Fiscal consolidation and its cross-country effects. Is there a conflict of interests?*

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Abstract

We build a New Keynesian DSGE model consisting of two heterogeneous countries participating in a monetary union. We study how public debt consolidation in a country with high debt and sovereign risk premia (like Italy) affects welfare in a country with solid public finances (like Germany) and how these effects depend on the fiscal policy mix chosen to bring public debt down.

Keywords: Debt consolidation, country spillovers, feedback policy rules, new Keynesian.

JEL classification: E6, F3, H6

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1 Introduction

Most eurozone periphery countries are in a debt crisis. In view of rising sovereign risk premia and solvency concerns, these countries have been forced to take highly restrictive fiscal policy measures which have dampened demand in the short term. It is thus not surprising that fiscal consolidation has been one of the most debated policy areas over the past years. The controversy has been intensified by the lasting recession experienced by these countries.\(^1\) On the other hand, fiscal policy in eurozone center countries, like Germany, has been relatively neutral.\(^2\) Nevertheless, the recession in the crisis countries has also started to affect the German economy, which is another reminder of the importance of spillovers in an integrated area like the euro area.\(^3\)

In this paper, we study how public debt consolidation in a country with high debt and sovereign premia affects welfare in other countries with solid public finances. In particular, we study how public debt consolidation in a country like Italy affects welfare in a country like Germany and how these cross-border effects depend on the fiscal policy mix chosen to bring public debt down.

The setup is a New Keynesian world economy DSGE model consisting of two heterogeneous countries. An international asset allows agents in one country to borrow from, or lend to, agents in the other country. Our modelling implies that, as it is the case in the data, the home country (Germany) is a net lender and the other country is a net borrower (Italy) in the international asset market. This is driven by the assumption that agents differ in their degree of impatience. Namely, borrowers (the Italians) are less patient than lenders (the Germans). Being in a monetary union, there is a single monetary policy. On the other hand, the two countries are free to follow independent fiscal policies. Following most of the literature on debt consolidation, we assume that policy is conducted via simple and implementable feedback rules, meaning that the single monetary policy is conducted via a standard Taylor rule, while national fiscal policy instruments are allowed to respond to the gap between actual public debt and target public debt as shares of output, as well as to the gap between actual and target output. We experiment with various debt targets depending on whether national policymakers aim just to stabilize the economy around its status quo (defined as the solution consistent with the recent public finance data), or whether they also want to move the economy to a new reformed long run (defined as a solution with lower public debt and without sovereign premia).

\(^1\)This is in particularly true in Cyprus, Greece, Italy, Portugal and Spain. See e.g. EMU-Public Finances of the European Commission (2013) and the EEAG Report of CESifo (2013).

\(^2\)See e.g. EMU-Public Finances of the European Commission (2013) and the EEAG Report of CESifo (2013).

\(^3\)See e.g. the EEAG Report of CESifo (2013).
premia). Since we do not want our results to be driven by ad hoc differences in feedback policy coefficients across different rules, we compute optimized feedback policy rules when the welfare criterion is the weighted average of households’ expected lifetime utility in the two countries.

We solve the model numerically employing commonly used parameter values and policy data from Germany (the home country) and Italy (the foreign country). After we check that the model can mimic the key empirical characteristics of the two countries over the recent euro years, we use it as a point of departure to study the dynamic evolution of endogenous variables in response to policy reforms, focusing on debt consolidation in the high-debt country, Italy. Adopting the methodology of Schmitt-Grohé and Uribe (2004 and 2007), we compute the welfare-maximizing values of feedback policy coefficients by taking a second-order approximation to both the equilibrium conditions and the welfare criterion.

Our main results are as follows. First, fiscal consolidation in the high-debt country (Italy) benefits the country with solid public finances (Germany) over all time horizons. By constrast, in Italy itself, namely the country that takes the consolidation measures, such a policy is productive only if its citizens are relatively far-sighted. Thus, fiscal consolidation comes at a short- and medium-term pain in the country that undergoes it.

Second, the higher the say of Germany in policy setting, the stronger the fiscal consolidation in Italy should be. Also, as expected, the higher the say of Germany, the better off becomes Germany and the worse off becomes Italy.

These two first results combined imply that fiscal consolidation in a high debt country is a common interest over long horizons only. By contrast, in shorter horizons, there is a conflict of national interests. All this holds irrespectively of the fiscal policy mix used.

Third, the least distorting fiscal policy mix from the point of view of both countries is that Italy cuts public spending during the early phase of fiscal pain and, once its public debt has been reduced, uses the fiscal space created to cut labor or capital taxes which appear to be particularly distorting. Note that expectations of cuts in labor or capital taxes in the future, once debt consolidation has been achieved, play a key role. Use of public spending is also recommended in Germany, where the policy aim is cyclical stabilization only. In other words, using tax rates for debt reduction and/or shock stabilization is a bad idea from the viewpoint of both countries.

Our paper is related to two literatures. First, it is related to the literature on how monetary and fiscal policy instruments react, or should react, to the business cycle. Second, it is related

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to the literature on fiscal consolidation that usually compares spending cuts versus tax rises
needed for debt reduction. Nevertheless, as far as we know, there have not been any previous
attempts to welfare rank a rich menu of tax-spending policy instruments in a New Keynesian
DSGE model consisting of two interacting heterogeneous countries and study the cross-border
implications of various consolidation measures taken by the high-debt country.

The rest of the paper is organized as follows. Section 2 presents the model. The status
quo solution, using data from Germany and Italy, is in section 3. Section 4 explains our policy
experiments. Results are in section 5. Section 6 closes the paper.

2 Model

This section sets up a New Keynesian world economy DSGE model consisting of two hetero-
genous countries forming a monetary union.

2.1 Description of the model

Two heterogeneous countries form a closed system. An international asset allows agents in
one country to borrow from, or lend to, agents in the other country. International borrowing,
or lending, can only take place through a financial intermediary or an international bank (as
Curdia and Woodford, 2009 and 2010, point out, this can be thought as a financial friction).
The bank is located in the domestic country so any profits made by it are distributed to the
citizens of the domestic economy.

Our modelling implies that one country is a net lender and the other is a net borrower in the
international asset market. This systematic difference in behavior is driven by the assumption
that agents in the two countries differ in their impatience to consume or, equivalently, in
their time preference rates. In particular, the time preference rate of lenders is higher than
borrowers' or, equivalently, borrowers are more impatient than lenders (this is similar to the
modelling in e.g. Curdia and Woodford, 2009 and 2010). We like to think of the lender

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5See e.g. Coenen et al. (2008), Forni et al. (2010), Cogan et al. (2013), Erceg and Lindé (2012, 2013),
Papageorgiou (2012) and Philippopoulos et al. (2012, 2013) in DSGE models. Econometric studies on the
effects of debt consolidation strategies include Perotti (1996), Alesina et al. (2012) and Batini et al. (2012).

6See Okano (2014) for a recent New Keynesian currency union model consisting of two countries that provides
a good review of the related literature going back to Gali and Monacelli (2005, 2008).

7In Curdia and Woodford (2009, 2010), the systematic difference between lenders and borrowers is driven by
the assumption that the marginal utility of consumption is higher for the borrower than for the lender. Thus,
in both Curdia and Woodford (2009, 2010) and in our paper, agents differ in their preferences. The difference
is that in Curdia and Woodford (2009, 2010) agents differ in their utility functions, while in our paper agents
differ in their time preference rates. On the other hand, see e.g. Becker and Mulligan (1997) for the endogenous
determination of the time preference rate depending on income, education, effort, religion, etc. See also Nelson
et al. (2008) for a model calibrated to the US, where the time preference rate depends on consumption.
country as, say, Germany and the borrower country as, say, Italy.

On other dimensions, the model is a rather standard New Keynesian model. Each country produces an array of differentiated goods and, in both countries, firms act monopolistically facing Calvo-type nominal fixities. Nominal fixities can give a real role to monetary policy, at least in the transition path. We assume a single monetary policy but independent national fiscal policies.

In particular, the home economy is composed of $N$ identical households indexed by $i = 1, 2, ..., N$, of $N$ firms indexed by $h = 1, 2, ..., N$, each one of them producing a differentiated domestically produced tradable good, as well as of monetary and fiscal authorities. Similarly, in the foreign economy, where there are $N^*$ identical households indexed by $i^* = 1, 2, ..., N^*$, and $N^*$ differentiated firms indexed by $f = 1, 2, ..., N^*$. Population in both countries, $N$ and $N^*$, is constant over time. We assume for simplicity that the two countries are of equal size, $N = N^*$.

Below, we present the domestic country. The foreign country will be symmetric except explicitly said. A star will denote the counterpart of a variable or a parameter in the foreign country.

2.2 Households

This subsection presents household $i$ in the domestic country.

2.2.1 Consumption bundles

The quantity of variety $h$ produced at home by domestic firm $h$ and consumed by domestic household $i$ is denoted as $c^H_{i,t}(h)$. Using a Dixit-Stiglitz aggregator, the composite of domestic goods consumed by each household $i$, $c^H_{i,t}$, is given by:

$$c^H_{i,t} = \left[ \sum_{h=1}^{N} \kappa [c^H_{i,t}(h)] \phi = 1 \right]^{\frac{\phi}{1-\phi}}$$ (1)

where $\phi > 0$ is the elasticity of substitution across goods produced in the domestic country and $\kappa = 1/N$ is a weight chosen to avoid scale effects in equilibrium.

