How do simple fiscal policy rules perform in monetary union?

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30 April 2012

To be completed

Abstract

The paper discusses the stabilising potential of simple fiscal policy rules for a small member country of monetary union in a two-region DSGE model with financial, goods and labour market frictions. It considers simple instrument rules for government consumption, transfers, the consumption tax and the labour income tax. The model also incorporates the obligation to stabilise government deficits/debt over the medium term. Countercyclical policy is welfare-enhancing for liquidity-constrained consumers, but no positive impact on the welfare of Ricardian households. Moderate aggregate welfare gains from optimal simple rules are contrast with potentially large losses from non-optimal policy.

JEL classification: E37, E62, F41

Keywords: fiscal policy, monetary union, simple rules, stabilisation, welfare

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1. Introduction

This paper investigates the potential of simple fiscal policy rules to stabilise business cycle fluctuations and reduce the welfare cost of asymmetric supply and demand shocks in monetary union. We develop a two-region New Keynesian DSGE model with goods, labour and financial market frictions. The analysis focuses on a small member country of monetary union, which allows keeping monetary policy and the rest of monetary union (RoU) exogenous. The potential of fiscal stabilization is particularly relevant for small countries in monetary union as they have no/little impact on union-wide aggregates and risk to be more exposed to idiosyncratic supply and demand shocks due to higher openness and specialisation.

The small-country setting departs from previous research on fiscal policy in monetary union that has focused on monetary unions of two large/symmetric countries and interactions between centralised monetary and decentralised fiscal policies (e.g., Beetsma and Jensen, 2004; Ferrero, 2009; Kirsanova et al., 2007) and tended to limit fiscal stabilisation to a small set of instruments, namely government purchases and lump-sum taxes.

The present paper broadens the analysis of countercyclical fiscal rules in monetary union. Main inspiration for the model design is the work by Galí and Monacelli (2008) that analyses optimal monetary and fiscal policy in a monetary union of small countries with price stickiness as friction, government purchases as instrument and technology shocks as disturbance. We broaden the analysis of fiscal stabilisation in all three dimensions by adding frictions (price/wage stickiness, financial frictions), disturbances (supply and demand shocks) and policy instruments (government purchases, consumption and labour taxes, transfers). Contrary to previous work, the paper also presents the welfare gains/losses from such fiscal rules for a range of fiscal response parameters instead of restricting the analysis to one (optimal) parameter combination. Looking at a range of parameters in the reaction function enables us to assess the robustness of simple instrument rules and illustrates not only potential welfare gains from optimal stabilisation policy, but also welfare costs of non-optimal policy.

The most notable deviation from previous literature with respect to the modelling of adjustment frictions concerns the financial side. In light of the empirical evidence (e.g., Kollmann, 1996), we depart from the assumption of perfect international risk sharing made by Beetsma and Jensen (2004), Ferrero (2009), Galí and Monacelli (2008) and Kirsanova et al. (2007) and use a debt-dependent country risk premium (e.g., Schmitt-Grohé and Uribe, 2003) as alternative closure rule. The debt-dependent risk premium generates interest spreads between member countries of monetary union.

Second, we incorporate liquidity-constrained (LC) households. The liquidity constraints are modelled as in Galí et al. (2007). They can replicate the observed positive correlation between private and government consumption at business cycle frequencies (e.g., Galí et al., 2007) and have been found relevant for the euro area (e.g., Forni et al., 2009; Ratto et al., 2009). The presence of LC households strengthens the case for stabilisation policy beyond price/wage stickiness, because fiscal policy is able to smooth income and utility streams, thereby mitigating the welfare cost associated with borrowing/lending constraints.

The plurality of fiscal tools has been highlighted by the recent literature on fiscal devaluation as a policy to achieve real exchange rate adjustment in a system of fixed nominal exchange rates (e.g., de Mooij and Keen 2012, Farhi et al. 2011). The literature on fiscal devaluation focuses on (revenue-neutral) combinations of export subsidies and import taxes or combinations of lower labour costs with higher consumption taxes. Adao et al. (2009), e.g., use a two-country model of monetary union to show that adjustable consumption taxes that discriminate between domestic and imported goods, which is similar to an import tax, can substitute for exchange rate flexibility and eliminate the welfare costs of loosing monetary autonomy under certain conditions. Schmitt-Grohé and Uribe (2011) discuss the welfare costs of exchange rate pegs in a small open economy with downward wage rigidity and suggest a time-varying wage subsidy to implement wage cost reduction in the presence of downward wage rigidity.

The stabilising potential of fiscal policy has also gained attention in zero-bound economies, where, e.g., Correia et al. (2011) show in a closed-economy model how tax policy can stimulate the economy and deliver welfare gains when monetary policy is constraint at the zero bound.

The recent interest in the effectiveness of fiscal devaluations and fiscal stimulus at the zero bound illustrate the potential role of fiscal policy when monetary policy is constrained. This is also the theme of the present paper. Whereas the fiscal devaluation and zero-bound literature discusses temporary or permanent discretionary measures, we consider simple policy rules to stabilise cyclical fluctuations. Simple rules are generally worse than the optimal solution in an economy exposed to different shocks at different moments, but they overcome the strong information requirements of the fully optimal solution and mitigate the time-consistency problem of discretionary policy. In addition, the discussion includes only non-discriminatory fiscal measures as discrimination between producers of different origin trough import taxes/export subsidies is not allowed in settings such as the EU internal market. While the literature on fiscal devaluation investigates how and when fiscal instruments can replicate the effect of nominal exchange rate adjustment, this paper looks more general at the potential of fiscal policy rules to stabilise aggregate demand and supply when nominal interest rates and the nominal exchange rates are fixed.

The political feasibility of fiscal instrument rules has traditionally been questioned. This paper's perspective is: if counter-cyclical fiscal rules of this type were feasible, what are the potential welfare gains, and how do potential gains from business-cycle stabilisation compare to the costs of pro-cyclical policies.

The paper finds a dichotomy in welfare effects of countercyclical policy for liquidity-constrained (LC) and Ricardian (NLC). LC households gain from the fiscal stabilisation of consumption (utility). NLC households tend to gain nothing or even lose from countercyclical fiscal rules. Welfare gains from optimal simple rules are modest compared to the welfare costs of non-optimal policy.

2. Model

The model consists of two regions: the small domestic member country of monetary union and the rest of monetary union (RoU). The model includes monopolistic competition in goods and labour markets, nominal price and wage stickiness, liquidity constraints and a set of fiscal instruments, namely consumption and income taxes, government purchases and public transfers. The presence of intertemporal optimising (NLC) and liquidity-constrained (LC) households implies that fiscal variables have substitution and income effects of fiscal variables.

RoU variables and monetary policy are exogenous from the perspective of the small member country. Goods and financial markets are imperfectly integrated across borders, namely there is home bias in consumption and limited substitutability between domestic and imported goods and a country risk premium for investment in foreign assets. Labour markets are segmented between countries, i.e. labour is immobile across countries.

Households

The household sector consists of a continuum of households *i*. The welfare of household *i* is the discounted sum of the period utilities:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[(1-\chi) \ln C_t^i + \chi \ln G_t - \kappa / (1+\varphi) \left(L_t^i \right)^{1+\varphi} \right] \tag{1.1}$$

Household utility is additive in private consumption (C^i), government purchases (G) and hours worked (L^i). The parameters β, χ, κ and 1/φ are the discount factor, the weight of the utility from government purchases, the weight of the disutility of hours worked and the elasticity of labour supply.

NLC households, who are a fraction 1-*slc* of the population, make optimal intertemporal choices under the period budget constraint:

$$\left(1-\tau_t^w\right) W_t^i L_t^i + TR_t^{NLC} + PR_t + \left(1+i_{t-1}\right) Q_{t-1} = \left(1+\tau_t^c\right) P_t C_t^{NLC} + Q_t + \frac{\gamma_w}{2} \left(\frac{W_t^i}{W_{t-1}^i} - 1 \right)^2 P_{H,t} L_t^{NLC} \tag{1.2}$$

On the revenue side, W^i is the nominal wage, τ^w is the (linear) tax rate on labour income, TR are lump-sum transfers, PR is nominal profit income and (1+i)Q the return on one-period assets of price Q. The expenditure side includes consumption expenditure, with P as the consumer price index and τ^c as the consumption tax, financial investment in assets of face value Q and quadratic wage adjustment costs ($\gamma_w/2$).

NLC households maximise welfare (1.1) given the budget constraint (1.2). The optimisation provides the first-order conditions (FOC) for consumption and saving:

$$(1-\chi) / C_t^{NLC} - \left(1+\tau_t^c\right) \lambda_t^{NLC} = 0 \tag{1.3}$$

$$\lambda_t^{NLC} / P_t - \beta \left(1+i_t\right) E_t \left(\lambda_{t+1}^{NLC} / P_{t+1} \right) = 0$$

Combining the two FOC gives the Euler equation for the optimal path of NLC consumption:

$$\beta E_t \left(\frac{1+\tau_t^c}{1+\tau_{t+1}^c} \frac{P_t C_t^{NLC}}{P_{t+1} C_{t+1}^{NLC}} \right) = \frac{1}{1+i_t} \tag{1.4}$$

The period budget constraint of LC households constituting the share *slc* of the population is:

$$\left(1-\tau_t^w\right)W_t^i L_t^i + TR_t^{LC} = \left(1+\tau_t^c\right)P_t C_t^{LC} + \frac{\gamma_w}{2}\left(\frac{W_t^i}{W_{t-1}^i}-1\right)^2 P_{H,t}L_t^{LC} \tag{1.5}$$

LC consumption is constrained by the disposable labour and transfer income and equals:

$$C_t^{LC} = \frac{1-\tau_t^w}{1+\tau_t^c}\frac{W_t^i}{P_t}L_t^i + \frac{1}{1+\tau_t^c}\frac{TR_t^{LC}}{P_t} - \frac{1}{1+\tau_t^c}\frac{\gamma_w}{2}\left(\frac{W_t^i}{W_{t-1}^i}-1\right)^2 \frac{P_{H,t}}{P_t}L_t^{LC} \tag{1.6}$$

