Budget-neutral Fiscal Rules Targeting Inflation Differentials

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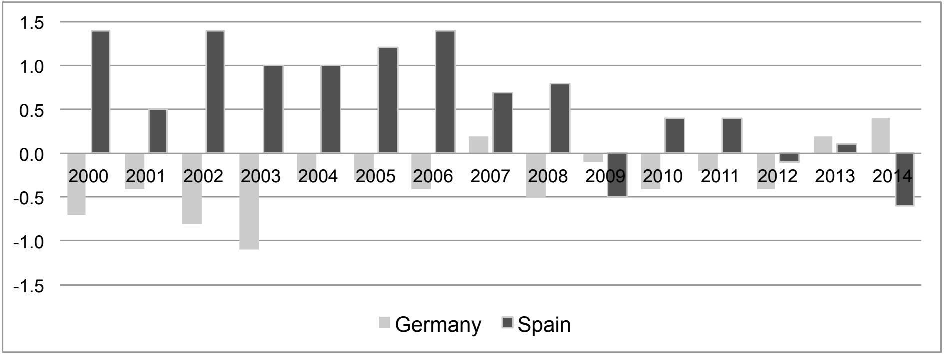
Motivation

Figure: Differences in annual HICP-inflation relative to the EA average, 2000-2014



Comparison to HICP at constant taxes

- Loss/gain of competitiveness due to persistent inflation differentials
- Rising debt levels limit the scope of fiscal intervention → budget-neutrality

Research question

Can national fiscal authorities use budget-neutral policies to counteract inflation differentials?
Would such a policy be welfare-improving?

Approach:

- Two-sector, two-country NK-DSGE model with fiscal authorities
- Fiscal rule: consumption taxes respond to the domestic inflation differential while labour income taxes balance budget

Preview of results:

- Benchmark: welfare costs of business cycle fluctuations can be reduced by up to 15% relative to constant consumption taxes
- Gains in welfare stem from mean consumption effects

Related literature

Fiscal feedback to national differences:
Beetsma and Jensen (2005), Kirsanova et al. (2007), Duarte and Wolman (2002, 2008), Vogel et al. (2013)

Optimal joint conduct of policies:
Lombardo and Sutherland (2004), Beetsma and Jensen (2004, 2005), Gali and Monacelli (2008), Kirsanova and Wren-Lewis (2012)

Fiscal devaluations:
Lipinska and Van Thadden (2012), Engler et al. (2013)

The model

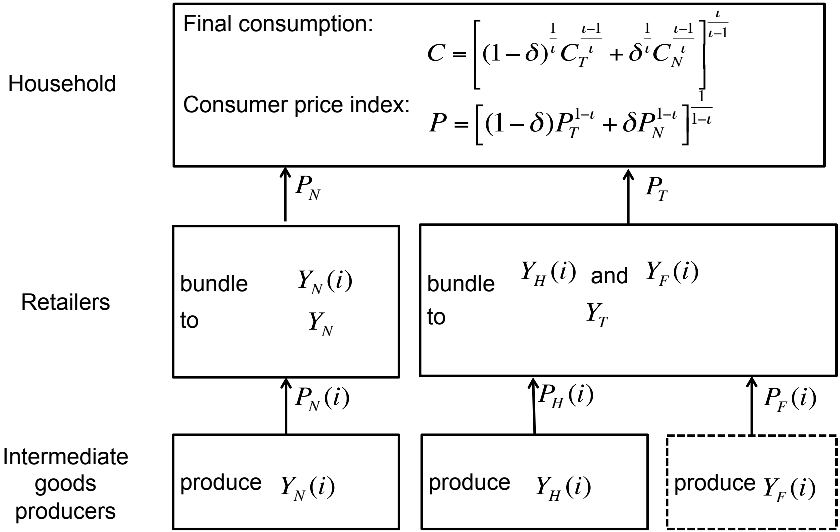
General set-up:

- Two symmetric countries of equal size in a monetary union ($H\&F$)
- Union-wide monetary policy and country-specific fiscal policy
- Labour is immobile across countries but mobile across sectors

In each country:

- Traded (T) and non-traded (N) goods sector
- Nominal rigidities in each sector (Calvo-pricing)
- Competitive labour market

Economic structure



Household

Maximises lifetime utility

$$\mathbb{E}_t \sum_{k=0}^{\infty} \beta^t \left[U(C_{t+k}) - V(L_{t+k}) \right]$$

subject to

$$(1+\tau_t^C)C_t + \frac{B_t}{P_t} = R_{t-1}\frac{B_{t-1}}{P_t} + (1-\tau_t^L)w_t L_t + \Pi_t$$

Optimality conditions:

$$\begin{aligned} U'(C_t) &= \beta \mathbb{E}_t \left[U'(C_{t+1}) R_t \frac{P_t}{P_{t+1}} \frac{1+\tau_t^C}{1+\tau_{t+1}^C} \right] \\ \frac{V'(L_t)}{U'(C_t)} &= \frac{1-\tau_t^L}{1+\tau_t^C} w_t \end{aligned}$$

Firms - intermediate goods producers (T)

Monopolistically competitive, set prices to maximise

$$\max_{P_{H,t}(i)} \mathbb{E}_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} \left[Y_{H,t+k}(i) P_{H,t}(i) - W_{t+k} L_{T,t+k}(i) \right]$$

given a linear production function:

$$Y_{H,t}(i) = \exp(Z_{T,t}) L_{T,t}(i)$$

where $Z_{T,t}$ is stochastic

analogous set-up in the non-traded sector intermediate goods producers (N)

Firms - Retailers (T)

Perfectly competitive, maximise profits

$$P_{T,t}Y_{T,t} - \int_0^1 P_{H,t}(i)Y_{H,t}(i)di - \int_0^1 P_{F,t}(i)Y_{F,t}(i)di$$

by combining varieties via

$$Y_{H,t} = \left(\int_0^1 Y_{H,t}(i)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}, \quad \text{and} \quad Y_{F,t} = \left(\int_0^1 Y_{F,t}(i)^{\frac{\epsilon-1}{\epsilon}}\right)^{\frac{\epsilon}{\epsilon-1}}$$

and bundling them to the final traded good via

$$Y_{T,t} = \left[(1-\omega)^{\frac{1}{\varphi}} Y_{H,t}^{\frac{\varphi-1}{\varphi}} + (\omega)^{\frac{1}{\varphi}} Y_{F,t}^{\frac{\varphi-1}{\varphi}}\right]^{\frac{\varphi}{\varphi-1}}$$

Retailers in N sector maximise

$$P_{N,t}Y_{N,t} - \int_0^1 P_{N,t}(i)Y_{N,t}(i)di \quad \text{s.t.} \quad Y_{N,t} = \left(\int_0^1 Y_{N,t}(i)^{\frac{\epsilon-1}{\epsilon}}di\right)^{\frac{\epsilon}{\epsilon-1}}$$

demand for varieties

Terms of trade and price/inflation differentials

Competitiveness measures

- External terms of trade: $T_t = \frac{P_{F,t}}{P_{H,t}}$
- Internal terms of trade $T_{N,t} = \frac{P_{N,t}}{P_{T,t}}$

Consumer price differential: $\frac{P_t}{P_t^*} = \frac{P_{T,t}}{P_{T,t}^*}\left[\frac{1-\delta+\delta T_{N,t}^{1-\iota}}{1-\delta+\delta T_{N,t}^{*1-\iota}}\right]^{\frac{1}{1-\iota}}$

where $\frac{P_{T,t}}{P_{T,t}^*} = \left[\frac{(1-\omega)P_{H,t}^{1-\varphi}+\omega P_{F,t}^{1-\varphi}}{(1-\omega)P_{F,t}^{1-\varphi}+\omega P_{H,t}^{1-\varphi}}\right]^{\frac{1}{1-\varphi}}$