Similarly, the quantity of imported variety $f$ produced abroad by foreign firm $f$ and consumed by domestic household $i$ is denoted as $c^F_{i,t}(f)$. Using a Dixit-Stiglitz aggregator, the

\footnote{As in e.g. Blanchard and Giavazzi (2003), we find it more convenient to work with summations rather than with integrals.}
composite of imported goods consumed by each household \(i\), \(c^F_{i,t}\), is given by:

\[
c^F_{i,t} = \left[ \sum_{f=1}^{N} \kappa(c^F_{i,t}(f))^{\phi-1} \right]^{\frac{\phi}{\phi-1}}
\]  

(2)

In turn, having defined \(c^H_{i,t}\) and \(c^F_{i,t}\), household \(i\)’s consumption bundle, \(c_{i,t}\), is:

\[
c_{i,t} = \left( \frac{c^H_{i,t}}{\nu} \right)^\nu \left( \frac{c^F_{i,t}}{(1-\nu)^{1-\nu}} \right)
\]

(3)

where \(\nu\) is the degree of preference for domestic goods (if \(\nu > 1/2\), there is a home bias).

### 2.2.2 Consumption expenditure, prices and terms of trade

Household \(i\)’s total consumption expenditure is:

\[
P_t c_{i,t} = P^H_t c^H_{i,t} + P^F_t c^F_{i,t}
\]

(4)

where \(P_t\) is the consumer price index (CPI), \(P^H_t\) is the price index of home tradables, and \(P^F_t\) is the price index of foreign tradables (expressed in domestic currency).

Each household’s total expenditure on home goods and foreign goods are respectively:

\[
P^H_t c^H_{i,t} = \sum_{h=1}^{N} \kappa P^H_t(h)c^H_{i,t}(h)
\]

(5)

\[
P^F_t c^F_{i,t} = \sum_{f=1}^{N} \kappa P^F_t(f)c^F_{i,t}(f)
\]

(6)

where \(P^H_t(h)\) is the price of variety \(h\) produced at home and \(P^F_t(f)\) is the price of variety \(f\) produced abroad, both denominated in domestic currency.

We assume that the law of one price holds meaning that each tradable good sells at the same price at home and abroad. Thus, \(P^F_t(f) = S^*_t P^H_t(f)\), where \(S_t\) is the nominal exchange rate (where an increase in \(S_t\) implies a depreciation) and \(P^H_t(f)\) is the price of variety \(f\) produced abroad denominated in foreign currency. A star denotes the counterpart of a variable or a parameter in the rest-of-the world. Note that the terms of trade are defined as \(P^F_t / P^H_t\) \((= S^*_t P^H_t / P^F_t)\), while the real exchange rate is defined as \(S^*_t / P^*_t\).

### 2.2.3 Household’s problem

Each household \(i\) acts competitively to maximize expected discounted lifetime utility, \(V_0\):
$V_0 \equiv E_0 \sum_{t=0}^{\infty} \beta^t U (c_{i,t}, n_{i,t}, m_{i,t}, g_t)$ (7)

where $c_{i,t}$ is $i$'s consumption bundle as defined above, $n_{i,t}$ is $i$'s hours of work, $m_{i,t}$ is $i$'s real money holdings, $g_t$ is per capita public spending, $0 < \beta < 1$ is the time discount rate, and $E_0$ is the rational expectations operator conditional on the information set.

The period utility function is assumed to be of the form (see also e.g. Gali, 2008):

$$u_{i,t}(c_{i,t}, n_{i,t}, m_{i,t}, g_t) = \frac{c_{i,t}^{1-\sigma}}{1 - \sigma} - \frac{n_{i,t}^{1+\varphi}}{1 + \varphi} + \chi_m m_{i,t}^{1-\mu} + \chi_g g_t^{1-\zeta}$$

where $\chi_n$, $\chi_m$, $\chi_g$, $\sigma$, $\varphi$, $\mu$, $\zeta$ are preference parameters. Thus, $\sigma$ is a coefficient of intertemporal substitution and $\varphi$ is the inverse of Frisch labour elasticity.

The period budget constraint of household $i$ written in real terms is:

$$(1 + \tau_{i,t}^r) \left[ \frac{P^H}{P_t} c_{i,t}^{H} + \frac{P^F}{P_t} c_{i,t}^{F} \right] + \frac{P^H}{P_t} x_{i,t} + b_{i,t} + m_{i,t} + \frac{S_t P_t^*}{P_t} f_{i,t}^h + \frac{\phi^h}{2} \left( \frac{S_t P_t^*}{P_t} f_{i,t}^h - \frac{S P^*}{P} f_{i,t}^h \right)^2 =$$

$$= \left( 1 - \tau_{i,t}^k \right) \left[ \tau_{i,t}^k \frac{P_t}{P_{t-1}} k_{i,t-1} + \bar{\omega}_{i,t} \right] + (1 - \tau_{i,t}^u) w_{i,t} + R_{t-1} \frac{P_{t-1}}{P_t} b_{i,t-1} +$$

$$+ \frac{P_{t-1}}{P_t} m_{i,t-1} + Q_{t-1} \frac{S_t P_t^*}{P_t} \frac{P_{t-1}}{P_t} f_{i,t-1}^h - \tau_{i,t}^r f_{i,t}^h + \pi_{i,t}$$

(9)

where $x_{i,t}$ is $i$'s domestic investment, $b_{i,t}$ is the real value of $i$'s end-of-period domestic government bonds, $m_{i,t}$ is $i$'s end-of-period real domestic money holdings, $f_{i,t}^h$ is the real value of $i$'s end-of-period internationally traded assets denominated in foreign currency, $\tau_{i,t}^k$ denotes the real return to the beginning-of-period domestic capital, $k_{i,t-1}$, $\bar{\omega}_{i,t}$ denotes $i$'s real dividends received by domestic firms, $w_{i,t}$ is the real wage rate, $R_{t-1} \geq 1$ denotes the gross nominal return to domestic government bonds between $t - 1$ and $t$, $Q_{t-1} \geq 1$ denotes the gross nominal return to international assets between $t - 1$ and $t$, $\tau_{i,t}^r$ are real lump-sum taxes/transfers to each household, $\pi_{i,t}$ is profits distributed to the domestic household by the financial intermediary (see below) and $0 \leq \tau_{i,t}^r, \tau_{i,t}^k, \tau_{i,t}^u \leq 1$ are tax rates on consumption, capital income and labour income respectively. Small letters denote real values, namely, $m_{i,t} \equiv \frac{M_{i,t}}{P_t}$, $b_{i,t} \equiv \frac{B^h_{i,t}}{P_t}$, $f_{i,t}^h \equiv \frac{F^h_{i,t}}{P_t}$, $w_{i,t} \equiv \frac{W_2}{P_t}$, $\bar{\omega}_{i,t} \equiv \frac{\bar{\Omega}_{i,t}}{P_t}$, $\tau_{i,t}^r \equiv \frac{\tau_{i,t}^{r,i}}{P_t}$, where capital letters denote nominal values. The parameter $\phi^h \geq 0$ measures transaction costs related to foreign assets as a deviation from their long-run value, $f_{i,t}^h$.

These costs are not important to the main results but help the model with the data.
The law of motion of physical capital for each household $i$ is:

$$k_{i,t} = (1 - \delta)k_{i,t-1} + x_{i,t} - \frac{\xi}{2} \left( \frac{k_{i,t}}{k_{i,t-1}} - 1 \right)^2 k_{i,t-1}$$  \hspace{1cm} (10)$$

where $0 < \delta < 1$ is the depreciation rate of capital and $\xi \geq 0$ is a parameter capturing adjustment costs related to physical capital.

Each household $i$ acts competitively taking prices and policy as given. Details, the first-order conditions and implications for price bundles are in the Appendix (see Appendix 1).

### 2.3 Firms

Each domestic firm $h$ produces a differentiated good of variety $h$ under monopolistic competition and facing Calvo-type nominal fixities.

#### 2.3.1 Demand for firm’s product

Household’s problem above implies that the demand for firm $h$’s product is:

$$y_t^H(h) = c_t^H(h) + x_t(h) + g_t(h) + c_t^{F*}(h) = \left( \frac{P_H^t(h)}{P_{H'}^t} \right)^{-\phi} y_t^H$$  \hspace{1cm} (11)$$

where, demand for firm $h$’s product, $y_t^H(h)$, comes from domestic households’ consumption and investment, $c_t^H(h)$ and $x_t(h)$, where $c_t^H(h) \equiv \sum_{i=1}^{N} c_{i,t}^H(h)$ and $x_t(h) \equiv \sum_{i=1}^{N} x_{i,t}(h)$, from the domestic government, $g_t(h)$, and from foreign households’ consumption, $c_t^{F*}(h) \equiv \sum_{i=1}^{N^*} c_{i,t}^{F*}(h)$.

#### 2.3.2 Firm’s problem

Nominal profits of firm $h$ are defined as:

$$\tilde{\Omega}_t(h) \equiv P_t^H(h)y_t^H(h) - r_t^f P_t^H(h)k_{t-1}(h) - W_t n_t(h)$$  \hspace{1cm} (12)$$

This is maximized subject to the demand function above and the production function:

$$y_t^H(h) = A_t[k_{t-1}(h)]^\alpha [n_t(h)]^{1-\alpha}$$  \hspace{1cm} (13)$$

where $A_t$ is an exogenous stochastic TFP process whose motion is defined below.