The marginal value of the income of LC households is given analogously to equation (1.3) as:

$$\left(1-\chi\right)/C_t^{LC} - \left(1+\tau_t^c\right)\lambda_t^{LC} = 0 \tag{1.7}$$

The aggregate consumption level is the weighted average of NLC and LC consumption:

$$C_t \equiv \left(1-slc\right)C_t^{NLC} + slc C_t^{LC} \tag{1.8}$$

NLC and LC household consumption combines domestic (C_H) and imported (C_F) goods:

$$C_t^{(\eta-1)/\eta} = \alpha^{1/\eta}C_{H,t}^{(\eta-1)/\eta} + \left(1-\alpha\right)^{1/\eta}C_{F,t}^{(\eta-1)/\eta} \tag{1.9}$$

The parameters α and η measure the home bias and the elasticity of substitution between C_H and C_F. The demand functions for given prices P_H and P_F are:

$$C_{H,t} = \alpha\left(P_{H,t}/P_t\right)^{-\eta}C_t \tag{1.10}$$

$$C_{F,t} = \left(1-\alpha\right)\left(P_{F,t}/P_t\right)^{-\eta}C_t \tag{1.11}$$

C_H is itself a composite of varieties C^j produced by firms *j*:

$$C_{H,t}^{\frac{\varepsilon-1}{\varepsilon}} = \int_0^1 C_t^{j\,\frac{\varepsilon-1}{\varepsilon}}dj \tag{1.12}$$

where ε is the elasticity of substitution. The demand function for variety *j* is:

$$C_t^j = \left(P_t^j/P_{H,t}\right)^{-\varepsilon}C_{H,t} \tag{1.13}$$

The elasticity ε determines the price setting power of firms. The pricing margin declines with increasing ε. Higher values of ε amplify the impact of deviations from competitor prices on firm *j*'s market share.

Households *i* supply labour services (L^i) in a labour market in monopolistic competition. Total employment is a composite of the differentiated labour services:

$$L_t^{\frac{\theta-1}{\theta}} = \int_0^1 L_t^{i\,\frac{\theta-1}{\theta}} di \quad (1.14)$$

with θ as the elasticity of substitution between the varieties. Firms' demand for variety *i* is:

$$L_t^i = \left(W_t^i / W_t\right)^{-\theta} L_t \quad (1.15)$$

The market power of household *i* declines with increasing θ. High values of θ amplify the decline in the relative demand for L^i that would occur in reaction to higher individual wage claims. The labour services are equally distributed across NLC and LC households.

Labour unions set wages for the different types of labour services that maximise the household average of the marginal value of labour. Wage setting is subject to quadratic adjustment costs that introduce an incentive to smooth wage adjustment and lead to nominal wage stickiness. The union's optimisation problem is:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[-\frac{\kappa}{1+\varphi}\left(L_t^i\right)^{1+\varphi} + \lambda_t^i\left(1-\tau_t^w\right)\frac{W_t^i}{P_t} L_t^i - \lambda_t^i \frac{\gamma_w}{2}\left(\frac{W_t^i}{W_{t-1}^i}-1\right)^2 \frac{P_{H,t}}{P_t} L_t \right] \quad (1.16)$$

The optimal wage W^i maximises (1.16) given labour demand (1.15) and the marginal value of income (1.3) and (1.7). Wages are the same for NLC and LC households and derived from an averaging of NLC and LC marginal utilities by the wage-setting unions:

$$\lambda_t^{tot} \equiv \left(1-slc\right)\lambda_t^{NLC} + slc\lambda_t^{LC} \quad (1.17)$$

The optimisation problem is symmetric across unions, implying symmetric wages (W^i=W) and symmetric labour demand (L^i=L) across households, determined by:

$$\left(\eta-1\right)\left(1-\tau_t^w\right)\frac{W_t}{P_t} = \frac{\kappa\eta L_t^{\varphi}}{\lambda_t^{tot}} - \gamma_w\left(1+\pi_t^w\right)\pi_t^w \frac{P_{H,t}}{P_t} + \beta\gamma_w E_t\left[\frac{\lambda_{t+1}^{tot}}{\lambda_t^{tot}}\left(1+\pi_{t+1}^w\right)\pi_{t+1}^w \frac{P_{H,t+1}}{P_{t+1}}\frac{L_{t+1}}{L_t}\right] \quad (1.18)$$

where $\pi_t^W \equiv W_t/W_{t-1}-1$ is nominal wage inflation. Labour income taxation (τ^W) increases gross wage claims for given levels of employment.

Government sector

The government collects labour taxes and consumption taxes and issues 1-period bonds (B) to finance government purchases (G), lump-sum transfers (TR) and the servicing of outstanding debt:

$$\tau_t^w W_t L_t + \tau_t^c P_t C_t + B_t = P_t G_t + TR_t + \left(1 + i_{t-1}\right) B_{t-1} \tag{1.19}$$

Government purchases are an aggregate of domestic and imported goods analogously to private consumption in equations (1.9) and (1.12):[1]

$$G_t^{(\eta-1)/\eta} = \alpha^{1/\eta} G_{H,t}^{(\eta-1)/\eta} + \left(1-\alpha\right)^{1/\eta} G_{F,t}^{(\eta-1)/\eta} \tag{1.20}$$

$$G_{H,t}^{\frac{\varepsilon-1}{\varepsilon}} = \int_0^1 G_t^{j\,\frac{\varepsilon-1}{\varepsilon}} dj \tag{1.21}$$

The demand functions follow analogously as:

$$G_{H,t} = \alpha \left(P_{H,t} / P_t \right)^{-\eta} G_t \tag{1.22}$$

$$G_{F,t} = \left(1-\alpha\right)\left(P_{F,t} / P_t \right)^{-\eta} G_t \tag{1.23}$$

$$G_t^j = \left(P_t^j / P_{H,t} \right)^{-\varepsilon} G_{H,t} \tag{1.24}$$

In the benchmark setting, the government adjusts labour taxes to ensure the sustainability of public debt according to:

$$\tau_t^w = \tau_{t-1}^w + \xi_b \left(\frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} - btar \right) + \xi_d \Delta \frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} \tag{1.25}$$

where *btar* is the target debt-to-GDP ratio.

Furthermore, the fiscal authority can adjust government purchases, transfers or consumption tax rates following instrument rules that are similar to simple monetary policy rules:

[1] The EU's internal market and public procurement policies have weakened the case for the alternative assumption of strong/full home bias in government consumption.

$$\frac{G_t}{Y_t} = \rho \frac{G_{t-1}}{Y_{t-1}} + (1-\rho)\frac{G}{Y} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right) \quad (1.26)$$

$$\frac{TR_t}{Y_t} = \rho \frac{TR_{t-1}}{Y_{t-1}} + (1-\rho)\frac{TR}{Y} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right) \quad (1.27)$$

$$\tau_t^c = \rho\tau_{t-1}^c + (1-\rho)\overline{\tau}^c + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right) \quad (1.28)$$

Responding to fluctuations in the terms of trade (ToT) is motivated by the key role of price competitiveness for output, demand and external balances in monetary union. The ToT are included in fiscal rules also by Ferrero (2009). They are a robust indicator of capacity utilisation and price competitiveness under supply and demand shocks. Using the terms of trade in levels instead of first differences is motivated by the fact that output and employment stabilisation in the open economy requires a stabilisation of relative price levels. In addition, relative price level targeting is more aggressive than relative inflation targeting for given values of ξ_p to accelerate relative price adjustment in the presence of nominal price and wage stickiness.[2]

The analysis has been repeated with versions of the policy rules (1.26)-(1.28) that include a response to (lagged) output growth in addition to the response to the ToT.[3] Adding a direct fiscal response to output growth adds very little to the welfare consequences of the reaction functions (1.26)-(1.28). Against this background, the paper does not include simulations for the extended policy rules to keep the display and the discussion of the results concise.

The fiscal rules respond to economic conditions with 1-quarter delay to account for recognition/implementation lags as in Kirsanova et al. (2007), whereas Beetsma and Jensen (2004), Ferrero (2009), and Galí and Monacelli (2008) assume contemporaneous feedback.

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[2] In this sense, the policy rule is similar to price level versus inflation targeting in monetary policy, which is discusses by Cournède and Moccero (2009). However, an important difference compared to monetary rules is that ToT stationarity in a small member country of monetary union requires the stationarity of domestic prices, whereas ToT stationarity in an economy with flexible nominal exchange rate is compatible with a unit root in domestic prices as long as the combination of domestic prices and the nominal exchange rate is stationary.

[3] The advantage of output growth over the theoretical output gap in the policy rule is that the former is an observable. We have also tested the difference between domestic and foreign output levels as indicator of economic activity and found it to give contradictory signals for the fiscal stance. Positive domestic technology shocks, e.g., would suggest demand expansion to match the higher output potential and stabilise employment, whereas positive domestic demand shocks call for fiscal contraction to avoid an overheating of the economy. Hence, tightening in response to increasing relative output without correcting for potential output would amplify employment fluctuations in the case of TFP shocks.

Comparing the performance of the rules (1.26)-(1.28) to the no-stabilisation case will illustrate potential welfare gains from active fiscal policy. The focus on simple rules, as opposed to the optimal commitment solutions, derives from the fact that simple rules are easier to implement and to monitor, improving the government's ability to react timely and mitigating time-inconsistency problems.

