N,t}\) to maximize profits given by

\[
\max P_{N,t} y_{N,t} - \int_0^1 P_{N,t}(i) y_{N,t}(i) di,
\]
subject to the production function $y_{N,t} = \left( \int_{0}^{1} y_{N,t}(i)^{\frac{\theta - 1}{\theta}} \, di \right)^{\frac{\theta}{\theta - 1}}$. The parameter $\theta$ denotes the elasticity of substitution between any two varieties of the nontraded good and $P_{N,t}(i)$ represents the price of home nontraded variety $i$ in period $t$. This problem yields the demand functions

$$y_{N,t}(i) = \left( \frac{P_{N,t}}{P_{N,t}(i)} \right)^{\theta} y_{N,t}.\,$$

Zero profit by retail firms implies that the price of the nontraded composite good is given by

$$P_{N,t} = \left( \int_{0}^{1} P_{N,t}(i)^{1-\theta} \, di \right)^{\frac{1}{1-\theta}}.$$

Retailers of the final composite traded good, $y_{T,t}$, combine home and foreign traded intermediate varieties, $y_{Th,t}(i)$ and $y_{Tf,t}(i)$, $i \in [0,1]$, to produce the (wholesale) tradable good $y_{T,t}$. They then combine each unit of this good with $\phi$ units of the nontraded composite good in order to produce one unit of the final (retail) composite traded good $y_{T,t}$. Retail firms choose inputs $y_{Th,t}(i)$, $y_{Tf,t}(i)$, $y_{dN,t}^d$, and output $y_{T,t}$ to maximize profits

$$\max P_{T,t} y_{T,t} - \int_{0}^{1} P_{Th,t}(i) y_{Th,t}(i) \, di - \int_{0}^{1} P_{Tf,t}(i) y_{Tf,t}(i) \, di - P_{N,t} y_{dN,t}^d,$$

subject to

$$y_{T,t} = \min \left( \tilde{y}_{T,t}, \frac{y_{dN,t}^d}{\phi} \right), \quad (10)$$

$$\tilde{y}_{T,t} = \left[ \frac{1}{\omega_T} y_{Th,t} + \left(1 - \omega_T\right) \frac{1}{\gamma_T} y_{Tf,t} \right]^{\gamma_T}, \quad (11)$$

$$y_{Tj,t} = \left( \int_{0}^{1} y_{Tj,t}(i)^{\frac{\theta - 1}{\theta}} \, di \right)^{\frac{\theta}{\theta - 1}}, \quad j = h, f. \quad (12)$$

Equation (10) describes the production function of the final traded good $y_T$, which requires the use of the wholesale traded good $\tilde{y}_T$ and the nontraded composite good in fixed propor-

---

9This assumption reflects the need to use distribution services (intensive in local nontraded goods) in the production of final traded goods. The importance of distribution services in explaining consumer-price differentials of traded goods across countries has been emphasized by Burstein, Neves, and Rebelo (2004) and Corsetti and Dedola (2004).
tions. The parameter $\phi$ determines the amount of the nontraded composite good needed to produce each unit of the final traded composite good. Equations (11) and (12) describe the production function of $\tilde{y}_{T,t}$. The parameter $\gamma > 0$ denotes the elasticity of substitution between home and foreign traded goods $y_{Th,t}$ and $y_{Tf,t}$ used in the production of $\tilde{y}_{T,t}$, and the weight $\omega_T$ determines the bias for the domestic traded input. Finally, $P_{Th,t}(i)$ and $P_{Tf,t}(i)$ denote the price of home and foreign traded variety $i$, respectively. The solution to this problem implies the following conditions

\begin{align*}
y_{Th,t}(i) &= \omega_T \left( \frac{P_{Th,t}}{P_{Th,t}(i)} \right)^\theta \left( \frac{\tilde{P}_{T,t}}{P_{Th,t}} \right)^\gamma y_{T,t}, \\
y_{Tf,t}(i) &= (1 - \omega_T) \left( \frac{P_{Tf,t}}{P_{Tf,t}(i)} \right)^\theta \left( \frac{\tilde{P}_{T,t}}{P_{Tf,t}} \right)^\gamma y_{T,t}, \\
y_d^{N,t} &= \psi y_{T,t}, \\
\bar{P}_{T,t} &= \bar{P}_{T,t} + \phi P_{N,t},
\end{align*}

where $P_{T,j,t} = \left( \int_0^1 P_{T,j,t}(i)^{1-\theta} \, di \right)^{\frac{1}{1-\theta}}$, $j = h, f$, and $\bar{P}_{T,t} = (\omega_T P_{Th,t}^{1-\gamma} + (1 - \omega_T) P_{Tf,t}^{1-\gamma})^{\frac{1}{1-\gamma}}$.

Equations (13) and (14) represent the demand functions for home and foreign intermediate varieties and equation (15) represents the demand function for the nontraded input used for distribution, $y_d^{N,t}$. Equation (16) determines the final (retail) price of the traded composite good, $P_{T,t}$, as a function of its price before distribution, $\bar{P}_{T,t}$, and the price of distribution services, $P_{N,t}$.