Main channels of price/inflation differentials

- presence of non-traded goods ($\delta \neq 0$)
- home/foreign bias in traded goods ($\omega \neq 0.5$)

Monetary and fiscal policy

Union-wide gross inflation: $\pi_t^U = 0.5\pi_t + 0.5\pi_t^*$
Inflation differential: $\pi_t^{diff} = \pi_t / \pi_t^U$

Union-wide monetary policy follows Taylor rule: $R_t = \frac{1}{\beta}\left(\pi_t^U\right)^{\phi}$

On the country level:
government budget constraint: $\tau_t^C C_t + \tau_t^L w_t L_t = G_t$

Public consumption of non-traded goods follows an AR(1)

Taylor-type fiscal rule for consumption taxes $1 + \tau_t^C = (1 + \bar{\tau}^C)\left(\pi_t^{diff}\right)^{\zeta}$

market clearing

Calibration

Utility functions: $U(C_t) = \frac{C_t^{1-\sigma}-1}{1-\sigma}$ $\quad V(L_t) = \frac{L_t^{1+\kappa}}{1+\kappa}$

Parameter	Value	Target or reference
β - discount factor	0.99	annual real interest of 4%
σ - relative risk aversion	1	log-utility
κ - inverse Frisch elasticity	1	
ι - elastic. of subs. btw. N and T goods	0.74	Duarte and Wolman (2008)
φ - elastic. of subs. btw. H and F goods	1.5	Duarte and Wolman (2008)
ϵ - elastic. of subs. btw. diff. goods	10	Duarte and Wolman (2008)
δ - share of N goods in C	0.4	Duarte and Wolman (2008)
ω - import share in Y_T	0.4	home-bias in traded goods
θ - Calvo parameter prices	2/3	Druant et al. (2012)
ϕ - strength of monetary policy	1.5	Taylor (1993)
$\bar{\tau}^C$ - steady state consumption tax	0.15	Lipinska & von Thadden (2012
steady state public consumption	0.25	
$\bar{\tau}^L$ - steady state labour income tax	0.153	balanced-budget requirement

Calibration - shocks

AR(1) technology process $Z_t = AZ_{t-1} + \epsilon_{Z,t}$ where $Z_t = [Z_{T,t}, Z_{N,t}, Z^*_{T,t}, Z^*_{N,t}]$,

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

and covariance-matrix

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

Government consumption follows

$$(G_t/Y_t) = (\bar{G}/\bar{Y}) + \rho_G (G_{t-1}/Y_{t-1}) + \epsilon_{G,t}$$

with $\rho_g = 0.42$ and $\sigma^2_{e_G} = 0.000214$ (uncorrelated across countries)
Estimates by Duarte and Wolman (2008)

IRFs - Government spending shock

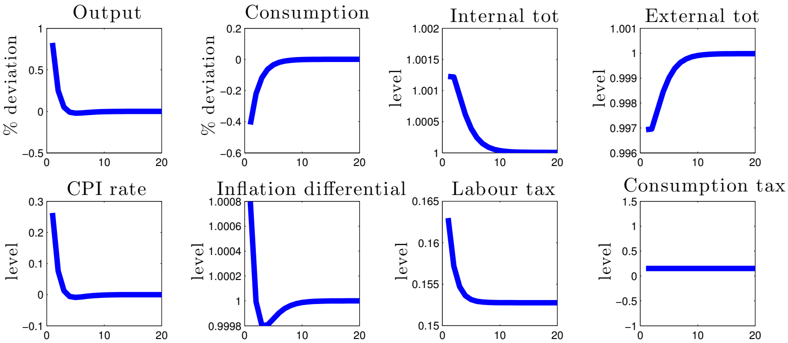


Figure: Impulse-response functions to a 1% point increase in G/Y under constant consumption taxes.