Firms

The economy is home to a continuum of monopolistically competitive firms. Firms are owned by NLC households that receive the profit income. Each firm *j* produces a differentiated good (Y^j) under constant returns to scale with exogenous productivity (A) and with labour (L^j) as the only factor input:

$$Y_t^j = A_t L_t^j \tag{1.29}$$

The firms face quadratic price adjustment costs ($\gamma_p/2$) and set prices (P^j) to maximise the discounted expected profit:

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t^{NLC}}{\lambda_0^{NLC}} \left[\frac{P_t^j}{P_{H,t}} Y_t^j - \frac{W_t}{P_{H,t}} L_t^j - \frac{\gamma_p}{2} \left(\frac{P_t^j}{P_{t-1}^j} - 1 \right)^2 Y_t \right] \tag{1.30}$$

The FOC with respect to P^j under the demand functions (1.13) and (1.24), the production technology (1.29) and the NLC households' marginal utility of wealth (1.3) describes the pricing behaviour of firm *j*. As the FOC is identical for all firms, pricing is symmetric ($P^j = P_H$):

$$P_{H,t} = \frac{\varepsilon}{\varepsilon - 1 + \gamma_p \left(1 + \pi_{H,t}\right) \pi_{H,t} - \gamma_p \beta_t E_t \left[\frac{\lambda_{t+1}^{NLC}}{\lambda_t^{NLC}} \left(1 + \pi_{H,t+1}\right) \pi_{H,t+1} \frac{Y_{t+1}}{Y_t} \right]} \frac{W_t}{A_t} \tag{1.31}$$

with $\pi_{H,t} \equiv P_{H,t}/P_{H,t-1} - 1$ as the percentage change in the GDP price deflator.[4] Contrary to the model of staggered price setting, the symmetry of the pricing behaviour with quadratic adjustment costs excludes price dispersion, so that firms' output can be easily aggregated to total domestic production:

[4] Kumhof and Laxton (2009) use inflation adjustment instead of price adjustment costs in their discussion of simple fiscal policy rules for open economies. Contrary to the standard price adjustment costs that imply purely forward-looking inflation dynamics, inflation adjustment costs generate endogenous inflation persistence.

$$Y_t = \int_0^1 A_t L_t^j dj = A_t L_t \qquad (1.32)$$

External accounts

The total demand for domestic output is the sum of final domestic demand, net exports and the wage and price adjustment costs (ADC):

$$Y_t = \frac{P_t}{P_{H,t}}\left(C_t + G_t\right) + X_t - \frac{P_{F,t}}{P_{H,t}}\left(C_{F,t} + G_{F,t}\right) + ADC_t \qquad (1.33)$$

$$ADC_t \equiv \frac{\gamma_w}{2}\left(\frac{W_t}{W_{t-1}} - 1\right)^2 L_t + \frac{\gamma_p}{2}\left(\frac{P_{H,t}}{P_{H,t-1}} - 1\right)^2 Y_t$$

Inserting household and government demand functions (1.10)-(1.11) and (1.22)-(1.23) in (1.9) and (1.20) gives the consumer price level (P) of the domestic economy before consumption taxes:

$$P_t^{1-\eta} = \alpha P_{H,t}^{1-\eta} + \left(1-\alpha\right) P_{F,t}^{1-\eta} \qquad (1.34)$$

Exports (X) equal the import demand of the RoU analogously to equation (1.11):

$$X_t = \left(1-\alpha\right)\zeta\left(P_{H,t} / P_t^*\right)^{-\eta} Y_t^* \qquad (1.35)$$

which uses the fact that RoU production and consumption prices are approximately the same from the small-country perspective. The parameter $\zeta \equiv Y/Y^*$ measures the relative size of the two regions and guarantees the consistency of trade flows. The law of one price is assumed to hold, which excludes price discrimination between countries.

Combining the private and government budget constraints (1.2), (1.5) and (1.19) with the income definition of GDP as the sum of factor income and profits and net foreign assets (NFA) as the difference between private asset holding (Q) and domestic public sector debt (B) gives the aggregate resource constraint of the domestic economy:

$$NFA_t = \left(1 + i_{t-1}\right) NFA_{t-1} + P_{H,t} Y_t - P_t\left(C_t + G_t\right) - P_{H,t} ADC_t \qquad (1.36)$$

Borrowing rates in the domestic economy depend on the level of foreign indebtedness. The domestic agents pay a risk premium that varies with the NFA-to-GDP position:

$$i_t = i^* - \omega \frac{NFA_{t-1}}{4P_{H,t-1}Y_{t-1}} + \varepsilon_t^i \tag{1.37}$$

The debt-dependent borrowing rates exclude foreign debt explosion (e.g., Schmitt-Grohé and Uribe, 2003). A risk-premium shock (ε^i) is added to the endogenous risk premium (ω) on the interest rate.

Rest of monetary union

The RoU is treated as one single block. Trade with the small country is negligible in relation to output and domestic demand, so that we approximate the RoU as closed economy. The welfare function parallels the one for households in the small member country:

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[(1-\chi) \ln C_t^{i*} + \chi \ln G_t^* - \kappa / (1+\varphi) \left(L_t^{i*} \right)^{1+\varphi} \right] \tag{1.38}$$

The equivalent budget constraints imply analogous consumption and labour supply decisions:

$$\beta E_t \left(\frac{1+\tau_t^{c*}}{1+\tau_{t+1}^{c*}} \frac{P_t^* C_t^{NLC*}}{P_{t+1}^* C_{t+1}^{NLC*}} \right) = \frac{1}{1+i_t^*} \tag{1.39}$$

$$C_t^{LC*} = \frac{1-\tau_t^{w*}}{1+\tau_t^{c*}} \frac{W_t^{i*}}{P_t^*} L_t^{i*} + \frac{1}{1+\tau_t^{c*}} \frac{TR_t^{LC*}}{P_t^*} - \frac{\gamma_w}{2} \left(\frac{W_t^{i*}}{W_{t-1}^{i*}} - 1 \right)^2 L_t^{LC*} \tag{1.40}$$

$$C_t^* \equiv (1-slc) C_t^{NLC*} + slc C_t^{LC*} \tag{1.41}$$

$$(\eta-1)\left(1-\tau_t^{w*}\right)\frac{W_t^*}{P_t^*} = \frac{\kappa\eta\left(L_t^*\right)^{\varphi}}{\lambda_t^{tot*}} - \gamma_w\left(1+\pi_t^{w*}\right)\pi_t^{w*} + \gamma_w \beta E_t \left[\frac{\lambda_{t+1}^{tot*}}{\lambda_t^{tot*}} \left(1+\pi_{t+1}^{w*}\right)\pi_{t+1}^{w*} \frac{L_{t+1}^*}{L_t^*} \right] \tag{1.42}$$

The government budget constraint is:

$$\tau_t^{w*} W_t^* L_t^* + \tau_t^{c*} P_t^* C_t^* + B_t^* = P_t^* G_t^* + TR_t^* + \left(1+i_{t-1}^*\right) B_{t-1}^* \tag{1.43}$$

The government adjusts labour income taxes when public debt and deficits deviate from the targets:

$$\tau_t^{w*} = \tau_{t-1}^{w*} + \phi_b \left(\frac{B_{t-1}^*}{4P_{t-1}^* Y_{t-1}^*} - btar \right) + \phi_d \Delta \frac{B_{t-1}^*}{4P_{t-1}^* Y_{t-1}^*} \tag{1.44}$$

Fiscal authorities in the RoU may also react to cyclical fluctuations. However, given our focus on the small country and the availability of monetary policy at the aggregate level, we omit countercyclical fiscal rules in the RoU.

The central bank sets interest rates according to the simple rule:

$$i_t^* = \psi_i i_{t-1}^* + (1-\psi_i)(1-\beta)/\beta + (1-\psi_i)\left(\psi_y \Delta \ln Y_{t-1}^* + \psi_\pi \pi_{t-1}^*\right) \tag{1.45}$$

The RoU firms face a profit maximisation problem analogous to firms in the small economy, which determines the foreign price level:

$$P_t^* = \frac{\varepsilon}{\varepsilon - 1 + \gamma_p\left(1+\pi_t^*\right)\pi_t^* - \gamma_p \beta_t E_t\left[\frac{\lambda_{t+1}^{NLC*}}{\lambda_t^{NLC*}}\left(1+\pi_{t+1}^*\right)\pi_{t+1}^* \frac{Y_{t+1}^*}{Y_t^*}\right]} \frac{W_t^*}{A_t^*} \tag{1.46}$$

Total production is the aggregate of firm-level production:

$$Y_t^* = \int_0^1 A_t^* L_t^{j*} dj = A_t^* L_t^* \tag{1.47}$$

Demand in the RoU union equals private and public consumption plus adjustment costs:

$$Y_t^* = C_t^* + G_t^* + ADC_t^* \tag{1.48}$$

$$ADC_t^* \equiv \frac{\gamma_w}{2}\left(\frac{W_t^*}{W_{t-1}^*} - 1\right)^2 L_t^* + \frac{\gamma_p}{2}\left(\frac{P_t^*}{P_{t-1}^*} - 1\right)^2 Y_t^*$$

The NFA position of the RoU is the mirror image of the small economy's position, i.e. NFA*=-NFA. But given that Y/Y* is assumingly very small, NFA can be omitted from the RoU's aggregate resource constraint.

Parameterisation

Numerical values have to be given to the parameters to simulate the model. The values of the benchmark model are summarised in Table 1. The discount factor 0.995 for quarterly intervals implies an equilibrium annual real interest rate of 2%. The weight of government consumption in household utility is 0.20 and implies an optimal steady-state GDP-share of government consumption of 20%, which corresponds to the simple average value of the smaller

EMU-12 member countries during 1999q1-2009q4.[5] The elasticity of labour supply is set to 0.25, which falls in the range of microeconomic estimates, although DSGE models often uses higher values (e.g., Evers et al., 2008; Fiorito and Zanella, 2008). Estimates for the share of liquidity-constrained households in the euro area cluster around 0.40 (e.g., Forni et al., 2009; Ratto et al., 2009).