### 2.3.2 Intermediate Goods Producers

We now turn to the problem of intermediate goods producers. In each sector there is a continuum of monopolistically competitive firms indexed by $i$, $i \in [0,1]$, that produce differentiated varieties of a traded and nontraded good. The production function for each firm $i$ in each sector is given by $z_t l_t(i)$, where $l_t(i)$ represents the labor input and $z_t$ is a sector- and country-specific productivity shock. We denote the real marginal cost of production by $\psi = w_t / z_t$. Note that marginal cost is specific to the sector and country: two firms in the same country and in the same sector have the same level of productivity and hence (since they face the same wage) the same marginal cost. Firms producing intermediate inputs set
prices for $J$ periods in a staggered way. In particular, in each period $t$, a fraction $1/J$ of firms in each sector chooses optimally prices that are set for $J$ periods.

The problem of a firm in the nontraded goods sector adjusting its price in period $t$ is given by

$$\max_{P_{N,t}(0)} \sum_{j=0}^{J-1} E_t \left[ \vartheta_{t+j|t} \left( \frac{P_{N,t}(0)}{P_{t+j}} - \psi_{N,t+j} \right) y_{N,t+j}(j) \right].$$

The term $y_{N,t+j}(j)$ denotes the total demand at date $t + j$ faced by a firm in this sector that has last adjusted its price in period $t$. The term $\vartheta_{t+j|t}$ denotes the pricing kernel used to value date $t + j$ profits, which are random as of date $t$, and in equilibrium is given by $\beta^j \frac{U_{c,t} + \psi_{T,t+j} y_{T,t+j}(j)}{U_{c,t} + \psi_{Th,t+j}(j) + y^*_Th,t+j(j)}$.

In the traded-goods sector, a firm adjusting its price in period $t$ chooses $P_{Th,t}(0)$ and charges this price in both markets. This firm’s problem is

$$\max_{P_{Th,t}(0)} \sum_{j=0}^{J-1} E_t \left[ \vartheta_{t+j|t} \left( \frac{P_{Th,t}(0)}{P_{t+j}} - \psi_{T,t+j} \right) \left( y_{Th,t+j}(j) + y^*_{Th,t+j}(j) \right) \right]$$

where $y_{Th,t+j}(j)$ ($y^*_{Th,t+j}(j)$) denotes home (foreign) demand in period $t + j$ faced by a firm in this sector that has last adjusted its price in period $t$.

Nominal output in the home region in period $t$ is given by

$$Y_t = P_t (c_t + g_t) + P_{Th,t} y^*_{Th,t} - P_{Tf,t} y_{Tf,t},$$

where $P_{Th,t} y^*_{Th,t}$ and $P_{Tf,t} y_{Tf,t}$ represent the value of exports and imports in period $t$, respectively. Nominal output in the foreign region is denoted by $Y^*_t$.

2.4 The Central Monetary Authority

The central monetary authority issues non-interest bearing money and allocates seigniorage revenue to the regions. Let the superscript $U$ denote a union-wide variable; for example total nominal money balances in the union are $M^U_t = M_t + M^*_t$.

In period $t$, the monetary authority earns revenue from printing money equal to $M^U_t -$
and it distributes this revenue among the regional fiscal authorities.\footnote{In the description of the problem of the central monetary authority we abstract, without loss of generality, from the central bank’s balance sheet and from each government’s borrowing from the central bank. To solve the model, we need to specify how the revenue from money creation is allocated across regions. We do this by choosing a rule for the allocation of the change in the monetary base. This choice eliminates the need to keep track of the central bank’s balance sheet. If we were, instead, to specify the allocation rule in terms of the central bank’s interest revenues, we would need to keep track of its balance sheet.} Recalling that \( Z \) denotes seigniorage, we have

\[
M_t^U - M_{t-1}^U \equiv Z_t^U = Z_t + Z_t^*.
\] (18)

We have to specify the rule for allocating seigniorage. We assume that seigniorage is allocated according to each country’s share of nominal consumption in the stationary steady-state, \( s_c \), so that

\[
Z_t = s_c Z_t^U.
\] (19)

The monetary authority is assumed to follow an interest rate rule similar to the rules studied by Taylor (1993) and Clarida, Gali, and Gertler (1998). In particular, the nominal interest rate \( R_t \) is set as a function of the lagged nominal rate, next period’s expected inflation rate in the union, and union-wide real output,

\[
R_t = \rho_R R_{t-1} + (1 - \rho_R) \left[ \bar{R} + \alpha_{R,\pi} (E_t \pi_{t+1}^U - \pi^U) + \alpha_{R,y} \ln \left( \frac{y_{t+1}^U}{\bar{y}_t^U} \right) \right],
\] (20)

where a bar over a variable denotes its target value. In order to implement this rule, the central monetary authority needs a measure for the inflation rate and real output in the whole currency union, \( \pi^U_t \) and \( y^U_t \), respectively.