IRFs - Government spending shock with fiscal rule

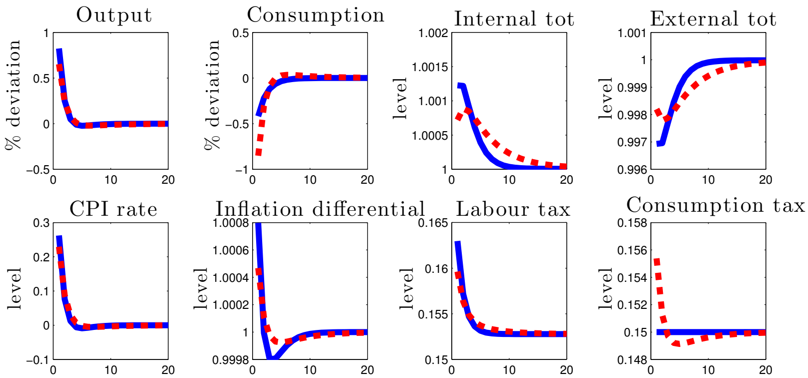


Figure: Impulse-response functions to a 1% point increase in G/Y. Blue line: constant consumption taxes ($\zeta = 0$), red line: responsive consumption taxes ($\zeta = 5$).

IRFs - Technology shock (N)

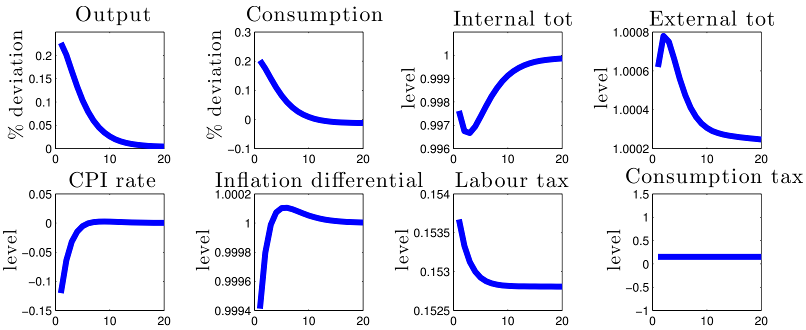


Figure: Impulse-response functions to a 1% point increase in Z_N under constant consumption taxes.

IRFs - Technology shock (N) with fiscal rule

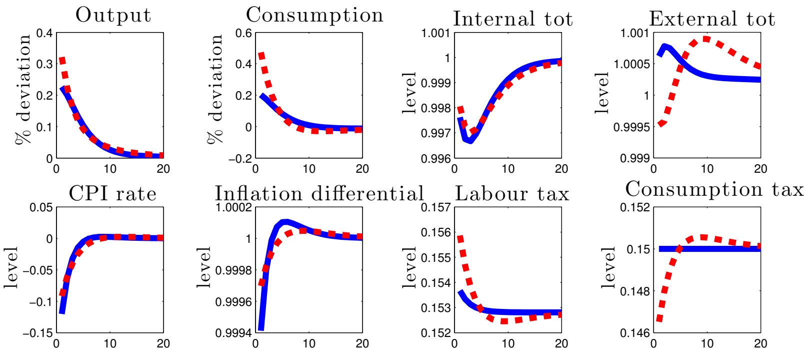


Figure: Impulse-response functions to a 1% point increase in Z_N. Blue line: constant consumption taxes ($\zeta = 0$), red line: responsive consumption taxes ($\zeta = 5$).

IRFs - Technology shock (T)

Summary - IRFs

Government spending as well as technology shocks create inflation differentials

Under responsive fiscal rule:

- dampened response of domestic inflation and the inflation differential
- amplified response of consumption

Should the specified consumption tax rule

$$1 + \tau_t^C = (1 + \bar{\tau}^C) \left(\pi_t^{diff}\right)^{\zeta}$$

be responsive?