The aggregate price elasticity of trade flows of 1.5 corresponds to euro-area country estimates by Imbs and Méjean (2010). The value of 6 for the elasticity of substitution between varieties of goods and labour services implies price and wage mark-ups of 20%, which is in line with the mark-up estimates by Christopoulou and Vermeulen (2008). The price (wage) adjustment costs are calibrated as to generate the average price (wage) durations of 4 (5) quarters reported by Druant et al. (2009) and Knell (2010).

The consumption home bias is calculated as one minus the average trade openness, which itself corresponds to the average import-to-GDP share of 50% for the smaller EMU-12 countries in 1999q1-2009q4. With respect to the country-risk premium, the annualised borrowing rate increases by one basis point with every one percentage-point deterioration in the NFA-to-GDP position. An external risk premium of this magnitude has been estimated for Spain by Aspachs-Bracons and Rabanal (2010).

The labour income and consumption tax rates correspond to the average effective rates for the smaller EMU-12 economies as reported in the European Commission's Taxation Trends database. Public transfers are set to achieve stable government debt in the steady state for given government consumption and tax rates. Parameters of the debt-stabilisation rule are set so that the labour tax rate increases by 0.001 (1.0) percentage point per percentage-point increase of the government debt-to-GDP (deficit-to-GDP) ratio beyond their target levels. The parameters of the monetary policy rule (1.45) are standard and have no bearing on our results.

We estimate the technology (TFP) shock as an AR(1) process for the percentage deviation of labour productivity in the smaller EMU-12 countries from the EMU-12 average in 1999q1-2009q4. The focus on productivity gaps to the EMU mean instead of absolute fluctuations in

[5] The group of smaller EMU-12 countries includes the early EMU members with the exception of France, Germany and Italy; Luxemburg is also excluded. Focusing the parameterisation on early EMU members derives from the fact that these countries have more than one decade of EMU history to quantify the role of asymmetric supply and demand shocks. The macroeconomic series used in the parameterisation are taken from the OECD Main Economic Indicators database.

productivity owes to the assumption that monetary policy reacts to and stabilises shocks at the aggregate level. In the same spirit, the risk-premium shock is the AR(1) dynamics of the smaller EMU-12 countries' interest rate spreads over the German rate for 10-year government bonds in 1999q1-2009q4. The estimated innovations for TFP and the risk premium are not correlated.

Table 1: Model parameters

Parameter	Symbol	Value
Discount factor	β	0.995
Consumption utility weights	χ	0.20
Labour utility weight	K	1.00
Labour supply elasticity	$1/\varphi$	0.25
Share LC households	slc	0.40
Trade price elasticity	η	1.5
Substitution elasticity between goods varieties j	ε	6.0
Substitution elasticity between labour services i	θ	6.0
Price adjustment costs	γ_p	48
Wage adjustment costs	γ_w	80
Consumption home bias	α	0.50
Sensitivity of interest rates to debt	ω	-0.0025
Government consumption to GDP	G/Y	0.20
Labour income tax rate	τ^w	0.35
Consumption tax rate	τ^c	0.20
Debt-to-GDP target	btar	0.60
Fiscal reaction to debt	ξ_b	0.001
Fiscal reaction to deficits	ξ_d	1.00
Fiscal instrument persistence	ρ	0.50
Interest rate persistence	ψ_i	0.75
Coefficient on output growth	ψ_y	0.05
Coefficient on inflation	ψ_π	1.15
Persistence of technology shock	θ_a	0.643
Persistence of risk premium shock	θ_i	0.849
Standard error of technology shock	σ_a	0.040
Standard error of risk-premium shock	σ_i	0.024

Table 2 compares characteristic moments from the simulated model with baseline parameterisation, namely TFP and risk-premium shocks and no counter-cyclical fiscal reaction to the ToT, to their data equivalents for the smaller EMU-12 countries. The model matches important aspects of the data fairly well. It replicates the variables' correlation with output qualitatively and approximates well the strength of the correlations and the relative size of the standard deviations. The exception is employment, which is uncorrelated with output in the model and more volatile than in the data. The low correlation between employment and output illustrates the strong influence of TFP shocks in the model.[6] In addition, the model and data moments for employment are not easily compared. Employment in the model corresponds to hours worked. As encompassing data on hours worked at quarterly frequency are not available, however, employment in the data refers to the number of employees. Government consumption accounts for a fixed share of GDP in the baseline model setup, which implies perfect correlation between government consumption and output and a relative standard deviations of one.

Table 2: Moments from model benchmark parameterisation and EMU data

Variable	Baseline calibration		Actual data					
	Correlation with output	Standard deviation	Correlation with output			Standard deviation		
			Mean	Max	Min	Mean	Max	Min
Output	1.00	0.02	1.00	1.00	1.00	0.02	0.03	0.01
Private demand	0.61	1.80	0.89	0.96	0.80	1.20	1.79	0.59
Public consumption	1.00	1.00	0.17	0.53	-0.57	0.93	2.47	0.42
Trade balance	-0.28	1.07	-0.23	0.32	-0.68	1.12	1.42	0.80
Employment	0.00	1.76	0.68	0.97	0.29	0.75	1.40	0.47
Inflation	0.05	0.13	0.13	0.68	-0.62	0.60	1.05	0.37

Note: All variables are quarterly and - except for inflation and the trade balance - in logarithms and HP-filtered (λ=1600). The actual data are non-weighted 1999q1-2009q4 averages for EMU-12 countries, excluding Germany, France, Italy and Luxemburg. The data are seasonally adjusted and taken from the OECD Main Economic Indicators database. The trade balance is measured in percent of GDP. Inflation is the year-on-year percentage change of the core consumer price index. The standard deviation is the absolute standard deviation for output and for all other variables the standard deviation of the respective variable relative to the standard deviation of output.

We run simulations over the interval [-5; 5] of the fiscal stabilisation parameter ξ_p in steps of 0.1, even though the presentation of the results in sections 4 and 5 will be limited to sub-intervals of more limited fiscal responses. The welfare implications of $\xi_p \neq 0$ are displayed in percent of steady-state consumption for NLC households, LC households and the population average, which is the weighted mean of the NLC and LC groups.

[6] Other disturbances on the demand or supply side, such as fiscal shocks or swings in the monetary union aggregate, have been excluded in line with the focus on systematic fiscal policy and asymmetric shocks.

3. Model dynamics

This section presents impulse responses for TFP and risk-premium shocks in different versions of the model (Table 3) to illustrate the model dynamics.

Table 3: Model versions for impulse responses

Model version	Assumptions
Frictionless (FL)	No wage/price stickiness (γ_p=γ_w=0) and no liquidity constraints (slc=0) No cyclical fiscal policy response (ξ_p=0)
No policy (NP)	Wage/price stickiness and liquidity constraints as in Table 1 No cyclical fiscal policy response (ξ_p=0)
Countercyclical policy (CP)	Wage/price stickiness and liquidity constraints as in Table 1 Countercyclical fiscal policy response (ξ_p=-0.5)
Procyclical policy (PC)	Wage/price stickiness and liquidity constraints as in Table 1 Procyclical fiscal policy response (ξ_p=0.5)

Counter- and procyclical policies are captured by the policy rule for government consumption (1.26):

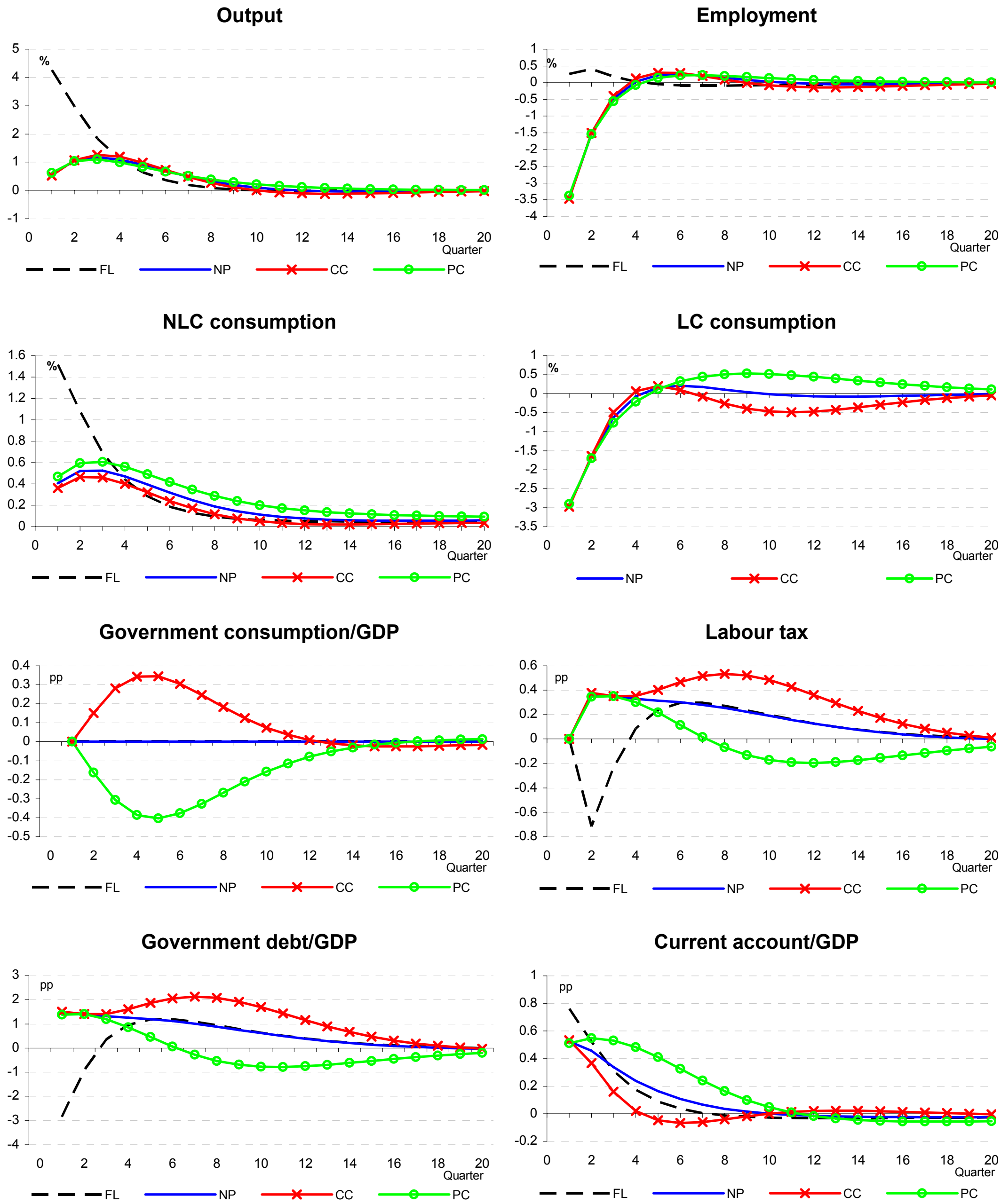
$$\frac{G_t}{Y_t} = (1-\rho)\frac{G}{Y} + \rho\frac{G_{t-1}}{Y_{t-1}} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right)$$

in which public consumption reacts with one-period lag to the terms of trade.