We define the “union-wide” inflation rate, \( \pi^U_t \), as a weighted average of each region’s inflation rate, where the weight is determined by the region’s share of nominal consumption. That is,

\[
\pi^U_t = s_c \pi_t + (1 - s_c) \pi_t^*.
\]

In order to define “union-wide” real output, we first define union nominal output as the sum of each region’s nominal output, \( Y_t^U = Y_t + Y_t^* \). Union-wide real output is obtained by computing the Fisher ideal quantity index and normalizing its level to one in steady-state.
2.5 Market Clearing Conditions

The market clearing conditions for labor, traded goods and nontraded goods are given by

\[ l_t = \int_0^1 (l_{T,t}(i) + l_{N,t}(i)) \, di, \]

\[ y_{N,t} = c_{N,t} + g_{N,t} + y_{N,t}^d, \]

\[ y_{T,t} = c_{T,t} + g_{T,t}. \]

Note that the market clearing condition for nontraded goods reflects the three uses of these goods: private consumption, public consumption, and distribution services. Note also that the market clearing condition for traded goods reflects only local demand: This good is \textit{traded} in the sense that it is produced using traded inputs but it is \textit{nontradable} in the sense that consumers are restricted to buy this good from the local retailer.

2.6 Equilibrium and Model Solution

An equilibrium for this economy is defined as a collection of allocations for home and foreign consumers, allocations and prices for home and foreign firms (retailers and intermediate goods producers), composite goods prices, real wages, and bond prices that satisfy the efficiency conditions for households and firms (first-order conditions for the maximization problems stated above) and market clearing conditions, given the policy rules assumed for the monetary and fiscal authorities. We approximate the equilibrium linearly around its steady-state.

3 Calibration

In this section we report the parameter values used in solving the model. Our benchmark calibration assumes that both regions in the currency union are symmetric and share the same structure and parameter values. The model is calibrated using German data and we assume that each time period in the model corresponds to one quarter.
3.1 Preferences and Production

We follow Chari, Kehoe, and McGrattan (2002) closely in the preference specification. We consider a momentary utility function which is separable between a consumption-money aggregate and leisure and is given by

$$U(c, l, \frac{M}{P}) = \frac{1}{1-\sigma} \left( a c^\eta + (1-a) \left( \frac{M}{P} \right)^\eta \right)^{\frac{1-\sigma}{\eta}} + \psi \frac{(1-l)^{1-\nu}}{1-\nu}.$$ 

We set the curvature parameter, $\sigma$, equal to two. The parameters $\psi$ and $\nu$ are set to 11 and 1.5, respectively, so that the fraction of working time in steady-state is 0.3 and the elasticity of labor supply with marginal utility of consumption held constant is 2.

The parameters $a$ and $\eta$ are obtained from estimating the money demand equation implied by the first-order condition for bond holdings. Using the utility function defined above, this equation can be written as

$$\log \frac{M_t}{P_t} = \frac{1}{\eta-1} \log a + \log c_t + \frac{1}{\eta-1} \log \frac{R_t - 1}{R_t}.$$ 

We ran a regression using German quarterly data from 1995:01 to 2000:01 for M1, CPI, real private consumption and the three-month Libor rate. We set $\frac{1}{\eta-1}$ equal to our estimate of the interest elasticity, $-0.45$, and obtain $\eta = -1.22$. The value for the weight coefficient $a$ was set to 0.91 and it was derived from the estimate for the intercept, $-1.026$. The discount factor $\beta$ is set to 0.99, implying a 4% annual real rate in the stationary steady-state economy.

The consumption index for $c$ depends on $\rho$, the elasticity of substitution between traded and nontraded goods, and on $\omega$, the weight on consumption of traded goods. We use Mendoza’s (1995) estimate of the elasticity of substitution between traded and nontraded goods for industrialized countries and set $\rho$ equal to 0.74.\textsuperscript{11} To set the weight $\omega$ we refer to Stockman and Tesar (1995) who report that nontraded goods account for about half of consumption in OECD countries. We set $\omega = 0.6$ to match this ratio.

For the production function of composite traded goods $\tilde{y}_T$ we need to assign values to $\gamma$,

\textsuperscript{11}This estimate is higher than the one found by Stockman and Tesar (1995), who use data from both developing and industrialized countries.
the elasticity of substitution between domestic and imported traded goods, and to $\omega_T$, the weight on home traded goods. Collard and Dellas (2002) estimate $\gamma$ for France and Germany using data from 1975:1 to 1990:4. Their estimate for France is 1.35 while their point estimate for Germany is substantially higher, 2.33, but imprecise. In the benchmark calibration we set $\gamma$ equal to 1.5, which is also the standard value used in models calibrated for US data. The weight $\omega_T$ is set equal to 0.5, implying that the import share in steady state is 18% of GDP.

Finally, we need to choose the values for the distribution parameter $\phi$ and for $\theta$, the elasticity of substitution across varieties of goods, and the number of periods for which prices are set, $J$. We follow Burstein, Neves, and Rebelo (2004) in setting $\phi$ equal to 0.82 so that distribution services represent 45% of the retail price of traded goods in steady state.

The elasticity of substitution between different varieties of a given good $\theta$ is related to the markup chosen when firms adjust their prices. If inflation were zero, the steady state markup would simply be $\theta / (\theta - 1)$ (with low but non-zero inflation the steady state markup differs insignificantly from $\theta / (\theta - 1)$). We set $\theta = 10$, which is a representative value in the literature. It implies a markup of 1.11 in steady state, which is consistent with the empirical work of Basu and Fernald (1997) and Basu and Kimball (1997). We assume that firms set their price for 3 quarters ($J = 3$).