In addition, following Calvo (1983), firms choose their prices facing a nominal fixity. In particular, in each period, each firm $h$ faces an exogenous probability $\theta$ of not being able to reset its price. A firm $h$, which is able to reset its price at time $t$, chooses its price $P_t^#(h)$ to
maximize the sum of discounted expected nominal profits for the next \( k \) periods in which it
may have to keep its price fixed. This objective is given by:

\[
E_t \sum_{k=0}^{\infty} \theta^k \Xi_{t,t+k} \Omega_{t+k} (h) = E_t \sum_{k=0}^{\infty} \theta^k \Xi_{t,t+k} \left\{ P_t^* (h) y_{t+k}^H (h) - \Psi_{t+k} (y_{t+k}^H (h)) \right\}
\]

where \( \Xi_{t,t+k} \) is a discount factor taken as given by the firm, \( y_{t+k}^H (h) = \left[ \frac{P_t^* (h)}{P_{t+k}^*} \right]^{-\phi} y_{t+k}^H \) and
\( \Psi_t(.) \) is the minimum nominal cost function for producing \( y_t^H (h) \) at \( t \) so that \( \Psi_t(.) \) is the
associated nominal marginal cost. Details for the firm’s problem and first-order conditions are
in the Appendix (see Appendix 2).

### 2.4 Government budget constraint

The period budget constraint of the consolidated government sector expressed in real terms
and aggregate quantities is:

\[
b_t + \frac{S_t P_t^*}{P_t^*} f_t^g + m_t = R_{t-1} \frac{P_{t-1}^*}{P_t^*} b_{t-1} + Q_t \frac{S_t P_t^*}{P_t^*} P_{t-1}^* f_{t-1}^g + \frac{P_{t-1}^*}{P_{t}} m_{t-1} +
\]

\[
+ \phi^g \left( \frac{S_t P_t^*}{P_t^*} f_t^g - \frac{S_t P_{t-1}^*}{P_{t-1}^*} f_{t-1}^g \right)^2 + \frac{P_t^*}{P_{t+1}^*} g_t - \tau_t^g \left( \frac{P_t^*}{P_{t+1}^*} c_t^H + \frac{P_t^*}{P_{t+1}^*} c_t^F \right) - \tau_t^g k_{t-1} + \tilde{\omega}_{i,t} - \tau_t^g m_t - \tau_t^g
\]

\[(14)\]

where \( b_t \) is the end-of-period domestic real public debt, \( f_t^g \) is the end-of-period foreign real
public debt expressed in foreign prices and \( m_t \) is the end-of-period stock of real money balances.

Thus, we use \( c_t^H \equiv \sum_{i=1}^{N} c_{i,t}^H \), \( c_t^F \equiv \sum_{i=1}^{N} c_{i,t}^F \), \( k_{t-1} \equiv \sum_{i=1}^{N} k_{i,t-1} \), \( \Omega_t \equiv \sum_{i=1}^{N} \tilde{\Omega}_{i,t} \), \( n_t \equiv \sum_{i=1}^{N} n_{i,t} \), \( F_{t-1}^h \equiv \sum_{i=1}^{N} F_{i,t-1}^h \), \( B_{t-1} \equiv \sum_{i=1}^{N} B_{i,t-1} \) and \( T_t^l \equiv \sum_{i=1}^{N} T_{i,t}^l \). As above, small letters
denote real variables, namely, \( b_t \equiv B_t \), \( m_t \equiv M_t \) and \( f_t^g \equiv F_t^g \). Also, the government allocates
its total expenditure among product varieties \( h \) by solving an identical problem with household
\( i \), so that \( g_t (h) = \left[ \frac{P_t^* (h)}{P_{t+1}^*} \right]^{-\phi} g_t \). The parameter \( \phi^g \geq 0 \) captures transaction costs similar to
those of the household.

In each period, one of the fiscal policy instruments \( (\tau_t^g, \tau_t^k, \tau_t^f, g_t, \tau_t^l, b_t, f_t^g) \) has to
follow residually to satisfy the government budget constraint. We assume that the residual
instrument is the end of period total public debt. That is, if we define total nominal public
debt in the domestic country as \( D_t \equiv B_t + S_t P_t^* \), so that in real terms \( d_t \equiv b_t + \frac{S_t P_t^*}{P_t^*} f_t^g \), we
then have \( b_t \equiv \lambda_t d_t \) and \( \frac{S_t P_t^*}{P_t^*} f_t^g \equiv (1 - \lambda_t) d_t \), where \( \lambda_t \) denotes the fraction of domestic public
debt in total public debt. Then, the exogenously set policy instruments are \( (\tau_t^g, \tau_t^k, \tau_t^f, g_t, \tau_t^l, \lambda_t) \), while \( d_t \) follows residually (see below for other cases).
2.5 World financial intermediary

We use a popular model of financial frictions (see e.g. Uribe and Yue, 2006). International borrowing or lending takes place through a financial intermediary or a bank. This bank is located in the home country. It borrows from domestic investors at a rate $Q_t$ and lends to foreign agents at a rate $Q_t^*$. At the same time, the bank faces operational costs which are increasing and convex in the amount of the loan.

The real profit of the bank is:

$$
\pi_t = Q_t^* \left[ (f_t^{*g} - f_t^{*h}) - \frac{\psi}{2} ((f_t^{*g} - f_t^{*h}) - \bar{f})^2 \right] - Q_t \frac{S_t P_t^*}{P_t} \left( f_t^h - f_t^g \right)
$$

(15)

where $\psi \geq 0$ and $\bar{f} \geq 0$ are parameters. Thus, $\bar{f}$ is a threshold value above which costs emerge. According to our notation, $(f_t^{*g} - f_t^{*h})$ is net foreign liabilities in the foreign country and $(f_t^h - f_t^g)$ is net foreign assets in the home country. Note that since the bank is located in the home country, its profits are distributed to private agents in the domestic country in a lump-sum fashion (see equation (9) above).

The bank chooses the amount of its loan taking $Q_t$ and $Q_t^*$ as given. Using the equilibrium condition that net borrowing equals net lending, namely, $F_t^{*g} - F_t^{*h} = S_t \left( F_t^h - F_t^g \right)$ or equivalently, after dividing by $P_t$, $f_t^{*g} - f_t^{*h} = \frac{S_t P_t^*}{P_t} \left( f_t^h - f_t^g \right)$, then the optimality condition of the international bank with respect to the amount of the loan is:

$$
Q_t^* = \frac{Q_t}{1 - \psi[(f_t^{*g} - f_t^{*h}) - \bar{f}]}
$$

(16)

so that $Q_t^* > Q_t$. Thus, borrowers have to pay a sovereign premium.10

2.6 Monetary and fiscal policy

To solve the model, we need to specify monetary and fiscal policy.

2.6.1 Single monetary policy rule

If we had flexible exchange rates, the exchange rate would be an endogenous variable and the two countries' nominal interest rates, $R_t$ and $R_t^*$, could be free to follow, say, Taylor rules. Here, to mimic the eurozone regime, we instead assume that only one of the interest rates,

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10Recall that, by contrast, in a single open economy model, in order to avoid the problem of non-stationary dynamics, one has to assume a deviation from the benchmark small open economy setup. A popular deviation has been to use an interest-elastic risk premium. This would produce an equation like (16). See Schmitt-Grohé and Uribe (2003) for a review of this literature.
say Germany’s, $R_t$, can follow a Taylor rule, while $R^n_t$ is an endogenous variable replacing the exchange rate which becomes an exogenous policy variable (this modelling is similar to that in e.g. Benigno and Benigno, 2008).\footnote{For various ways of modelling monetary policy in a monetary union, see also e.g. Dellas and Tavlas (2005) and Collard and Dellas (2006).}

In particular, we assume a single monetary policy rule of the form:

$$\log \left( \frac{R_t}{R} \right) = \phi_\pi \log \left( \frac{\Pi_t}{\Pi} \right) + \phi_y \log \left( \frac{y^H_t}{y^H} \right) + \phi^*_\pi \log \left( \frac{\Pi_t^*}{\Pi^*} \right) + \phi^*_y \log \left( \frac{y^*_t}{y^*_H} \right)$$  \hspace{1cm} (17)

where $\phi_\pi, \phi_y, \phi^*_\pi, \phi^*_y \geq 0$ are feedback monetary policy coefficients on inflation and output in each country and variables without time subscripts denote deterministic steady state values (defined below).