Impulse responses for a positive technology shock are shown in Figure 1. Output in the frictionless economy (FL) closely tracks the temporary TFP increase. Private consumption increases in response to the shock. Employment remains fairly stable, but increases slightly in reaction to the temporary labour tax reduction, which is a consequence of the budgetary closure rule (1.44) given the temporary decline in the government debt-to-GDP ratio. Net exports and the current account increase because of the improvement in price.

The output expansion in response to an exogenous TFP increase is less pronounced in the economy with price/wage stickiness and binding liquidity constraints (NP). Price stickiness dampens the decline in domestic goods prices, so that consumption and export demand do not increase in line with productivity and employment drops sharply. Falling employment reduces the wage income, so that consumption by LC households even declines.

Figure 1: Positive technology shock under alternative model settings



Countercyclical policy (CP) implies a rise in government spending in response to a positive TFP shock to narrow the gap between actual and potential output. Under the given coefficient (ξ_p=-0.5), the output expansion is small and much below the output increase in the frictionless economy, however. Increasing government consumption raises the level of public debt and triggers an increase in the labour tax according to the debt-stabilisation rule. The labour tax increase dampens the employment response to the TFP shock and higher gross real wages. The labour tax adjustment even reduces the disposable income of LC households, so that LC consumption falls below its level in the no-policy scenario in the medium term. Welfare gains from countercyclical policy in this scenario derive from government consumption being part of household utility (1.1), so that an increase in government purchases smoothes household utility in times when private consumption declines. Hence, given the decline in LC but not NLC consumption, the welfare gain should be relevant primarily for LC households. However, the labour tax increase that follows the expansion in government spending and reduces the disposable income of LC households partly offsets the beneficial impact in the medium term.

Finally, the procyclical policy (PC) means falling government demand in response to increasing TFP, which weights negatively on output and employment. Lower expenditure also reduces debt and future tax liabilities below the no-policy case, however, which raises NLC consumption. Lower labour taxes also increase the disposable income of LC households. The current account improves more strongly given lower government demand and the dampening impact of more moderate increases in labour taxation on wage claims and production costs.

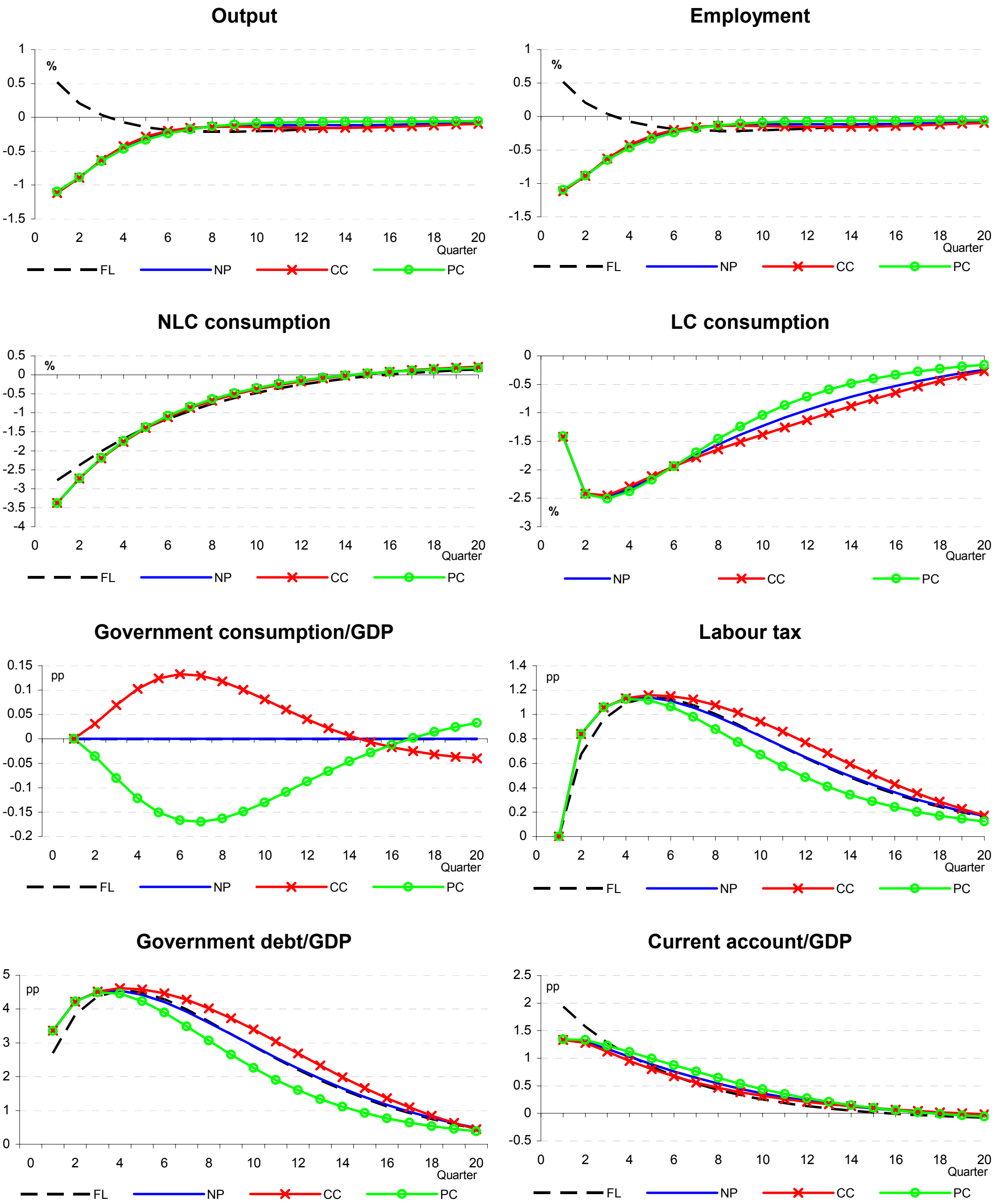
Impulse responses for the risk-premium shock are shown in Figure 2. The shock raises domestic borrowing rates, which dampens domestic demand. Wage and price adjustment in the frictionless economy mitigate the decline in domestic demand and increases net exports and the current account, however. The increase in the government's borrowing costs and declining consumption tax revenue increase the government debt burden and are met by increasing labour taxation, which further dampens demand and output in the medium term.

Price and wage stickiness (NP) weakens the decline in prices/wages, leading to a stronger real interest rate increase, hence less domestic demand, and less ToT correction, hence less net export growth, than in the flexible economy.

Countercyclical policy (CP) does not add much output, employment and demand stabilisation. Higher government consumption improves household welfare (1.1), however, insofar as it counteracts the welfare loss associated with declining private consumption. Hence, as in the case of the TFP shock, the countercyclical policy weakens the correlation between private fluctuations in private consumption and household welfare. The labour tax response to growing debt, however, raises production costs and translates into less net export and current account improvement in the medium term.

Finally, procyclical policy (PC) reduces government consumption in response to falling domestic prices associated with declining domestic demand. Hence, it reduces government purchases in times of low private consumption, which amplifies fluctuations in period utility. The procyclical policy also mitigates the raise in government debt and labour taxes compared to the no-policy case or countercyclical policy, however. The more tax increase dampens the rise in gross wage claims, with positive consequences for price competitiveness and net exports and the purchasing power of LC households in the medium term.

Figure 2: Risk-premium shock under alternative model settings



In sum, countercyclical government spending weakens the correlation between private consumption and household utility, notably for LC households, if government purchases enter household utility with positive sign. Hence, countercyclical government spending lowers the welfare cost of binding liquidity constraints by dampening utility fluctuations associated with volatility in constrained private consumption. A countercyclical variation of transfers, consumption taxes or labour taxes would similarly improve LC households' welfare by weakening the correlation between purchasing power and employment/gross wage income. The performance of countercyclical policy appears limited, however, if the government is obliged to combine business-cycle and deficit/debt stabilisation in the short/medium term and if deficit/debt can be stabilised only by increasing distortionary taxes.

4. Fiscal policy rules and welfare

Having discussed impulse responses in the previous section, this section adds explicit welfare analysis of policy rules of the type (1.26)-(1.28) in the context of business-cycle stabilisation. The previous discussion has already emphasised the link between business-cycle and deficit/debt stabilisation if the latter has to be based on distortionary taxes that reduce factor supply and/or future disposable income in the economy. The debt/deficit reaction function (1.25) reflects that most fiscal measures are distortionary and labour taxation tends to be the main source of the government revenue.