### 3.2 Monetary and Fiscal Policy Rules

The parameters of the nominal interest rate rule are taken from the estimates in Clarida, Gali, and Gertler (1998, Table I) for the Bundesbank. We set $\rho_r = 0.91$, $\alpha_{R,\pi} = 1.31$, and $\alpha_{R,y} = 0.25/4$, where this last term is converted for quarterly data. The target values for $R$, $\pi_U$, and $y_U$ are their steady-state values. We assume that in steady-state prices grow at 2% per year (or 0.5% per quarter).

The steady-state tax rate on labor income $\tau$ is set to 0.36, the average effective tax rate on labor income in Germany between 1991 and 1997 estimated by Carey and Tchilinguirian (2000). The response of the tax rate to the inflation differential $\alpha_{\tau,\pi}$ is set to zero in the benchmark calibration.
3.3 Exogenous processes

The technology shocks are assumed to follow an AR(1) process $z_{t+1} = Az_t + \varepsilon_{z,t+1}$, where $z_t$ is the vector $[z^T_t, z^N_t, z^T_\tau, z^N_\tau]$ and $A$ is a $4 \times 4$ matrix. The vector $\varepsilon_z$ represents the innovation to $z$ and has variance-covariance matrix $\Omega$. We identify technology shocks in the traded goods sector with Solow residuals in the manufacturing sector and technology shocks in the nontraded goods sector with Solow residuals in the service sector. We estimated the stochastic process for technology shocks using quarterly data for Germany and France from 1992:1 to 2000:4 for hours worked and GDP in the manufacturing and service sectors. Since we assume a symmetric economic structure across countries, we impose cross-country symmetry on the auto-correlation and variance-covariance matrices $A$ and $\Omega$. The estimates are

$$A = \begin{bmatrix}
0.708 & 0.169 & 0.006 & -0.435 \\
-0.023 & 0.707 & -0.061 & -0.038 \\
0.006 & -0.435 & 0.708 & 0.169 \\
-0.061 & -0.038 & -0.023 & 0.707 \\
\end{bmatrix}$$

and

$$\Omega = \begin{bmatrix}
0.16 & 0.05 & 0.03 & 0 \\
0.05 & 0.06 & 0 & 0 \\
0.03 & 0 & 0.16 & 0.05 \\
0 & 0 & 0.05 & 0.06 \\
\end{bmatrix} \times 10^{-3}.$$

Shocks to government expenditures in each country are assumed to follow the same independent AR(1) process $\hat{g}_{t+1} = c_g + \rho_g\hat{g}_t + \varepsilon_{\hat{g},t+1}$, where $\hat{g}$ represents the share of government expenditures in GDP. We estimated this process using quarterly data for Germany from 1991:2 to 2001:3. The estimate for $\rho_g$ is 0.57 and the estimate for $\sigma^2_{\varepsilon_g}$ is 0.000214.

4 Mechanisms Behind Regional Price Differentials

The model contains three mechanisms that can generate price (and inflation) differentials across regions in a currency union. Two of these mechanisms work through the presence of local nontraded goods and the third works through home bias for the local traded good. We
emphasize that these three mechanisms are independent of the presence of nominal price rigidities.

When prices are flexible \((i.e., J = 1)\), intermediate goods firms set prices as a constant markup over marginal cost \(\psi = w/z\). Therefore, in the flexible-price version of our two-region two-sector model, regional price differentials can be expressed as a combination of real wage rates and productivity levels. In log-linear terms we have:

\[
\hat{P}_t - \hat{P}^*_t = \left(1 - \omega\right)\Omega_1 + \phi \omega \Omega_2 \left(\hat{w}_t - \hat{w}^*_t + \hat{z}^*_N_t - \hat{z}_{N,t}\right) + (2\omega_T - 1)\omega \Omega_3 \left(\hat{w}_t - \hat{w}^*_t + \hat{z}^*_T_t - \hat{z}_{T,t}\right),
\]

where a hat variable represents its deviation from the steady-state value and the constants \(\Omega_1, \Omega_2,\) and \(\Omega_3\) are positive functions of relative prices in steady-state.\(^{12}\) Wages are of course endogenous, so \((21)\) is as an approximation of an equilibrium condition relating several endogenous variables. Nevertheless, this equation can be used to highlight the three mechanisms behind regional price differentials present in our model: consumption of local nontraded goods \((\omega)\), use of local distribution services in the production of traded goods \((\phi)\), and home bias in the production of traded goods \((\omega_T)\).

Note that when households do not consume nontraded goods \((\omega = 1)\), when there are no distribution costs \((\phi = 0)\), and when retailers of the traded good place equal weight on home and foreign traded inputs \((\omega_T = 0.5\) in equation \(11)\), the model does not generate regional price differentials in response to exogenous shocks. In this case, consumers in both countries have identical preferences defined over the same basket of (traded) goods and the law of one price holds. Hence, the price level in both countries responds identically to (country-specific) exogenous shocks.