2.6.2 National fiscal policy rules

Countries can follow independent fiscal policies. Following Schmitt-Grohé and Uribe (2007) and many others, we focus on simple fiscal rules meaning that the fiscal authorities react to a small number of easily observable macroeconomic indicators. In particular, in each country, we allow the spending-tax policy instruments,\footnote{We focus on distorting policy instruments, because using lump-sum ones would be like a free lunch.} namely, government spending as share of output, defined as $s^g_t$, and the tax rates on consumption, capital income and labor income, $\tau^c_t$, $\tau^k_t$ and $\tau^n_t$, to react to the public debt-to-output ratio as deviation from a target, as well as to the output gap, according to the linear rules:\footnote{For similar rules, see e.g Schmitt-Grohé and Uribe (2007), Bi (2010) and Cantore et al. (2012). See also European Commission (2011) for fiscal reaction functions used in practice. Note that we include reaction to output because it is usually practice. In any case, since the magnitude of feedback policy coefficients is chosen optimally, adding more indicators is not restrictive (on the contrary).}

$$s^g_t - s^g = -\gamma^g_t (lt_{t-1} - l) - \gamma^g_y (y^H_t - y^H)$$  \hspace{1cm} (18)

$$\tau^c_t - \tau^c = \gamma^c_t (lt_{t-1} - l) + \gamma^c_y (y^H_t - y^H)$$  \hspace{1cm} (19)

$$\tau^k_t - \tau^k = \gamma^k_t (lt_{t-1} - l) + \gamma^k_y (y^H_t - y^H)$$  \hspace{1cm} (20)

$$\tau^n_t - \tau^n = \gamma^n_t (lt_{t-1} - l) + \gamma^n_y (y^H_t - y^H)$$  \hspace{1cm} (21)

where
\[ l_t = \frac{R_t \lambda_t D_t + Q_t \frac{S_{t+1}}{S_t} (1 - \lambda_t) D_t}{P_t^H y_t^H} \]  \hspace{1cm} (22)

where \( \gamma^q_t \geq 0 \) and \( \gamma^q_Y \geq 0 \) for \( q \equiv (g, c, k, n) \) are feedback fiscal policy coefficients on inherited public liabilities and output while variables without time subscripts denote deterministic steady state values (defined below).\(^{14}\) All other fiscal policy instruments (namely, lump-sum transfers, \( \tau^f \), and the fraction of domestic public debt in total public debt, \( \lambda \)) are set at their data average values (see below).

Fiscal policy in the foreign country is modelled similarly.

2.7 Exogenous variables and productivity shocks

We now specify the exogenous variables, \( \{A_t, A^*_t, \tau^f_t, \lambda_t, \tau^{f*}_t, \lambda^*_t, S_{t+1}/S_t\}_{t=0}^\infty \). Starting with TFP, we assume stochastic AR(1) processes of the form:

\[ \log (A_t) = (1 - \rho^a) \log (A) + \rho^a \log (A_{t-1}) + \varepsilon^a_t \]  \hspace{1cm} (23)

\[ \log (A^*_t) = (1 - \rho^{a*}) \log (A^*) + \rho^{a*} \log (A^*_{t-1}) + \varepsilon^{a*}_t \]  \hspace{1cm} (24)

where \( 0 < \rho^a, \rho^{a*} < 1 \) are persistence parameters, variables without time subscript denote long-run values and \( \varepsilon^a_t \sim N (0, \sigma^2_a) \), \( \varepsilon^{a*}_t \sim N (0, \sigma^{a*2}) \).

The exogenously set fiscal policy instruments, \( \{\tau^f_t, \lambda_t, \tau^{f*}_t, \lambda^*_t\}_{t=0}^\infty \), or equivalently, if we express lump-sum transfers as share of output, \( \{s^f_t, \lambda_t, s^{f*}_t, \lambda^*_t\}_{t=0}^\infty \),\(^{15}\) are assumed to be constant and equal to their data average values (see below). Finally, since this is a closed-system currency union model, the exogenous gross rate of exchange rate depreciation, \( S_{t+1}/S_t \), is set at 1 for simplicity.

2.8 Equilibrium system (given feedback policy coefficients)

We now combine all the above to present the Decentralized Equilibrium (DE) system which is for any feasible policy. The DE is defined to be a sequence of allocations, prices and policies such that: (i) households maximize utility; (ii) a fraction \( (1 - \theta) \) of firms maximize profits

\(^{14}\)We could assume that the long-run target of public liabilities, \( l \), is time-varying and stochastic. Our qualitative results do not depend on this. For time-varying and stochastic debt targets, see Coenen et al. (2008), Ercge and Linde (2013) and Philippopoulos et al. (2013).

\(^{15}\)Thus, \( s^f_t \equiv \frac{\tau^f_t}{y_t^H} \) and \( s^{f*}_t \equiv \frac{\tau^{f*}_t}{y^*_t} \).
by choosing an identical price $P_t^\#, \text{ while a fraction } \theta \text{ just set their previous period prices; (iii) the international bank maximizes its profit (iv) all constraints, including the government budget constraint and the balance of payments, are satisfied; (v) all markets clear, including the international asset market.}

Solution steps and the final DE system is presented in Appendix 3. It consists of a system of 58 equations in 58 variables, \{V_t, y_t^H, c_t, c_t^H, f_t, n_t, x_t, k_t, f_t^h, m_t, TT_t, \Pi_t, \Pi_t^H, \Theta_t, \Delta_t, w_t, mc_t, d_t, \tau_t, f_t^g, \Pi_t^s, z_t^1, z_t^2, \pi_t, Q_t, l_t, V_t^*, y_t^H, c_t^*, c_t^F, n_t^*, x_t^*, k_t^*, f_t^h, m_t^*, \Pi_t^H^*, \Theta_t^*, \Delta_t^*, w_t^*, mc_t^*, d_t^*, \tau_t^{xk}, d_t^*, z_t^{1*}, z_t^{2*}, Q_t^*, \Pi_t^s, R_t, s_t^0, \tau_t^c, \tau_t^n, R_t^*, s_t^g, \tau_t^{c*}, \tau_t^{k*}, \tau_t^{n*}\}_{t=0}^\infty. \text{ This is given the values of feedback policy coefficients as defined in subsection (2.6), the exogenous variables, } \{A_t, A_t^*, s_t^l, \lambda_t, s_t^{l*}, \lambda_t^*, \frac{s_t^{l1}}{S_t}\}_{t=0}^\infty, \text{ as defined in subsection 2.7, and initial conditions for the state variables.}

To solve this system, we take a second-order approximation around its steady state (we report that we have also experimented with non-approximate dynamics and they give the same results qualitatively). In the next section, we start with the steady state solution when policy is set as in the data. This "status quo" solution will in turn serve as a point of departure to study various policy reforms.

3 Data, parameterization and the status quo solution

This section solves the model numerically using common parameter values in related studies and fiscal data from Germany and Italy over 2001-2011. As we shall see, the model’s steady state solution will resemble the main empirical characteristics of the two countries over the recent euro years. Hence, we call it the "status quo" solution.

Recall that, since policy instruments react to deviations of macroeconomic indicators from their long-run values, feedback policy coefficients do not play any role in the long-run solution. Also recall that money is neutral in the long run so that the monetary and exchange rate policy regime do not matter to the real economy in the long run.

3.1 Data and parameterization

The fiscal and public finance data for Germany and Italy are from OECD Statistics and the Eurostat. The time unit is meant to be a year. The baseline parameter values, as well as the values of exogenous policy variables, are summarized in Table 1.

The model’s key parameters, $\beta, \beta^*$ and $\psi$, are calibrated to match the interest rate premium and the foreign position of the two countries in the data. In particular, the values of $\beta$ and $\beta^*$ follow from the Euler equations in the two countries which, at steady state, simplify to:
\[ \beta Q = 1 \quad (25) \]

\[ \beta^* Q^* = 1 \quad (26) \]

so that, since \( Q < Q^* \) in the data, \( \beta > \beta^* \). That is, the Germans are more patient than the Italians.

In turn, from the optimality condition of the bank:

\[ Q^* = \frac{Q}{1 - \psi[(f^{*g} - f^{*h}) - f]} \quad (27) \]

so that, given data from all variables, the value of \( \psi \) follows (while we set \( f = 0 \)).

We fix the values of all other parameters using commonly used values in related studies. We assume that these parameter values are the same across countries, so that the two countries can differ in the degree of patience and fiscal policy only. Interestingly, these two differences will be enough to give us a steady state solution close to the data averages.
Table 1: Baseline parameter values and policy variables