Welfare analysis - methodology

Following Lucas (1987, 2003) welfare costs measured by consumption compensation v

$$\underbrace{\mathbb{E}\sum_{t=0}^{\infty}\beta^t\left[U(C_t)-V(L_t)\right]}_{\mathbb{E}\text{ utility given ergodic distribution}} = \underbrace{\sum_{t=0}^{\infty}\beta^t\left[U((1+v)\bar{C})-V(\bar{L})\right]}_{\text{utility in deterministic st.st.}}$$

v is a function of first- and second-order moments of the ergodic distribution and can be decomposed into

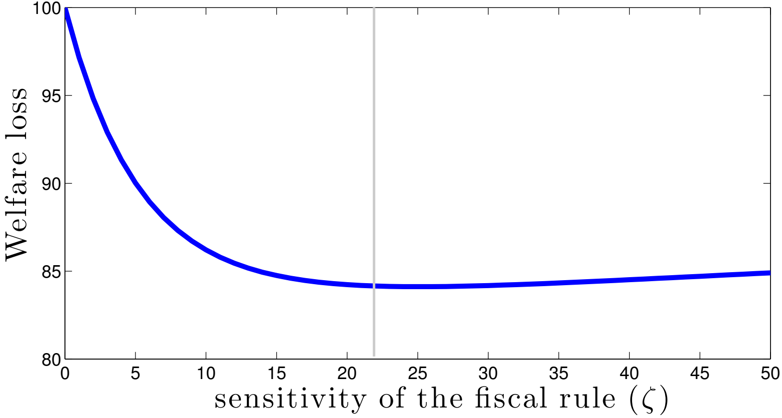
$$v = v_{meanC} + v_{meanL} + v_{volatilityC} + v_{volatilityL}$$

Theoretical moments from NLMA-method by Lan and Meyer-Gohde (2013)

Decomposition given $U(C_t)$ and $V(L_t)$

Welfare analysis

Figure: Welfare loss for different ζ relative to constant consumption taxes (=100).



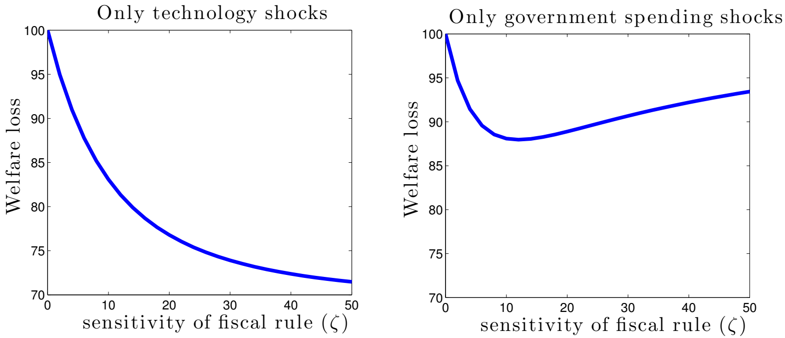
Welfare analysis - Decomposition

	Complete shock structure		
	baseline	responsive	$\Delta\%$
Welfare costs of fluctuations	-1.3107	-1.1026	15.88
Decomposition:			
v_{meanC}	-1.1764	-0.8384	25.79
v_{meanL}	0.0174	0.0015	-1.22
$v_{volatilityC}$	-0.0641	-0.2166	-11.63
$v_{volatilityL}$	-0.0876	-0.0490	2.94

Table: Welfare loss $\times 10^{-3}$ and % gains under the welfare-maximising consumption tax rule (responsive, $\zeta = 22$) relative to constant taxes (baseline, $\zeta = 0$)

Welfare analysis by shock specification

Figure: Welfare loss for different ζ relative to constant consumption taxes (=100).