The first mechanism behind regional price differentials is associated with the consumption of nontraded goods. When households consume both traded and nontraded goods \((\omega < 1)\), the consumption price indices in the two countries correspond to distinct baskets of goods.

\(^{12}\)Equation \((21)\) is obtained from combining (the log-linearized versions of) equation \((5)\) for the price level \(P\), equation \((16)\) for the consumer price of traded goods \(P_T\), and the pricing equations for intermediate good producers in the two sectors, \(P_N/P = \psi_N \theta / (\theta - 1)\) and \(P_{Nt}/P = \psi_{Nt} \theta / (\theta - 1)\), in both countries. In deriving this expression we make use of the fact that the model is symmetric in steady-state.
Even if the law of one price holds for traded goods ($\phi = 0$ and $\omega_T = 0.5$), the consumption price indices differ in the two countries in response to movements in the relative price of nontraded goods across countries. The second mechanism behind regional price differentials is associated with the use of local nontraded goods in the production of the final traded composite good ($\phi > 0$), implying that the consumer price of the traded good depends on the price of the local nontraded composite good. Movements in the relative price of nontraded goods across countries thus imply consumption price index differentials. Finally, when retailers of traded goods have a bias towards the local traded input ($\omega_T > 0.5$), the price of the traded composite good reflects disproportionately variations in productivity in the home traded sector.\textsuperscript{13}

When prices are sticky, regional price differentials are not well approximated by (21). Sticky prices, in particular, generate transitory dynamics that complicate the relationship between relative price levels and marginal costs. To gain some insight into the dynamics associated with sticky prices, we now look at the equilibrium price differential associated with permanent shocks to productivity and government spending.\textsuperscript{14} In these experiments we assume that monetary policy is given by a constant money growth rate. When prices are flexible, all variables jump on impact to their new steady-state levels. When prices are sticky, the same new steady-state levels are reached after approximately 3 quarters (that is, after all firms had the opportunity to adjust their price).

**Government Expenditure Shock** Fiscal policy in each region is summarized by an exogenous process for government expenditures as a share of output and by a feedback rule for the labor income tax. Here we illustrate the effects of permanent shocks to home government spending on price differentials when the tax response parameter $\alpha_T$ is zero. Recall that in our setup government spending is a pure resource drain on the economy.

\textsuperscript{13}By setting $\omega_T = 0.5$ we eliminate this mechanism in our model. That is, $\tilde{P}_{T,t} = \tilde{P}^*_T$. Note that in this case, productivity shocks to the traded goods sector still generate relative price differentials in our model by generating an equilibrium wage differential across countries. The Balassa-Samuelson effect predicts that countries with higher productivity in the traded goods sector also have higher price levels. See Duarte and Wolman (2003) and Altissimo, Benigno, and Rodriguez-Palenzuela (2004) for a discussion of the effect of higher productivity in the traded goods sector on price levels in new open-economy models.

\textsuperscript{14}Thus, in the remainder of this section we depart from the calibrated shock processes described in section 3.
Figure 1 displays the response of selected variables to a one percentage point permanent increase in the share of government spending in output, when government spending is financed by lump-sum taxes. The shock generates an increase in government spending of about 7%, increasing demand for both home and foreign traded goods as well as for the local nontraded good (partly to be used for the distribution of traded goods). Domestic real output increases by less than 1% and the transmission of the shock to foreign output is even smaller. The shock has a negative effect on private consumption, bigger in the home country than in the foreign country, and it generates a positive price differential with respect to the foreign region of about 0.05 percentage points on impact and a permanent price differentials of about 0.17 percentage points. In response to a permanent increase in government spending, the home household works more hours permanently. The foreign household also works more, but less so than the household in the home country. The real wage in the home country jumps on impact and decreases gradually as consumption and hours fall.

The relative price of home traded goods to foreign traded goods increases, and all agents substitute consumption away from home traded goods towards foreign traded goods. This substitution effect leads to the relative expansion of the traded goods sector in the foreign country, while the nontraded goods sector expands relatively more in the home country.

**Productivity Shocks** Figure 2 plots the response to a 1% permanent increase in productivity in the home nontraded goods sector when the labor income tax is constant. On impact, this shock generates a negative price differential, with the home price level decreasing about 0.2 percentage points and the foreign price level increasing about 0.05. After all prices have adjusted to the shock, this shock generates a permanent negative price differential of about 0.4 percentage points. With optimal risk sharing, the fall in the home relative price is associated with a fall in the ratio of marginal utilities of consumption across countries and

---

15Betts and Devereux (1999) find identical responses of home and foreign output to government spending shocks. In our model the responses of home and foreign outputs are not identical because there are nontraded goods.

16The assumption of complete asset markets implies the optimal risk sharing condition $u_{c,t}/P_t = u^*_{c,t}/P^*_t$. This condition implies that the ratio of price levels moves together with the ratio of marginal utilities of consumption. Abstracting from the presence of money in the utility function, this condition implies a negative relationship between price differentials and consumption differentials.
an increase in home relative consumption.