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Home</th>
<th>Foreign</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$a, a^*$</td>
<td>0.4</td>
<td>0.4</td>
<td>shares of capital</td>
</tr>
<tr>
<td>$\nu, \nu^*$</td>
<td>0.5</td>
<td>0.5</td>
<td>home goods bias parameters</td>
</tr>
<tr>
<td>$\mu, \mu^*$</td>
<td>3.42</td>
<td>3.42</td>
<td>parameters related to money demand elasticity</td>
</tr>
<tr>
<td>$\delta, \delta^*$</td>
<td>0.06</td>
<td>0.06</td>
<td>capital depreciation rates</td>
</tr>
<tr>
<td>$\phi, \phi^*$</td>
<td>6</td>
<td>6</td>
<td>price elasticities of demand</td>
</tr>
<tr>
<td>$\varphi, \varphi^*$</td>
<td>1</td>
<td>1</td>
<td>the inverse of Frisch labour elasticities</td>
</tr>
<tr>
<td>$\sigma, \sigma^*$</td>
<td>1</td>
<td>1</td>
<td>elasticities of intertemporal substitution</td>
</tr>
<tr>
<td>$\theta, \theta^*$</td>
<td>0.2</td>
<td>0.2</td>
<td>price rigidity parameters</td>
</tr>
<tr>
<td>$\lambda_m, \lambda_m^*$</td>
<td>0.001</td>
<td>0.001</td>
<td>preference parameter related to real money balances</td>
</tr>
<tr>
<td>$\lambda_n, \lambda_n^*$</td>
<td>5</td>
<td>5</td>
<td>preference parameter related to work effort</td>
</tr>
<tr>
<td>$\lambda_g, \lambda_g^*$</td>
<td>0.1</td>
<td>0.1</td>
<td>preference parameter related to public spending</td>
</tr>
<tr>
<td>$\xi, \xi^*$</td>
<td>0.01</td>
<td>0.01</td>
<td>adjustment cost parameter on physical capital</td>
</tr>
<tr>
<td>$\phi^h, \phi^h^*$</td>
<td>0.1</td>
<td>0.1</td>
<td>adjustment cost parameter on foreign public debt</td>
</tr>
<tr>
<td>$\phi^h, \phi^h^*$</td>
<td>0.1</td>
<td>0.1</td>
<td>adjustment cost parameter on private foreign assets</td>
</tr>
<tr>
<td>$\beta, \beta^*$</td>
<td>0.9709</td>
<td>0.957</td>
<td>time preferences</td>
</tr>
<tr>
<td>$\psi$</td>
<td>0.095</td>
<td>-</td>
<td>risk premium parameter</td>
</tr>
<tr>
<td>$f$</td>
<td>0</td>
<td>-</td>
<td>threshold parameter in the borrowing cost function</td>
</tr>
<tr>
<td>$\tau^c, \tau^{*c}$</td>
<td>0.19</td>
<td>0.17</td>
<td>consumption tax rate</td>
</tr>
<tr>
<td>$\tau^k, \tau^{*k}$</td>
<td>0.21</td>
<td>0.32</td>
<td>capital tax rate</td>
</tr>
<tr>
<td>$\tau^n, \tau^{*n}$</td>
<td>0.38</td>
<td>0.42</td>
<td>labour tax rate</td>
</tr>
<tr>
<td>$s^g, s^{*g}$</td>
<td>0.21</td>
<td>0.22</td>
<td>government spending as share of output</td>
</tr>
<tr>
<td>$s^l, s^{*l}$</td>
<td>-0.18</td>
<td>-0.21</td>
<td>lump-sum taxes</td>
</tr>
<tr>
<td>$\lambda, \lambda^*$</td>
<td>0.52</td>
<td>0.61</td>
<td>share of total public debt held by domestic/foreign private agents</td>
</tr>
<tr>
<td>$\sigma_{\alpha}, \sigma_{\alpha^*}$</td>
<td>0.01</td>
<td>0.01</td>
<td>standard deviation of TFP</td>
</tr>
<tr>
<td>$\rho^\alpha, \rho^{\alpha^*}$</td>
<td>0.92</td>
<td>0.92</td>
<td>persistence of TFP</td>
</tr>
</tbody>
</table>

3.2 Steady state solution or the "status quo"

Table 2 presents the steady state solution of the model economy in section 2 when we use the parameter values and the policy instruments in Table 1. In Table 2, we also present some key ratios in the German and Italian data whenever available. Notice that most of the solved ratios are close to their actual values. This solution will serve as a point of departure. That is, in what follows, we will depart from this solution to study various policy experiments. We report
(and this is shown below) that an exogenous reduction is public debt stimulates output and improves welfare in both countries; this can provide a justification for our fiscal consolidation experiments.

### Table 2: Steady state solution (the status quo)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Home</th>
<th>Data</th>
<th>Foreign</th>
<th>Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>$u, u^*$</td>
<td>steady-state utility</td>
<td>0.49</td>
<td>-</td>
<td>0.44</td>
<td>-</td>
</tr>
<tr>
<td>$n, n^*$</td>
<td>hours worked</td>
<td>0.29</td>
<td>-</td>
<td>0.28</td>
<td>-</td>
</tr>
<tr>
<td>$w, w^*$</td>
<td>real wage rate</td>
<td>0.94</td>
<td>-</td>
<td>0.91</td>
<td>-</td>
</tr>
<tr>
<td>$r^k, r^{k*}$</td>
<td>real return to physical capital</td>
<td>0.11</td>
<td>-</td>
<td>0.15</td>
<td>-</td>
</tr>
<tr>
<td>$Q - Q^*$</td>
<td>interest rate premium</td>
<td>-</td>
<td>-</td>
<td>0.015</td>
<td>-</td>
</tr>
<tr>
<td>$\frac{c}{y^{\nu}}T^{1-\nu}, \frac{c^*}{y^{\nu}}$</td>
<td>consumption as share of GDP</td>
<td>0.63</td>
<td>0.58</td>
<td>0.64</td>
<td>0.73</td>
</tr>
<tr>
<td>$\frac{k}{y^{\nu}}, \frac{k^*}{y^{\nu}}$</td>
<td>physical capital as share of GDP</td>
<td>2.93</td>
<td>-</td>
<td>2.16</td>
<td>3.48</td>
</tr>
<tr>
<td>$TT_t^\nu f^h_t \frac{1}{y_H}, \frac{f^{<em>h}_t}{y^{</em>}_{H}}$</td>
<td>private foreign assets as share of GDP</td>
<td>0.61</td>
<td>0.61</td>
<td>0.3</td>
<td>0.35</td>
</tr>
<tr>
<td>$\frac{d}{y^{\nu}}T^{1-\nu} \frac{d^<em>}{y^{</em>}}$</td>
<td>total public debt as share of GDP</td>
<td>0.71</td>
<td>0.71</td>
<td>1.10</td>
<td>1.09</td>
</tr>
<tr>
<td>$\frac{TT_t^\nu \left(\frac{(1-\lambda)d}{y^{\nu}y^{<em>}<em>{H}} - f^h_t\right)}{TT_t^\nu \frac{f^{<em>h}_t}{y^{</em>}</em>{H}}} \frac{(1-\lambda)d^</em>}{TT_t^\nu \frac{f^{<em>h}_t}{y^{</em>}_{H}}}$</td>
<td>total foreign debt as share of GDP</td>
<td>-0.28</td>
<td>-0.21</td>
<td>0.3</td>
<td>0.35</td>
</tr>
</tbody>
</table>

4  **Policy experiments and solution strategy**

Before we present results in section 5, we need to define the role of fiscal policy in each country and explain how we compute optimized policy rules.

4.1  **National fiscal policies**

Motivated by the facts discussed in the opening paragraph of the Introduction, we choose to study two types of fiscal action, one for each country.
4.1.1 Fiscal policy in the home country with solid public finances

Since the home country (Germany) follows a neutral fiscal policy, the role of national policy is only to stabilize the economy against shocks. In other words, the home country does not take any fiscal consolidation measures. It just stabilizes the public debt-to-GDP ratio at its average level. For instance, say that the economy is hit by a temporary adverse shock to TFP as modelled in equations (23)-(24). This, as the impulse response functions can show, leads to a contraction in output and a rise in the public debt-to-output ratio. Then, the policy questions are which tax-spending policy instrument to use over time, and how strong the reaction of those policy instruments to deviations from targets should be, in order to minimize cyclical volatility. In other words, we depart from, and end up at, the same fiscal position.

In particular, fiscal policy in the home country is defined as: (a) All tax-spending policy instruments remain at the same value (data average value) in both the status quo and the new long run. Note that the new long run differs from the status quo because of fiscal consolidation in the foreign country. (b) During the transition to the new long run, all tax-spending instruments are allowed to react to deviations from policy targets. (c) All the time, the public debt serves as the residually determined public financing instrument.

4.1.2 Fiscal policy in the foreign country with weak public finances

In the foreign country (Italy), the role of policy is twofold: to stabilize the economy against the same shock(s) as above and, at the same time, to improve resource allocation by gradually bringing down the public debt-to-GDP ratio and reducing the associated sovereign premium. In other words, we depart from the status quo solution, but we end up at a reformed steady state with a new fiscal position.

In particular, fiscal policy in the foreign country is defined as: (a) In the new long run, the output share of public debt falls from 110% (which is the average value in the Italian data over the recent period and it was also the value in our status quo solution in subsection 3.2) to the target value of 90%\(^\text{16}\) and there are no sovereign premia, \(Q = Q^*\).\(^\text{17}\) (b) In the new long run, since the public debt has been reduced and fiscal space has been created, fiscal spending can be increased, or one of the tax rates can be reduced, depending on which policy instrument is assumed to follow residually. This is known as the long-term fiscal gain from debt

\(^{16}\)We choose the target value of 90% simply because this is consistent with evidence provided by e.g. Reinhart and Rogoff (2010) and Checherita-Westphal and Rother (2012) that, in most advanced economies, the adverse effects of public debt arise when it is around 90-100% of GDP. Our main results are not sensitive to this.

\(^{17}\)This is only one out of many possible reforms. Alternatively, we could assume that debt is reduced but there are still differences between domestic and foreign interest rates. Our main results are not sensitive to this.
consolidation. (c) During the transition to the new long run, all tax-spending instruments are allowed to react to deviations from policy targets. Given that the long term debt target is lower than in the status quo, this requires lower public spending, and/or higher tax rates, during the transition period. This is known as the short-term fiscal pain of debt consolidation.  

Nevertheless, we will also solve for the case in which Italy does take any fiscal consolidation measures (that is, it reacts like Germany by just stabilizing its public debt at its recent historically high level); this will serve as a benchmark to evaluate the merits of fiscal consolidation.