The welfare effect of government consumption, transfer or tax adjustment in response to ToT fluctuations caused by the combination of TFP and risk-premium shocks in the absence of nominal exchange rate adjustment is illustrated in Figure 3. The panels A-C show the performance of the reaction function (1.26)-(1.28):

$$\frac{G_t}{Y_t} = (1-\rho)\frac{G}{Y} + \rho\frac{G_{t-1}}{Y_{t-1}} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right)$$

$$\frac{TR_t}{Y_t} = \rho\frac{TR_{t-1}}{Y_{t-1}} + (1-\rho)\frac{TR}{Y} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right)$$

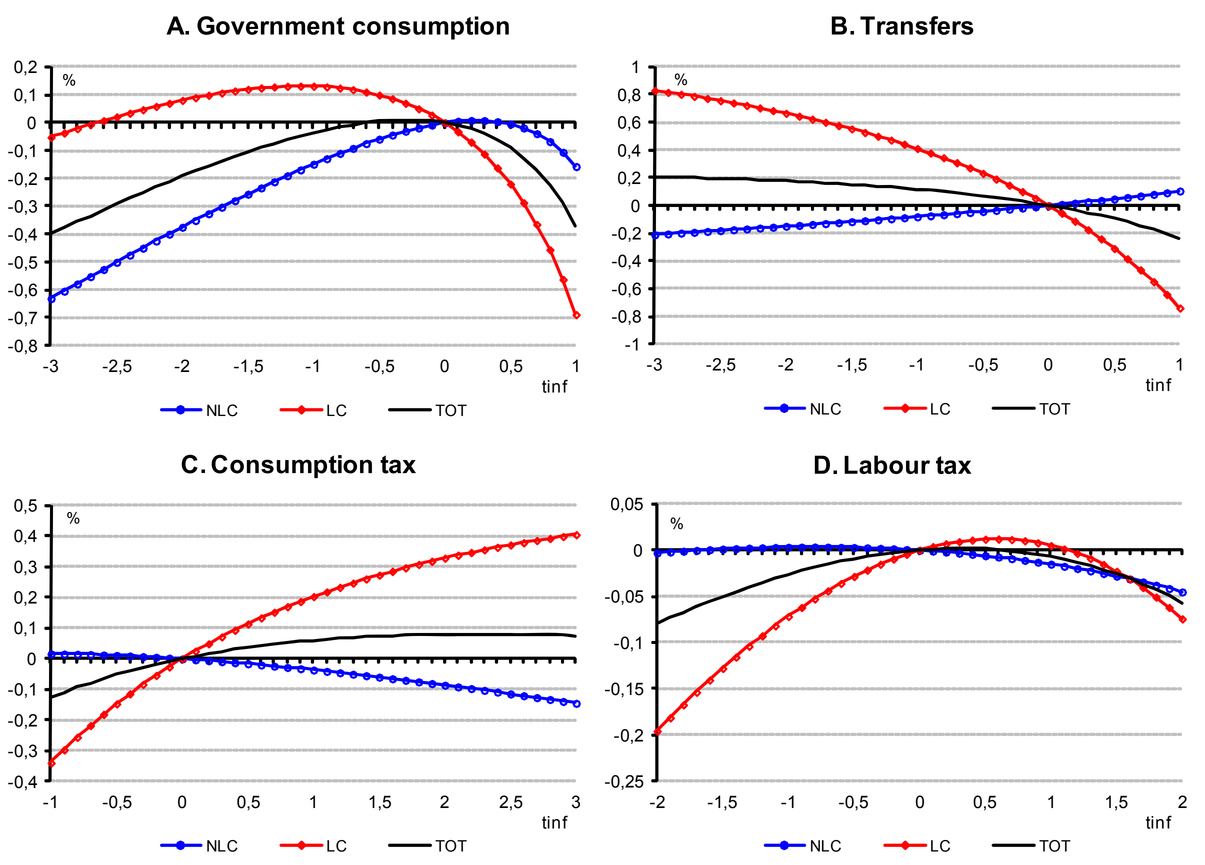
$$\tau_t^c = \rho\tau_{t-1}^c + (1-\rho)\overline{\tau}^c + (1-\rho)\xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right)$$

Panel D adds augments the labour tax rule (1.25) by a ToT response, i.e. charges the labour tax with the double objective of cyclical and deficit/debt stabilisation:

$$\tau_t^w = \tau_{t-1}^w + \xi_p \ln\left(\frac{P_{H,t-1}}{P_{F,t-1}}\right) + \xi_b\left(\frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} - btar\right) + \xi_d \Delta \frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} \qquad (1.25')$$

Figure 3 displays results for a range of values for the policy parameter ξ_p instead of focusing exclusively on welfare-maximising parameter values within this range. The broader parameter range illustrates differences between LC and NLC welfare, highlights the loss associated with non-optimal policy and provides information of the robustness of welfare effects with respect to variations in ξ_p.

Figure 3: Welfare under fiscal rules with budget stabilisation by labour tax



Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

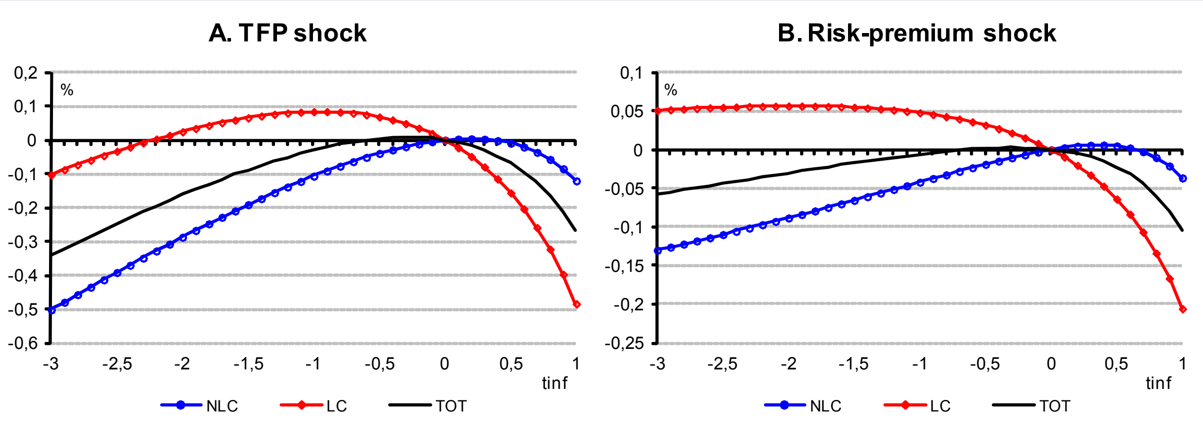
In the absence short-term fiscal stabilisation, i.e. ξ_p=0, the welfare losses associated with the combination of TFP and risk premium shocks (Table 1) in the model with LC households, wage and price stickiness correspond to 0.7% of steady-state consumption. The countercyclical adjustment of government consumption, transfers or taxes in response to shock-driven ToT fluctuations reduces welfare losses for LC households, but tends to increase the loss for NLC consumers.

The welfare gain for LC households from countercyclical government spending (A) attains a maximum of 0.13% of steady-state consumption at ξ_p=-1.1, similar to the 0.13% of steady-state consumption in Kumhof and Laxton (2009). The LC welfare gains owns to the fact that the government has an advantage over LC households in smoothing the shocks (see also Kumhof and Laxton, 2009). As explained in section 4, the countercyclical spending increases government consumption at a time when LC consumption is depressed. Given that government spending enters household welfare (1.1) with a positive sign, the countercyclical response stabilises the aggregate stream of utility from private and government purchases. The optimal rule for LC households (ξ_p=-1.1) is not the one that minimises the deviation of each of the individual welfare components (private consumption, government purchases, leisure) from the flexible-economy response to given exogenous shocks. Increasing government purchases when private consumption falls does, however, weaken the correlation between private LC consumption, which declines due to falling wage income, and total LC consumption utility, which is stabilised by the increase in government consumption. In addition, the increase in government purchases stabilises aggregate demand, employment and wage income and dampens the decline of private LC consumption, even though in our case Figures 1 and 2 show the strength of this channel to be modest and inversely affected by the deficit/debt stabilisation rule.

The NLC households adjust more easily to exogenous shocks than LC consumers, which is illustrated by the fact than NLC consumers deviate much less from the flexible-economy adjustment path than LC households. No policy response to ToT fluctuations (ξ_p=0) is (close to) optimal for NLC consumers. The reason is that adjusting government purchases reduces the related stream of utility compared to a constant mean under the decreasing marginal utility of government purchases embodied in (1.1). In addition, the utility weight of government purchases is lower than the one of private consumption (χ=0.2), so that resource shifting from private to government consumption deteriorates the consumption-leisure trade-off.

The total welfare gain from cyclical responses of government purchases as the weighted average of LC and NLC welfare effects is small in our model, because the gain of LC households from countercyclical policy is largely offset by NLC household losses. The parameter ξ_p=-0.3 optimises average welfare in panel A and improves the latter by 0.01% of steady-state consumption. A higher population share of LC households would increase the gain from countercyclical policy and the strength of the optimal policy response. One the other hand, the figure shows that contrary to the moderate welfare gain from optimal policy, the welfare loss from non-optimal policy can be very large. The combination of moderate LC welfare gains from optimal and potentially large welfare losses associated with non-optimal values for ξ_p applies to TFP (supply) and risk-premium (demand) shocks alike (Figure 4). Whether specific parameter values ξ_p improve or reduce welfare is furthermore fairly robust across both shocks.