In response to this shock, home producers of nontraded goods gradually lower their prices. Due to the presence of distribution costs, the fall in nontraded goods prices also reduces the consumer price of the composite traded good in the home country, but relatively less than the fall in the price of nontraded goods. Home consumption increases for all goods and real output increases in the home country; increased home demand for foreign traded goods also raises foreign real output. The foreign household, whose productivity has not changed, works slightly more and the home household works less by substituting hours away from the relatively more productive sector.

In contrast to a shock to nontraded goods productivity, a permanent productivity shock to the traded goods sector generates a small price differential (Figure 3). For our benchmark calibration, a 1% increase in productivity in the home traded goods sector generates a positive home price differential of 0.05 percentage points. The sign coincides with the textbook Balassa-Samuelson effect, where, in response to higher productivity in the traded goods sector, a country experiences an increase in its price level relative to the foreign country.\footnote{See, for example, Obstfeld and Rogoff (1996), page 210.}

\section{Fiscal Policy and Inflation Differentials}

Because we model the government spending process as exogenous, if a regional fiscal authority wishes to influence the behavior of regional inflation relative to the rest of the monetary union, its sole means for doing so is to move the labor income tax. We assume that if a region wishes to affect its inflation rate, it recognizes the dominance of the central bank in determining the overall level of inflation, and concentrates on the regional inflation differential relative to the union-wide average. To study the feasibility and effectiveness of policies aimed at stabilizing inflation relative to the union, we vary the parameter $\alpha_{\tau,\pi}$ in the policy rule in equation (20), which represents the feedback from the regional inflation differential to the tax rate.\footnote{In terms of units, $\alpha_{\tau,\pi}$ is the level derivative of the tax rate with respect to the inflation differential. For instance, if $\alpha_{\tau,\pi} = -1.0$, then an inflation differential of one percentage point would decrease the tax rate by one percentage point compared to a situation with zero inflation differential.} To summarize the effects of changes in the policy rule, we simulate the model
using the shock processes described in section 3, and illustrate the relationship between the volatility of the inflation differential and that of other endogenous variables.

The results are presented in Figure 4. Panel A displays the relationship between $\alpha_{\tau,\pi}$ and the endogenous volatility of the inflation differential, as measured by its standard deviation in percentage points.\footnote{We plot this relationship with the inflation volatility on the horizontal axis, instead of the tax rule parameter, because the other panels relate inflation volatility to other statistics involving endogenous variables. In this figure, the inflation differential and all inflation rates are annualized quarterly rates.} This plot shows that a region within a currency union can reduce the volatility of its inflation differential relative to the rest of the union by responding to the inflation differential with a negative coefficient in the tax rule. In fact, by choosing a rule that responds strongly to the inflation differential, a region can essentially force its inflation rate to move with that of the rest of the union. Furthermore, as Panel C shows, this reduced volatility of the inflation differential leaves the volatility of real output largely unchanged. Panel B displays the relationship between the volatility of the inflation differential and the volatility of inflation in both countries and union-wide inflation. Choosing a rule that reduces the volatility of the inflation differential, reduces the volatility of domestic inflation locally but it increases the volatility of both foreign and union-wide inflation. Finally, the use of tax policy to stabilize the inflation differential leads to substantially greater volatility of the distortionary tax rate.

Fundamentally, volatility in any of the endogenous variables in the model is a result of volatility in productivity and government spending. Thus, the tax rule alters endogenous volatility by altering the response of the economy to productivity and government spending shocks. As indicated by Panel A of Figure 4, a country can reduce the volatility of its inflation differential with respect to union-wide inflation by responding to this differential with a negative coefficient in the tax rule. Recall that the consumer’s problem implies that, in equilibrium, the after-tax wage rate $(1 - \tau_t)w_t$ equals the marginal rate of substitution between labor and consumption $u_{l,t}/u_{c,t}$. Now, consider the price-setting problem of firms. When prices are flexible, firms set their relative price as a constant markup $\theta/(\theta - 1)$ over marginal cost $\psi_t = w_t/z_t$. If the fiscal authority lowers the labor tax rate in response to a shock that generates a positive price differential, then, all else equal, the wage rate $w_t$ needs
to increase less (or decrease more) in order to satisfy the consumer’s optimality condition. Since the wage rate increases less, firms increase their relative price less and, in equilibrium, the price level increases less. Therefore, when prices are flexible, the fiscal authority can reduce the inflation differential associated with exogenous shocks by lowering (increasing) the tax rate on labor income in response to shocks that generate a positive (negative) inflation differential. When prices are sticky, the price set by firms at any given period depends not just on current marginal cost but also on future expected marginal costs and demand. The intuition above, however, still holds and a “pro-cyclical” distortionary tax rate is associated with lower inflation differentials.

By using fiscal policy, a region in a currency union can stabilize its inflation differential with the union. However, as Panel B in Figure 4 shows, this stabilization is not associated with the stabilization of the domestic inflation rate. In fact, by responding strongly to inflation differentials, the fiscal authority may increase the volatility of its domestic inflation. In addition, both the volatility of union-wide inflation and foreign inflation increase as the domestic fiscal authority responds to the inflation differential.