4.1.3 How we model fiscal policy

To understand the logic of our results, and following usual practice in related studies, we will start by experimenting with one fiscal instrument at a time. This means that, along the early costly phase, we allow only one of the fiscal policy instruments to react to public debt imbalances and, at the same time, it is the same fiscal policy instrument that adjusts residually in the long-run to close the government budget. Thus, we will start by assuming that the same policy instrument bears the cost of, and reaps the benefit from, debt consolidation. In turn, we will experiment with fiscal policy mixes, which means that we can use different fiscal policy instruments in the transition and in the long run.

The rules for fiscal policy instruments are as in subsection 2.6.2 above except that now the targetted values are those of the reformed long-run equilibrium. In all experiments, all other fiscal policy instruments, except the one used for stabilization, remain unchanged and equal to their pre-reform status quo values.

Specifically, we work as follows. We first compare the steady state equilibria with, and without, debt consolidation in the foreign country. In turn, setting, as initial conditions for the state variables, their values from the solution without debt consolidation (in particular, from the status quo solution in subsection 3.2), we compute the equilibrium transition path as we travel towards the steady state of the reformed economy. This is for each method of public financing used. The feedback policy coefficients of the instrument(s) used for stabilization along

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18 It is recognized that debt consolidation implies a tradeoff between short-term pain and medium-term gain (see e.g. Coenen et al., 2008). During the early phase of the transition, debt consolidation comes at the cost of higher taxes and/or lower public spending. In the medium- and long-run, a reduction in the debt burden allows, other things equal, a cut in tax rates, and/or a rise in public spending. Thus, one has to value the early costs of stabilization vis-a-vis the medium- and long-term benefits from the fiscal space created. It is also recognized that the implications of fiscal reforms, like debt consolidation, depend heavily on the public financing policy instrument used, namely, which policy instrument adjusts endogenously to accommodate the exogenous changes in fiscal policy (see e.g. Leeper et al., 2009). In the case of debt consolidation, such implications are expected to depend both on which policy instrument bears the cost of adjustment in the early period of adjustment and on which policy instrument is expected to reap the benefit, once consolidation has been achieved. Notice that if lump-sum policy instruments were available, the costs of adjustment, as well as the benefits after adjustment has been achieved, would be trivial.
the transition path are chosen optimally. The way we compute optimized feedback policy rules with, or without, debt consolidation is explained in the next subsection.

4.2 Optimized policy rules

To make the comparison of different policies meaningful, we compute optimized feedback policy rules, so that results do not depend on ad hoc differences in feedback policy coefficients across different regimes. We start with defining the welfare criterion.

4.2.1 Welfare criterion

The welfare criterion is a weighted average of household’s expected discounted lifetime utility in the two countries. In particular, we assume:

\[ W_t = \eta V_t + (1 - \eta) V_t^* \]  

(28)

where \( 0 \leq \eta \leq 1 \) is the political weight of the home country vis-a-vis the foreign country, while \( V_t \) and \( V_t^* \) are as defined in equation (7) above. We will experiment with various values of \( \eta \).

Notice that this practically means that national fiscal policies, although they are allowed to differ, are set in a coordinated way. We choose this modelling because, these days, most fiscal policy decisions, especially fiscal consolidation measures, are taken under the advice, or coordination, of the European Union (see EMU-Public Finances of the European Commission, 2013). Alternatively, one could solve a Nash game in national fiscal policies.

4.2.2 How we compute optimized feedback policy rules

In choosing feedback policy coefficients optimally, we work in two steps. In the first preliminary step, we search for the ranges of feedback policy coefficients (as defined in equations (18-21) for the home country and analogously for the foreign country), which allow us to get a locally determinate equilibrium (this is what Schmitt-Grohé and Uribe, 2007, call implementable rules). If necessary, these ranges will be further restricted so as to give economically meaningful solutions for the policy instruments (e.g. tax rates less than one and non-negative nominal interest rates). In our search for local determinacy, we experiment with one, or more, policy instruments and one, or more, operating targets at a time.

In the second step, within the determinacy ranges found above, we compute the welfare-maximizing values of feedback policy coefficients (this is what Schmitt-Grohé and Uribe, 2005
and 2007, call optimized policy rules). The welfare criterion is to maximize the conditional welfare of the two households as defined in (28) above, where conditionality refers to the initial conditions chosen; the latter are given by the status quo solution above. To this end, following e.g. Schmitt-Grohé and Uribe (2004), we take a second-order approximation to both the equilibrium conditions and the welfare criterion. As is known, this is consistent with risk-averse behavior on the part of economic agents and, in addition, it can help us to avoid possible spurious welfare results that may arise when one takes a second-order approximation to the welfare criterion combined with a first-order approximation to the equilibrium conditions (for details, see e.g. Gali, 2008, Benigno and Woodford, 2012, and Okano, 2014).

In other words, we first compute a second-order accurate approximation of both the conditional welfare and the decentralized equilibrium, as functions of feedback policy coefficients and in, turn, we use a matlab function (such as fminsearch.m or fminsearchbnd.m) to compute the values of the feedback policy coefficients that maximize this approximation (matlab routines are available upon request). In this exercise, as said above, if necessary, the feedback policy coefficients are restricted to be within some prespecified ranges so as to deliver determinacy and give meaningful values for policy instruments. All this is with, and without, debt consolidation. The case without consolidation serves as a benchmark.

5 Results

In this section, we present the main results. We start with the reformed long run and in turn study transition dynamics and welfare over different time horizons.

5.1 Steady state utility with debt consolidation

The new reformed steady state is as defined in subsection 4.1 above. In other words, fiscal policy in the home country (Germany) remains as in the status quo. Namely, all exogenously set tax-spending instruments are set as in the data, while public debt plays the role of the residual instrument. On the other hand, in the foreign country (Italy), the exogenous debt reduction implies that public spending can rise, or a tax rate can be reduced, residually.

Table 3 reports steady state utility in both countries under various scenaria regarding the residual policy instrument used in Italy. For instance, in the first row of Table 3, the assumption is that it is public spending that takes advantage of debt reduction, in the sense that once the debt burden has been reduced, public spending can increase relative to its value in the status quo solution. In the other rows, the fiscal space is used to finance cuts in one of the three tax
rates.\textsuperscript{19}

If we recall that, in the status quo solution of Table 2, we had $u = 0.491$ for Germany and $u^* = 0.441$ for Italy, the message is that debt consolidation in the high-debt country is Pareto-efficient in the long run. In other words, long-run utility rises in both countries. Our solution for the rest of the endogenous variables implies that Italy gains thanks to the fiscal space created but also because of higher consumption, exports and more competitive terms of trade. Germany also gains mainly because of higher exports to prospering Italy. Notice also in Table 3 that the highest utility for both countries is achieved when Italy uses capital or labor taxes as the residual fiscal instrument (this is discussed below).

Table 3: Steady-state utility in the reformed economy

<table>
<thead>
<tr>
<th>residual policy instrument used</th>
<th>steady-state utility in Germany</th>
<th>steady-state utility in Italy</th>
</tr>
</thead>
<tbody>
<tr>
<td>$s^g$</td>
<td>0.502806</td>
<td>0.512196</td>
</tr>
<tr>
<td>$\tau^c$</td>
<td>0.517672</td>
<td>0.518888</td>
</tr>
<tr>
<td>$\tau^k$</td>
<td>0.525765</td>
<td>0.533285</td>
</tr>
<tr>
<td>$\tau^n$</td>
<td>0.528167</td>
<td>0.522998</td>
</tr>
</tbody>
</table>

5.2 Local determinacy

It is well recognized that the interaction between fiscal and monetary policy, and in particular the magnitude of the associated feedback policy coefficients, are crucial to local determinacy (see e.g. Leith and Wren-Lewis, 2008, in a related set up). Before we present transition results, we report that economic policy can guarantee local determinacy when fiscal policy instruments ($s^g_t$, $\tau^c_t$, $\tau^k_t$, $\tau^n_t$ and $s^g_t^*, \tau^c_t^*, \tau^k_t^*, \tau^n_t^*$) react to public liabilities between critical minimum and maximum non-zero values, where these critical values differ across different fiscal policy instruments, and when monetary policy satisfies the so-called Taylor principle, meaning that the single nominal interest rate reacts aggressively to inflation. This is also shown by the results for optimized policy rules below. By contrast, fiscal and monetary policy reaction to the output gap is not found to be crucial to determinacy. Further details regarding ranges of feedback policy coefficients guaranteeing local determinacy are available upon request.

\textsuperscript{19}In the new reformed long run, Italy can increase the output share of government spending by 1.8%, or reduce the consumption tax rate by 3.4%, or reduce the capital tax rate by 4% or reduce the labour tax rate by 4.3%.
5.3 Lifetime utility with debt consolidation

Within the determinacy ranges found, we now compute optimized policy rules and the associated expected discounted lifetime utility. Recall that the home country goes for shock stabilization only (in particular, shocks to TFP), while the foreign country goes for both shock stabilization and debt consolidation. Also recall that we start with the case in which we use the same fiscal policy instrument over time and across countries.\(^{20}\)

Results are reported in Table 4. The first column lists the monetary and fiscal policy instruments used in each scenario, the second column reports the optimal reaction of the single nominal interest rate to inflation in the two countries, and the third column reports the optimal reaction of national fiscal policies to national public debt. The last three columns report expected discounted lifetime utility in the whole union, the domestic country (Germany) and the foreign country (Italy) respectively.\(^{21}\) Recall that, under each policy regime, feedback policy coefficients are chosen to maximize the weighted average in (28), where we start by assuming the politically neutral case in which the two countries matter the same, i.e. we set \(\eta = 0.5\). We report that the resulting values of all instruments used are well-defined in all solutions and over all periods, meaning that tax rates are between zero and one and that the nominal interest rate is above the zero bound. Recall also that here we compare results under optimized policy rules so one should not except to see big differences across different policy regimes.