Figure 4: Welfare under government consumption rule under TFP and risk-premium shocks



Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

Similarly, countercyclical transfer variations (Figure 3, panel B) are beneficial from the perspective of LC consumers. Consider a decline in the ToT, which in our model is the consequence of an increase in TFP or an increase in the risk premium. The TFP shock reduces employment and wage income in the context of price and wage stickiness (Figure 1) whereas the risk premium shock leads to a demand-driven decline in economic activity (Figure 2). Increasing transfers in this situations smoothes the disposable income of LC households and reduces the correlation between employment and consumption risk. Hence, the welfare gain derives from the government having an advantage over LC household in smoothing shocks. Namely, the transfers smooth the disposable income of the LC households over time. Note that the welfare gain of countercyclical transfers is larger than the one for countercyclical government purchases, because the transfer allows to smooth private consumption directly instead of meeting fluctuations in private consumption by fluctuations in government purchases and because the marginal utility of private consumption exceeds the one of government purchases in (1.1).

Lump-sum transfers have no direct impact on the intertemporal decisions of NLC households, on the other hand, so that the intertemporal consumption path of NLC households is not affected by the transfer adjustment.

The countercyclical variation of the consumption tax (Figure 3, panel C) also dampens the link between the decline in employment and the purchasing power of LC households. Hence, reducing the tax on consumption when the ToT declines acts like a transfer of purchasing power towards periods when labour income is low. Like for the countercyclical transfer, the government uses the advantage it has over LC households to smooth income over time. Like for countercyclical transfers, the welfare gain for LC households exceeds the benefits of countercyclical government consumption, because countercyclical consumption taxes directly stabilise the private demand of LC consumers.

From the perspective of NLC households, reducing the consumption tax rate when the ToT fall and increasing the rate when the ToT increase introduces additional volatility in the real interest rate, which increases the volatility compared to the no-stabilisation benchmark.

Finally, adding a countercyclical response to the labour tax as in equation (1.25') achieves only a marginal improvement in LC welfare (Figure 3, panel D). The countercyclical policy would reduce the labour tax rate when the ToT decline and output is below potential. The lower tax would dampen the decline in purchasing power, but less directly than the income smoothing via countercyclical transfer or consumption tax adjustment. In fact, countercyclical labour taxation would delay the deficit/debt-related increase in the labour tax rate that would then be more aggressive in subsequent periods, whereas procyclical policy would combine higher wage taxation in the short run with lower tax rates in the medium term. The intertemporal consumption path of NLC households remains unaffected.

The results for LC and NLC households can be related to previous literature. Kirsanova et al. (2007) report gains of 0.001% of steady-state consumption in a fully Ricardian model with purely forward-looking inflation dynamics, which matches the result in our model than NLC households gain close to nothing from fiscal stabilisation. Kirsanova et al. (2007), however, illustrate that increasing endogenous persistence in the model can increase the welfare gain. Namely, they obtain NLC welfare gains of 0.3% of steady-state consumption in a model version with inflation inertia, in which half of the agents has backward-looking expectations about future inflation. Inflation persistence increases the potential gain from fiscal/monetary stabilisation as countercyclical policy can dampen the overshooting of price/wage adjustment in response to shocks. Ferrero (2009), on the other hand, obtains welfare gains of up to 5% of steady-state consumption for flexible taxation rules that strongly react to the output gap in an environment with larger shocks, higher shock persistence and lower intertemporal substitution elasticity. However, Ferrero (2009) considers a monetary union of two large economies in which fiscal policy at the country level affects area-wide variables, notably inflation and inflation expectations.

5. Robustness checks

This section provides checks across different dimensions of the model in order to assess the robustness of the previous results. The checks focus on model dimensions that appear particularly important for the welfare effect of stabilisation policy and where parameter values come with substantial uncertainty or cross-country variation.

5.1 Deficit/debt stabilisation by transfer rule

The labour tax response (1.25) to the budgetary impact of cyclical fiscal policy adds a distortionary channel that might reduce or strengthen the initial impact of countercyclical policies on household welfare. To illustrate the interaction between cyclical and deficit/debt stabilisation and to separate the first-round effects of business-cycle stabilisation from the second-round effects of labour tax adjustment according to the reaction function (1.25) it is useful to consider a scenario where debt/deficit stabilisation is achieved by the adjustment of lump-sum transfers. Hence, this section repeats the previous simulations using the budgetary stabilisation rule:

$$\frac{TR_t}{Y_t} = \frac{TR_{t-1}}{Y_{t-1}} - \xi_b \left(\frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} - btar \right) - \xi_d \Delta \frac{B_{t-1}}{4P_{H,t-1}Y_{t-1}} \tag{1.25''}$$

instead of the reaction function on labour taxation. Contrary to an economy with 100% NLC population, lump-sum transfer adjustment also introduces fluctuations in the disposable income and consumption paths of LC household. The alternative of relegating debt/deficit stabilisation to a transfer component that only concerns NLC households so as to exclude the direct impact on LC income provides a further point for comparison.

*****Results and discussion still to be added*****

5.2 Response to consumer prices

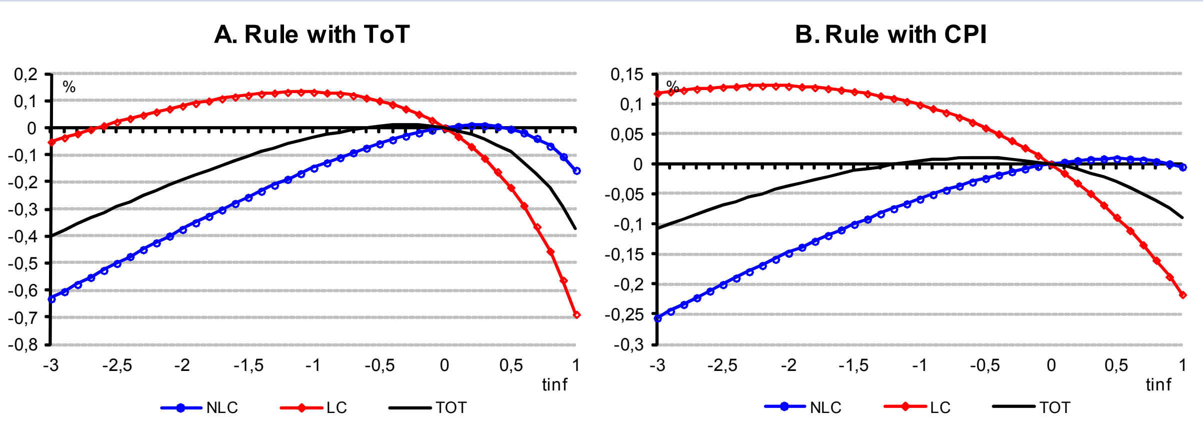
The previous discussion considered instrument rules (1.26)-(1.28) that react to fluctuation in the ToT as the ratio of domestic to foreign GDP price levels (as all goods are tradable in the model) around their steady-state value. An alternative specification lets the fiscal instrument react to relative consumer price (CPI) levels:

$$\frac{G_t}{Y_t} = \rho \frac{G_{t-1}}{Y_{t-1}} + (1-\rho)\frac{G}{Y} + (1-\rho)\xi_p \ln\left(\frac{P_{t-1}}{P_{t-1}^*}\right) \qquad (1.26')$$

The rational for this alternative is that CPI data tend to have the practical advantage of being available more timely than data for the GDP deflator and that timely availability is a precondition for a timely (discretionary) policy response.

Figure 5 shows that the welfare consequences of adjusting government consumption over the cycle are very similar for ToT- and CPI-based reaction functions. The only difference is that the optimal policy from the perspective of LC households shifts to the left on the ξ_p axis, i.e. a more aggressive response. The CPI equation (1.34) implies that the CPI reacts less than one-to-one to changes in the price level of domestically produced goods. On the other hand, foreign prices are exogenous and assumingly constant. Hence, the CPI-based rule requires stronger coefficients ξ_p to replicate the results of the ToT-based reaction function.

Figure 5: Welfare under government consumption rules with ToT and CPI



Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

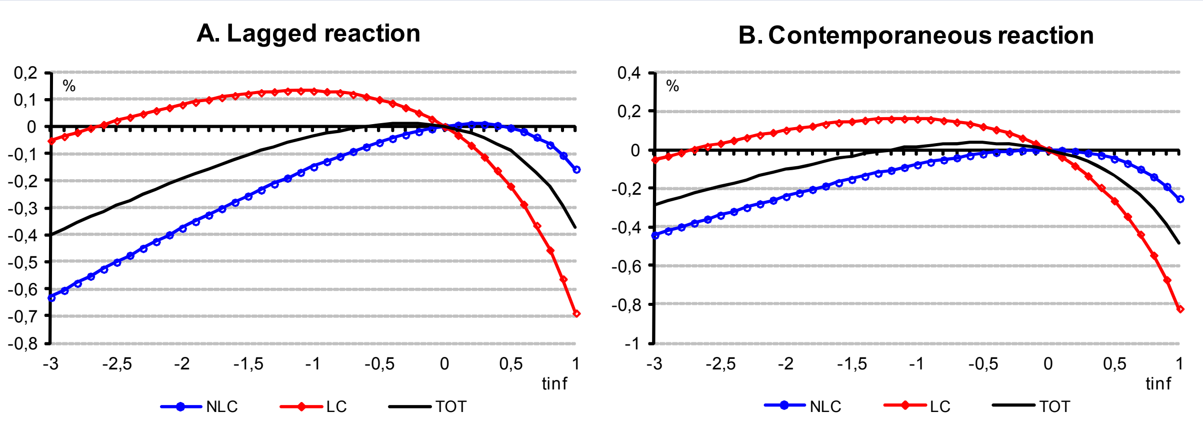
5.3 Reaction speed

The instrument rule (1.26) reacts with one period (quarter) lag to the ToT to incorporate the notion of recognition and implementation lags. Whether the lagged reaction reduces the stabilising potential substantially can be tested by comparison to an instrument rule that responds contemporaneously to the ToT:

$$\frac{G_t}{Y_t} = (1-\rho)\frac{G}{Y} + \rho\frac{G_{t-1}}{Y_{t-1}} + (1-\rho)\xi_p \ln\left(\frac{P_{H,t}}{P_{F,t}}\right) \quad (1.26'')$$

The comparison in Figure 6 shows no substantial difference between the lagged reaction and the contemporaneous response. The maximum welfare gain for the LC households from countercyclical government purchases increases from 0.13 to 0.16% of steady-state consumption, but the shape and position of the welfare curves remains otherwise unchanged.