When a regional fiscal authority responds to its inflation differential, it responds to any shock that affects its inflation rate relative to the union-wide inflation rate. In our model, the domestic (foreign) inflation rate in a country is mostly affected by domestic (foreign) shocks while union-wide inflation is the average of the inflation rates in the two countries. Therefore, all shocks in the union affect the inflation differential of a region with respect to the union-wide inflation rate. That is, a regional fiscal authority targeting its inflation differential will respond to all shocks, regardless of their origin. These effects are illustrated in Figure 5, for the case of productivity shocks to the home and foreign nontraded goods sector. This figure plots the response of domestic and foreign inflation and domestic real output to shocks originating in either country when $\alpha_{r,\pi}$ equals 0 and $-6.20$

The response of the fiscal authority to the inflation differential (with $\alpha_{r,\pi} < 0$) dampens the response of domestic inflation to the shocks that affect domestic inflation more than union-wide inflation (i.e., shocks originating in the home country). However, the response of

---

20 These effects are qualitatively similar for shocks to productivity of the traded goods sector or shocks to government spending.
fiscal policy magnifies the response of domestic inflation to the shocks that affect union-wide inflation more than domestic inflation (i.e., shocks originating in the foreign country). Intuitively, in order to stabilize the inflation differential, the home country effectively “imports” union-wide inflation when responding to shocks that originate in the foreign country. For small negative values of $\alpha_{\tau,\pi}$, the response of the domestic fiscal authority to shocks originating in the home country (which matter the most for home inflation volatility) dominates and the volatility of domestic inflation decreases. However, as $\alpha_{\tau,\pi}$ falls and the response to inflation differentials becomes stronger, the response of the domestic fiscal authority to shocks originating in the foreign country dominates and the volatility of domestic inflation increases. With respect to the behavior of foreign inflation, the response of the domestic fiscal authority to its inflation differential magnifies the response of foreign inflation to those shocks that matter the most for foreign inflation volatility (i.e., shocks originating in the foreign country). By forcing the domestic inflation rate to replicate the behavior of union-wide inflation, the domestic fiscal authority magnifies the response of the price of home traded goods which, in turn, magnifies the response of foreign inflation.\footnote{In the case of a productivity shock to the foreign nontraded goods sector, the domestic fiscal authority responds to the the initial inflation differential by lowering the tax rate on labor income. This response leads the before-tax wage rate in the home country to fall relative to the case in which the fiscal stance does not change. Since the wage rate falls, the price of home traded good does not rise as much and the price of traded goods do not rise as much in the foreign country. In equilibrium, thus, the foreign price level falls more in response to a productivity shock to the foreign nontraded goods sector when the home fiscal authority responds to its inflation differential.} As Figure 4 shows, the volatility of foreign (and union-wide) inflation increases as the response of the home region to its inflation differential becomes stronger.

In contrast to its effect on inflation rates, regional fiscal policy that responds the inflation differential leaves the volatility of real output largely unaffected. Because prices adjust slowly to exogenous shocks, output responds gradually to exogenous shocks as well. The response of the labor income tax to inflation differentials makes the response of output more sluggish, but it does not affect its volatility substantially.\footnote{In the case of a productivity shock to the home nontraded good depicted in Figure 5, the tax rate increases for three periods in response to the negative inflation differential associated with this shock. The increase in the tax rate is associated with less hours worked in equilibrium and, thus, lower real output compared to the case in which the tax rate does not respond. After three periods the tax rate falls and real output increases compared to the case in which the fiscal stance is constant.}
The results in Figure 4 suggest that regional fiscal authorities have a limited ability in controlling the volatility of domestic inflation by responding to the inflation differential. Underlying this result is the fact that by responding to the inflation differential, the domestic fiscal authority will respond to (shocks that affect) both domestic and union-wide inflation. This figure also suggests that regional fiscal policy that responds to the inflation differential has substantial spill-over effects in a currency union of two equally-sized regions. By affecting the volatility of foreign and union-wide inflation, these regional fiscal policies thus would affect the desired behavior of foreign regional fiscal policy and common monetary policy.

As discussed previously, the mechanisms for relative price differentials across regions in a currency union highlighted in our model do not require any mechanism for monetary non-neutrality. In the absence of price stickiness, the model would imply much higher variability of inflation and the inflation differential. When prices are flexible, a regional fiscal rule that responds to the inflation differential would imply unambiguously higher volatility of domestic inflation. As in the case when prices adjust gradually, lower volatility of the inflation differential and higher volatility of domestic inflation leave the volatility of real output largely unaffected. Moreover, as in the case with sticky prices, the volatility of foreign and union-wide inflation increases with the response of the domestic fiscal policy to the inflation differential when prices are flexible.

To summarize, a region that delegates monetary policy to a central monetary authority has limited ability to control the behavior of its domestic inflation when it responds to its inflation differential. Therefore, we investigate the implications of a tax rule that responds to domestic inflation.\(^{23}\) In Figure 6 we display the relationship between the volatility of domestic inflation and that of other endogenous variables when the domestic fiscal authority chooses to respond to domestic inflation rather than to the inflation differential. As before, the fiscal authority can reduce the volatility of its inflation rate by lowering (raising) the labor income tax rate in response to high (low) domestic inflation. Note that when the domestic fiscal authority responds to domestic inflation, the volatility of both foreign and union-wide inflation decrease as well. The increase in nominal stability, however, is associated with

\(^{23}\)That is, we assume that the tax rate on labor income is given by the rule \(\tau_t = \tau + \alpha_t \pi_t - \pi\), where \(\pi\) is the target value for domestic inflation.
higher real volatility.