\(^{20}\) In particular, as said above in subsection 4.1, Italy and Germany use the same fiscal instrument over the transition, and this instrument is also used by Italy in the long run to close its government budget. In Germany, public debt plays the role of the residual instrument all the time including the long run.

\(^{21}\) To compare welfare across regimes, we could also use a flat consumption subsidy that makes the agent indifferent between two regimes (see e.g. Lucas, 1990). The policy message will be the same.
Table 4: Optimized rules and lifetime utility with debt consolidation in Italy ($\eta = 0.5$)

<table>
<thead>
<tr>
<th>instruments used</th>
<th>monetary reaction to inflation rates</th>
<th>national fiscal reactions to debt</th>
<th>$E_0W_0$</th>
<th>$E_0V_0$</th>
<th>$E_0V_0^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_t \ s_t^g \ s_t^{cg}$</td>
<td>$\phi_\pi = 1.1168$ \ $\phi_\pi^* = 0$</td>
<td>$\gamma_l^g = 0.0296$ \ $\gamma_l^{cg} = 0.5081$</td>
<td>16.9083</td>
<td>17.4643</td>
<td>16.3523</td>
</tr>
<tr>
<td>$R_t \ \tau_t^c \ \tau_t^{*c}$</td>
<td>$\phi_\pi = 0$ \ $\phi_\pi^* = 3$</td>
<td>$\gamma_l^c = 0.3621$ \ $\gamma_l^{*c} = 0.9016$</td>
<td>17.0125</td>
<td>17.6372</td>
<td>16.3877</td>
</tr>
<tr>
<td>$R_t \ \tau_t^k \ \tau_t^{*k}$</td>
<td>$\phi_\pi = 3$ \ $\phi_\pi^* = 3$</td>
<td>$\gamma_l^k = 0.629$ \ $\gamma_l^{*k} = 2$</td>
<td>17.2065</td>
<td>17.7853</td>
<td>16.6277</td>
</tr>
<tr>
<td>$R_t \ \tau_t^n \ \tau_t^{*n}$</td>
<td>$\phi_\pi = 3$ \ $\phi_\pi^* = 3$</td>
<td>$\gamma_l^n = 0.1208$ \ $\gamma_l^{*n} = 0.1194$</td>
<td>17.0802</td>
<td>17.7727</td>
<td>16.3878</td>
</tr>
</tbody>
</table>

Notes: In all solutions, $R_t \geq 1$, $0 < s_t^g$, $\tau_t^c$, $\tau_t^k$, $\tau_t^n < 1$, at all $t$.

Although we prefer to postpone a detailed interpretation of our results until below when we study policy mixes and various time horizons, it is worth pointing out, at this early stage, two results that remain unchanged throughout the paper. First, in all cases and over all time horizons, welfare in Germany (the patient country) is higher than welfare in Italy (the impatient country). Second, when we are restricted to use the same fiscal policy instrument in both countries and all the time, the capital tax rate scores better than all other fiscal policy instruments and this applies to both countries. This happens because, although fiscal consolidation implies a tradeoff between short-term pain and long-term gain in Italy, expectations of cuts in capital taxes in the future, once fiscal consolidation has been achieved, dominate over any other short-term effects and this is good for both countries since such expectations stimulate investment, growth and exports in both countries.\footnote{This is also the case in a semi-small open economy (see Philippopoulos et al., 2013). By contrast, in a closed economy without sovereign premia, public spending scores the best in terms of expected discounted lifetime utility (see Philippopoulos et al., 2012).}

The fact that it is expectations of cuts in capital and labor taxes in the future, that play the dominant role in lifetime results, is confirmed when we assume instead that the fiscal space created by fiscal consolidation in Italy is used to increase lump-sum transfers in this country, rather than to reduce distorting taxes, at steady state. In this case, with trivial expected benefits from fiscal consolidation, government spending and consumption taxes score better than capital and labor taxes. Results for this case are in Table 5.
Table 5: Optimized rules and lifetime utility with debt consolidation in Italy
when Italy uses the fiscal space to increase lump-sum transfers (\(\eta = 0.5\))

<table>
<thead>
<tr>
<th>instruments used</th>
<th>monetary reaction to inflation</th>
<th>national fiscal reactions to debt</th>
<th>(E_0W_0)</th>
<th>(E_0V_0)</th>
<th>(E_0V_0^*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(R_t) (s_t^g) (s_t^{sg})</td>
<td>(\phi_x = 0.1654) (\gamma_{1}^{g} = 0.0294)</td>
<td>(\gamma_{1}^{sg} = 0.6926)</td>
<td>17.1519</td>
<td>17.7780</td>
<td>16.5257</td>
</tr>
<tr>
<td>(R_t) (\tau_t^c) (\tau_t^{*c})</td>
<td>(\phi_\pi = 3) (\gamma_{1}^{c} = 0.2491)</td>
<td>(\gamma_{1}^{sc} = 0.7340)</td>
<td>16.9145</td>
<td>17.4574</td>
<td>16.3715</td>
</tr>
<tr>
<td>(R_t) (\tau_t^k) (\tau_t^{*k})</td>
<td>(\phi_\pi = 3) (\gamma_{1}^{k} = 0.0645)</td>
<td>(\gamma_{1}^{sk} = 1.4165)</td>
<td>16.8765</td>
<td>17.4469</td>
<td>16.3062</td>
</tr>
<tr>
<td>(R_t) (\tau_t^n) (\tau_t^{*n})</td>
<td>(\phi_\pi = 3) (\gamma_{1}^{n} = 0.1497)</td>
<td>(\gamma_{1}^{sn} = 0.1185)</td>
<td>16.7110</td>
<td>17.2070</td>
<td>16.2149</td>
</tr>
</tbody>
</table>

Notes: In all solutions, \(R_t \geq 1\), \(0 < s_t^{g}, \tau_t^{c}, \tau_t^{k}, \tau_t^{n} < 1\), at all \(t\).

5.4 Using different fiscal instruments over time and across countries

So far, we have studied one fiscal instrument at a time and this was both over time and across countries. Now we allow for policy mixes. In particular, both countries can now use all their national tax-spending policy instruments in the transition period. To the extent that feedback reactions are chosen optimally, this will tell us which fiscal mix is the least distorting along the transition to the new reformed long run. Also, we study what happens when Italy, the country that undergoes fiscal consolidation, uses different policy instruments in the long run once its public debt has been reduced.\(^{23}\)

The welfare implications of such mixes, all with debt consolidation in Italy, are reported in Table 6. The first row reports the case in which Italy reduces its labor tax rate once its public debt has been reduced. The next two rows report results when Italy cuts its capital tax rate or its consumption tax rate, while the last row reports results when the fiscal space is used to raise public spending. From the viewpoint of the monetary union as a whole, as well as from the viewpoint of Germany, the highest expected discounted utility is obtained by the mix in the first row. This mix implies that it is better to use public spending only during the early phase (the other feedback policy coefficients are practically zero), and this is irrespectively of whether the fiscal authorities aim at shock stabilization only or at both debt consolidation and

\(^{23}\) As said, Germany always uses public debt as the residual instrument in the long run.
shock stabilization, and in turn, once public debt has been stabilized, to cut labor taxes.

Table 6: Optimized rules and lifetime utility with debt consolidation in Italy when both Germany and Italy can use all instruments in the transition ($\eta = 0.5$)

<table>
<thead>
<tr>
<th>policy instruments in the transition</th>
<th>policy instrument in the long run</th>
<th>Feedbacks</th>
<th>$E_0W$</th>
<th>$E_0V$</th>
<th>$E_0V_0^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL $\tau^n$</td>
<td>$\phi_\pi = 1.0629$ $\phi_\pi^* = 0.0061$</td>
<td>$\phi_\pi = 1.0629$ $\phi_\pi^* = 0.0061$</td>
<td>$\gamma_i^g = 0.0293$ $\gamma_i^{g^*} = 0.7068$</td>
<td>$\gamma_i^{*c} = 0$ $\gamma_i^{*c} = 0.001$</td>
<td>$\gamma_i^{*k} = 0$ $\gamma_i^{*k} = 0.0007$</td>
</tr>
<tr>
<td>ALL $\tau^k$</td>
<td>$\phi_\pi = 0.1054$ $\phi_\pi^* = 1.0325$</td>
<td>$\phi_\pi = 0.1054$ $\phi_\pi^* = 1.0325$</td>
<td>$\gamma_i^g = 0.0295$ $\gamma_i^{g^*} = 0.7040$</td>
<td>$\gamma_i^{*c} = 0$ $\gamma_i^{*c} = 0.0002$</td>
<td>$\gamma_i^{*k} = 0$ $\gamma_i^{*k} = 0.0002$</td>
</tr>
<tr>
<td>ALL $\tau^c$</td>
<td>$\phi_\pi = 1.0987$ $\phi_\pi^* = 0$</td>
<td>$\phi_\pi = 1.0987$ $\phi_\pi^* = 0$</td>
<td>$\gamma_i^g = 0.0294$ $\gamma_i^{g^*} = 1.2571$</td>
<td>$\gamma_i^{*c} = 0$ $\gamma_i^{*c} = 0.0002$</td>
<td>$\gamma_i^{*k} = 0$ $\gamma_i^{*k} = 0.0002$</td>
</tr>
<tr>
<td>ALL $s^g$</td>
<td>$\phi_\pi = 1.1$ $\phi_\pi^* = 0.0004$</td>
<td>$\phi_\pi = 1.1$ $\phi_\pi^* = 0.0004$</td>
<td>$\gamma_i^g = 0.03$ $\gamma_i^{g^*} = 0.7346$</td>
<td>$\gamma_i^{*c} = 0$ $\gamma_i^{*c} = 0$</td>
<td>$\gamma_i^{*k} = 0$ $\gamma_i^{*k} = 0.0003$</td>
</tr>
</tbody>
</table>