Figure 6: Welfare under government consumption rules with lagged and contemporaneous reaction



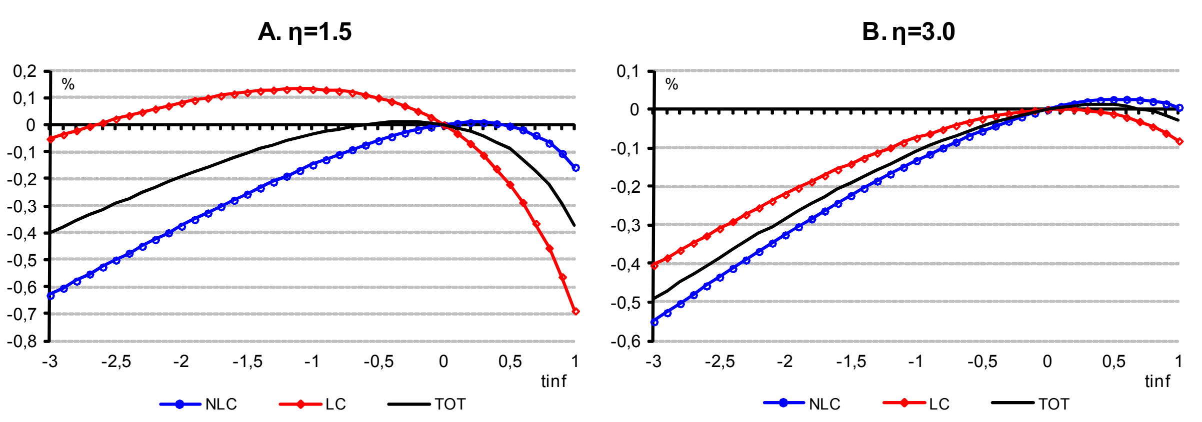
Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

5.4 Price elasticity of trade

The benchmark parameterisation in Table 1 has adopted a price elasticity of trade flows of η=1.5. The value corresponds to parameter estimates on the basis of aggregate time-series data (e.g., Imbs and Méjean, 2010) and estimated DSGE models for the euro area (e.g., Ratto et al., 2009). Micro-data estimates, on the other hand, finds higher elasticity values for several sectors and EMU countries. Correcting for aggregation bias, Imbs and Méjean (2010) suggest trade elasticity values of η=3, which we use here for the robustness check.

Increasing the price elasticity of trade flows strengthens the trade channel as automatic stabiliser in response ToT fluctuations that are associated with capacity under-/overutilization. Consequently, the welfare gain from fiscal stabilisation decreases for increasing values for the price elasticity of trade flows.

Figure 7: Welfare under government consumption rule with alternative trade elasticity values



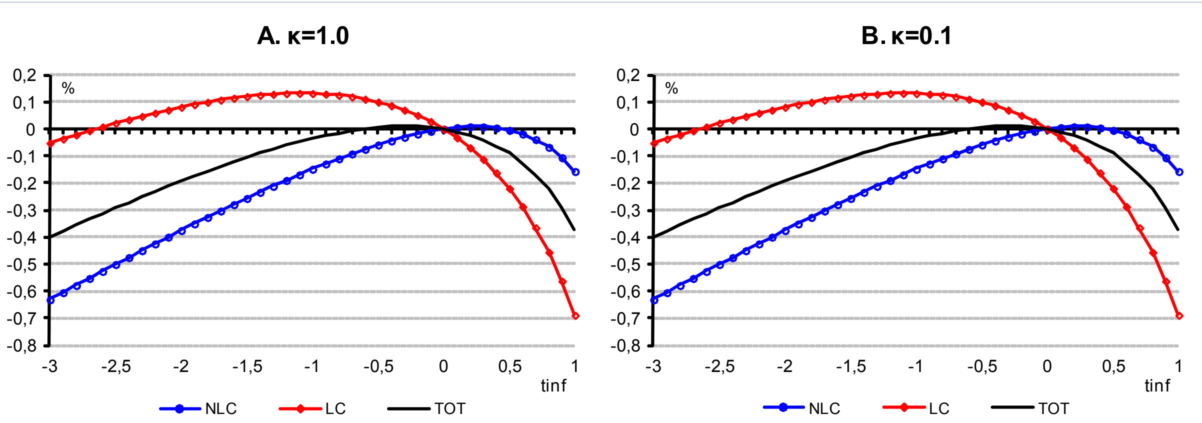
Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

5.5 Weights in welfare function

The benchmark model places equal weight on consumption utility and the disutility of work effort (κ=1) in the welfare function (1.1). This subsection considers an alternative weighting that reduces the impact of the disutility of effort to κ=0.1. The results for comparison are displayed in Figure 8.

Figure 8 shows that the impact of counter-/procyclical government consumption on welfare remains basically unchanged despite the reduction of κ. The result strengthens the previous result that the welfare gain from the countercyclical policy relates almost exclusively to the stabilisation of consumption utility.

Figure 8: Welfare under government consumption rule with alternative weights in welfare function



Note: Welfare is measured relative to non-stabilisation and expressed in % of steady state consumption.

5.6 Steady-state mark-ups

While the parameterisation in Table 1 implies steady-state price and wage mark-ups of 20% in line with empirical estimates for EMU countries (Christopoulou and Vermeulen, 2008), the previous literature on the welfare gains from fiscal stabilisation has usually relied on linear approximations of the model around an efficient steady state. For this purpose it is generally assumed that distortions from price/wage mark-ups are offset by production/wage subsidies that, in turn, are assumingly financed by lump-sum taxation.

To test for the impact of the steady-state mark-ups on the welfare results, the simulation for the instrument rule (1.26) has been repeated for values of ε=θ=21, which generate steady-state price/wage mark-ups of 5%.

*****Results and discussion still to be added*****

5.7 After-tax price stickiness

The model setup in section 2 assumed that price stickiness relates to pre-tax price of goods, i.e. the price net of the consumption tax. This assumption that has been made, e.g., by Correia et al. (2011) can be questioned. If price adjustment costs derive from menu costs, price stickiness should generally relate to the after-tax price. We incorporate this case by modifying the adjustment costs (1.30):

$$E_0 \sum_{t=0}^{\infty} \beta^t \frac{\lambda_t^{NLC}}{\lambda_0^{NLC}} \left[\frac{P_t^j}{P_{H,t}} Y_t^j - \frac{W_t}{P_{H,t}} L_t^j - \frac{\gamma_p}{2} \left(\frac{1+\tau_t^c}{1+\tau_{t-1}^c} \frac{P_t^j}{P_{t-1}^j} - 1 \right)^2 Y_t \right] \quad (1.30')$$

which provides the modified pricing rule:

$$P_{H,t} = \frac{\varepsilon}{\varepsilon - 1 + \gamma_p \left(1+\pi_{H,t}^{\tau}\right) \pi_{H,t}^{\tau} - \gamma_p \beta_t E_t \left[\frac{\lambda_{t+1}^{NLC}}{\lambda_t^{NLC}} \left(1+\pi_{H,t+1}^{\tau}\right) \pi_{H,t+1}^{\tau} \frac{Y_{t+1}}{Y_t} \right]} \frac{W_t}{A_t} \quad (1.31')$$

with $\pi_{H,t}^{\tau} \equiv (1+\tau_t^c) / (1+\tau_{t-1}^c) \, P_{H,t} / P_{H,t-1} - 1$. The economy's resource constraint becomes:

$$Y_t = \frac{P_t}{P_{H,t}} \left(C_t + G_t\right) + X_t - \frac{P_{F,t}}{P_{H,t}} \left(C_{F,t} + G_{F,t}\right) + ADC_t^{\tau} \quad (1.33')$$

$$ADC_t^{\tau} \equiv \frac{\gamma_w}{2}\left(\frac{W_t}{W_{t-1}}-1\right)^2 L_t + \frac{\gamma_p}{2}\left(\frac{1+\tau_t^c}{1+\tau_{t-1}^c}\frac{P_{H,t}}{P_{H,t-1}}-1\right)^2 Y_t$$

Figure XX illustrate the impact of the change from pre- to after-tax price stickiness on welfare for the consumption tax rule (1.28) for which the change is most relevant. The stickiness of after-tax prices eliminates the welfare gain from countercyclical responses of consumption taxes to the ToT. Pre-tax prices and profits will have to adjust in opposite direction to avoid the tax-related increase in adjustment costs, which increases the volatility of output and employment.

*****Figure to be added*****

6. Conclusions

The paper analyses fiscal stabilisation policy in a DSGE model for a small member economy of monetary union. The model includes financial, goods and labour market frictions. The paper discusses the welfare effects of simple expenditure and tax rules for LC and NLC households under supply (TFP) and demand (risk-premium) shocks.

Instead of limiting the discussion on optimal simple instrument rules, we show welfare effects over a broader range of policy parameters to provide information about the robustness of the results and the costs of non-optimal policy. We find a dichotomy in the welfare effects of countercyclical fiscal policy for LC and NLC households. While LC households gain from countercyclical income and consumption (utility) smoothing, NLC households tend to loose in welfare terms. Hence, the optimal policy varies across household types. It is more countercyclical for LC household and less so (or zero) for NLC consumers.

The paper focuses on fiscal stabilisation in response to temporary shocks that lead to temporary deviations from the steady state, i.e. on cyclical fluctuations. It does not address the potential of a long-lasting adjustment of fiscal variables (“fiscal devaluations”) to correct persistent imbalances in relative prices and economic activity (e.g., De Mooij and Keen, 2012; Farhi et al., 2011)

*****To be completed*****

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