Figure 7 illustrates the effects of a shock to the process of home and foreign nontraded productivity on domestic and foreign inflation and domestic real output. We consider the case in which the domestic fiscal authority does not respond to domestic inflation ($\alpha_{\tau,\pi} = 0$) and the case in which it responds to deviations of domestic inflation from steady-state (with $\alpha_{\tau,\pi} = -6$). When the home country responds home inflation, the response of the inflation differential and of foreign inflation to shocks that originate in the foreign country remains largely unaffected since these shocks have a relatively small impact on domestic inflation. The response of fiscal policy also dampens the response of foreign inflation (and union-wide inflation), by dampening the inflation response to shocks that originate in the home country. In response to shocks that originate in the foreign country, however, the response of the domestic tax rate magnifies the adjustment of real output. The results in Figure 6 suggest that reducing the volatility of domestic inflation through regional fiscal policy carries with it higher real volatility. As before, these policies also have important spill-over effects on union-wide and foreign inflation rates.

6 Conclusion

This paper investigates the extent to which regional fiscal policy can affect the behavior of regional inflation in a general equilibrium model of a two-region currency union. We find that a regional fiscal authority can decrease the absolute value of its inflation differential in response to the shocks driving the model by lowering (raising) the distortionary tax rate in response to positive (negative) inflation differentials. We find that fiscal policies that lower substantially the volatility of the inflation differential may raise the volatility of domestic inflation and unambiguously raise the volatility of foreign and union-wide inflation. The volatility of output remains largely unchanged by these policies.

When we consider fiscal policies that respond to domestic inflation, we find that policies that lower the volatility of domestic inflation also lower the volatility of foreign and union-

\footnote{In the case of a productivity shock to the foreign nontraded goods sector, the domestic tax rate increases in response to lower domestic inflation associated with the shock, magnifying the fall in domestic real output.}
wide inflation. The volatility of the inflation differential, however, remains largely unchanged while the volatility of domestic output increases.

Our results suggest that in the case of a currency union of two equally-sized regions, regional fiscal policies that affect the inflation rate or the inflation differential of a region, have substantial spill over effects on foreign and union-wide inflation rates. Thus, regional fiscal policy can affect the desired behavior of fiscal policy in the foreign country or of monetary policy by the central monetary policy. That is, our results suggest the need to study the problem of coordination between regional fiscal authorities and between the central monetary authority and regional fiscal authorities.

This paper addressed solely positive questions raised by the use of fiscal policy to affect inflation differentials in a currency union. Our emphasis on positive questions was motivated by the attention that has been focused recently on national inflation in EMU member countries. Specifically, there have been suggestions that countries should pursue policies aimed at affecting their national inflation rates. We study the feasibility and effectiveness of such policies. Nonetheless, the same developments in Europe also naturally motivate studying optimal fiscal and monetary policies in a currency union.
References


Figure 1: Government Spending Shock

Price Level: $h(x), f(\ast)$

Relative Prices: $\frac{p_T}{p_N(x)}, \frac{p_T^\ast}{p_N^\ast(\ast)} = \frac{p_T}{p_T^\ast}$

Consumption: $h(x) f(\ast)$

Output: $h(x) f(\ast)$

Real Wage: $h(x) f(\ast)$

Labor: $h(x) f(\ast)$
Figure 2: Productivity Shock to Nontraded Goods Sector

Price Level: $h(x), f(\ast)$

Relative Prices: $\frac{p_T}{p_N}(x), \frac{p_T^\ast}{p_N^\ast}(\ast), \frac{p_T}{p_T^\ast}(-)$

Consumption: $h(x) f(\ast)$

Output: $h(x) f(\ast)$

Real Wage: $h(x) f(\ast)$

Labor: $h(x) f(\ast)$

quarters
Figure 3: Productivity Shock to Traded Goods Sector

Price Level: $h(x), f(\cdot)$

Relative Prices: $p_T/p_N(x), p_T^*/p_N^*(\cdot), p_T/p_T^*(-)$

Consumption: $h(x) f(*)$

Output: $h(x) f(*)$

Real Wage: $h(x) f(*)$

Labor: $h(x) f(*)$
Figure 4: Home Country Responds to the Inflation Differential
Figure 5: Productivity Shock to Nontraded Goods Sector (home vs. foreign)

Home country responds to the inflation differential.
Figure 6: Home Country Responds to Domestic Inflation

Tax Response Parameter

Inflation Volatility

Output Volatility

Tax Rate Volatility

\[ \alpha_{\tau, \pi} \]

\[ \sigma(\pi) \]

\[ \sigma(\log(y)) \]

\[ \sigma(\pi) \]

\[ \sigma(\tau) \]

Graphs showing the relationship between various economic parameters, including tax response parameter, inflation volatility, output volatility, and tax rate volatility, as functions of inflation volatility.
Figure 7: Productivity Shock to Nontraded Goods Sector (home vs. foreign)

Home country responds to domestic inflation.