5.5 Welfare over various time horizons with, and without, debt consolidation

We now study what happens to welfare over various time horizons. This is important because, for several (e.g. political-economy) reasons, economic agents can be short-sighted in which case expectations about future benefits from fiscal consolidation do not matter. Studying various
time horizons can also help us to understand the possible conflicts between short-, medium- and long-term effects from debt consolidation.

To save on space, we focus on the case in which we use the best policy mix found, namely the mix in the first row of Table 6 above. Setting the feedback policy coefficients as in the first row of Table 6, the expected discounted utility over various time horizons for the two countries is reported in Table 7. Numbers in parentheses report results without debt consolidation, other things equal. As explained above, without debt consolidation, we again compute optimized feedback policy rules but now the economy starts from, and also returns to, its status quo with transition dynamics driven by temporary shocks only.\(^\text{24}\)

There is a key message from Table 7. Other things equal, debt consolidation in Italy is always good for Germany. By constrast, in Italy, debt consolidation improves welfare only if we are relatively far-sighted. In particular, our results imply that expected discounted utility is higher with debt consolidation only when we care beyond the first 20 periods, where the exact turning year depends on the fiscal policy mix used, in the sense that the more distorting the mix, the slower the fiscal correction should be. Reversing the argument, fiscal consolidation comes at a short-term welfare cost in the country that undergoes it, while the same fiscal correction is all the time beneficial to the other countries with solid public finances.\(^\text{25}\) Thus, as it happens with most reforms, the argument for, or against, debt consolidation involves a value judgment.

Table 7: Welfare in Germany and Italy over different time horizons with, and without, debt consolidation in Italy (\(\eta = 0.5\))

<table>
<thead>
<tr>
<th></th>
<th>2 periods</th>
<th>4 periods</th>
<th>10 periods</th>
<th>20 periods</th>
<th>lifetime</th>
<th>long run</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Germany</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.1437</td>
<td>2.1864</td>
<td>4.8416</td>
<td>8.0814</td>
<td>18.2768</td>
<td>0.502807</td>
</tr>
<tr>
<td></td>
<td>(0.9659)</td>
<td>(1.8754)</td>
<td>(4.2989)</td>
<td>(7.3217)</td>
<td>(16.8587)</td>
<td>(0.490818)</td>
</tr>
<tr>
<td><strong>Italy</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.5791</td>
<td>1.2838</td>
<td>3.4368</td>
<td>6.4492</td>
<td>16.6421</td>
<td>0.517672</td>
</tr>
<tr>
<td></td>
<td>(0.8614)</td>
<td>(1.6479)</td>
<td>(3.6151)</td>
<td>(5.7805)</td>
<td>(10.2491)</td>
<td>(0.490818)</td>
</tr>
</tbody>
</table>

Note: Results without debt consolidation in parentheses.

\(^{24}\)The optimal feedbacks for the case without debt consolidation are \(\phi_p = 1.3465, \phi_{p^*} = 1.3176, \gamma^q = 0.1411, \gamma^q_1 = 0.071, \gamma^q_2 = 0.1312, \gamma^q_3 = 0.1013, \gamma^{g^*} = 0.1179, \gamma^{g^*_1} = 0, \gamma^{g^*_2} = 0, \gamma^{g^*_3} = 0.\)

\(^{25}\)It should be pointed out that the rise in welfare is partly driven by the fact that debt consolidation and elimination of sovereign premia in the reformed long-run equilibrium allow a higher value of the time preference rate than in the pre-reformed long-run solution in section 3 (in particular, the calibrated value of \(\beta\) was 0.9603 in the status quo solution in section 3.2, while it is 0.9709 without premia).
5.6 Does political power matter?

So far, we have restricted ourselves to the "politically correct" case in which the two countries shared equal political power in policy decision making. Thus, we had set the weight $\eta$ in equation (28) at 0.5. Now we examine what happens over the whole range $0 \leq \eta \leq 1$ varies. Recall that the higher is $\eta$, the more Germany matters. Results are reported in Table 8. To save on space, we focus again on the best policy mix found in Table 6, namely, when Italy and Germany use public spending in the transition phase while Italy cuts labor taxes once its fiscal consolidation has been implemented.

The main messages are as follows. First, as expected, the higher the say of Germany, the better off becomes Germany and the worse off becomes Italy. Second, the higher the say of Germany, the stronger the fiscal consolidation in Italy. This is shown by the monotonic positive effect of $\eta$ on the magnitude of the feedback fiscal policy coefficients on public debt in Italy. In particular $\gamma_\eta^{\text{g}}$ rises, as $\eta$ rises (the other feedback policy coefficients are practically zero).
Table 8: Optimized rules and lifetime utility with debt consolidation in Italy when both Italy and Germany use all instruments in the transition and Italy cuts labour taxes in the long run (various $\eta$)

<table>
<thead>
<tr>
<th>weight on Germany’s welfare</th>
<th>optimal national fiscal reactions to debt</th>
<th>$E_0W$</th>
<th>$E_0V_0$</th>
<th>$E_0V_0^*$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\phi_\pi = 1.0708$ $\phi_{\pi^*} = 0.0057$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^g_\ell = 0.0295$ $\gamma^{*g}_\ell = 0.6144$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta = 0.3$</td>
<td>$\gamma^{*c}_\ell = 0$ $\gamma^{*c}_g = 0$</td>
<td>17.1342</td>
<td>18.2731</td>
<td>16.6460</td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*k}_\ell = 0$ $\gamma^{*k}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*n}_\ell = 0$ $\gamma^{*n}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\phi_\pi = 1.0662$ $\phi_{\pi^*} = 0.0091$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^g_\ell = 0.0295$ $\gamma^{*g}_\ell = 0.6322$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta = 0.4$</td>
<td>$\gamma^{*c}_\ell = 0$ $\gamma^{*c}_g = 0.0011$</td>
<td>17.2970</td>
<td>18.2756</td>
<td>16.6447</td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*k}_\ell = 0$ $\gamma^{*k}_g = 0.0015$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*n}_\ell = 0$ $\gamma^{*n}_g = 0.0004$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\phi_\pi = 1.0629$ $\phi_{\pi^*} = 0.0061$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^g_\ell = 0.0293$ $\gamma^{*g}_\ell = 0.7068$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta = 0.5$</td>
<td>$\gamma^{*c}_\ell = 0$ $\gamma^{*c}_g = 0.001$</td>
<td>17.4594</td>
<td>18.2768</td>
<td>16.6421</td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*k}_\ell = 0$ $\gamma^{*k}_g = 0.0007$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*n}_\ell = 0.0006$ $\gamma^{*n}_g = 0.0006$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\phi_\pi = 1.0676$ $\phi_{\pi^*} = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^g_\ell = 0.0295$ $\gamma^{*g}_\ell = 0.7554$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta = 0.6$</td>
<td>$\gamma^{*c}_\ell = 0$ $\gamma^{*c}_g = 0$</td>
<td>17.6239</td>
<td>18.2796</td>
<td>16.6403</td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*k}_\ell = 0$ $\gamma^{*k}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*n}_\ell = 0$ $\gamma^{*n}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\phi_\pi = 1.0648$ $\phi_{\pi^*} = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^g_\ell = 0.0295$ $\gamma^{*g}_\ell = 0.8251$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\eta = 0.7$</td>
<td>$\gamma^{*c}_\ell = 0$ $\gamma^{*c}_g = 0$</td>
<td>17.7881</td>
<td>18.2821</td>
<td>16.6356</td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*k}_\ell = 0$ $\gamma^{*k}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$\gamma^{*n}_\ell = 0$ $\gamma^{*n}_g = 0$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6 Concluding remarks

This paper studied fiscal and monetary policy in a New Keynesian model consisting of two heterogeneous countries being part of a monetary union. We used optimized, simple and implementable feedback policy rules for various categories of taxes and public spending, as well as of the common nominal interest rate, in order to study the general equilibrium implications of fiscal consolidation in the high-debt country. A main result is that, although there is a common interest in the long term, there is a conflict of national interests in shorter horizons, and this is irrespectively of the policy mix chosen for debt consolidation and/or shock stabilization in each country. An extension could be to search for unconventional union-wide policies that reduce the short-term pain in the country that undergoes fiscal consolidation without hurting the other country.
References