Welfare analysis - Decomposition by shock specification

	Technology shocks only			Government spending shocks only		
	baseline	responsive	Δ%	baseline	responsive	Δ%
Welfare costs of fluctuations	-0.4821	-0.3429	28.89	-0.8278	-0.7262	12.28
Decomposition:						
v_{meanC}:	-0.4316	-0.2534	36.97	-0.7448	-0.5812	19.77
v_{meanL}:	-0.0090	-0.0030	1.25	0.0264	0.0078	-2.25
$v_{volatilityC}$:	-0.0295	-0.0776	-9.97	-0.0342	-0.1073	-8.83
$v_{volatilityL}$:	-0.0121	-0.0090	0.64	-0.0752	-0.0455	3.59

Table: Welfare loss $\times 10^{-3}$ and % gains under the welfare-maximising consumption tax rule (responsive, $\zeta = 22$) relative to constant taxes (baseline, $\zeta = 0$))

→ Results are robust to shock specification

Robustness of the results

Robustness of the results (gains from the fiscal rule) with respect to

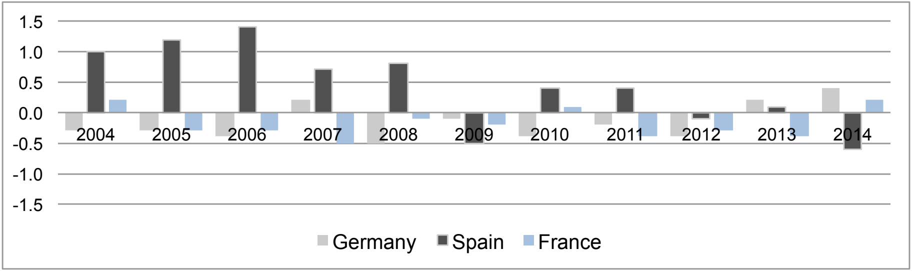
- parameters
  - the steady state share of non-traded goods δ here
    (gains increase in δ)
  - steady state import share ω here
    (gains decrease in ω)
  - the degree of the nominal rigidity θ here
    (larger gains from small ζ for lower θ)
- setting of the union
  - the size of the home economy here
    (gains decrease in the asymmetry in size of the countries)
  - unilateral policy here
    (gains are larger when fiscal policies are aligned)

Conclusion

Within the framework of a symmetric two-country NK-DSGE model with nominal price rigidities and two sectors (T&N):

- analyse budget-neutral fiscal rule for consumption taxes that responds to the domestic inflation differential
- fiscal rule is able to compress domestic inflation and inflation differentials
- in the benchmark, welfare costs of business cycle fluctuations can be reduced by around 15%
- welfare gains materialise under supply as well as demand disturbances

Thank you for your attention!



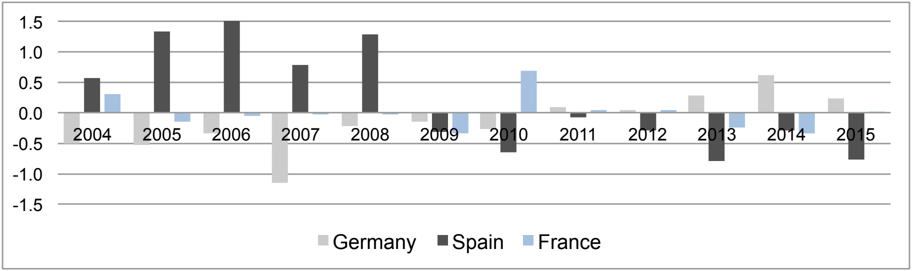


Figure: Differences in HICP-inflation at variable (above) and constant taxes (below) relative to the Euro area average, 2004-2014

Consumption baskets in 2007

Share of items in the overall consumption basket of the HICP

Item	Germany	Spain
Food and non-alcoholic beverages	11.47	21.95
Alcoholic beverages, tobacco and narcotics	5.20	2.83
Clothing and footwear	5.58	9.06
Housing, water, electricity, gas and other fuels	22.66	10.52
Furnishings, household equipment and maintenance	7.20	6.07
Health	4.60	2.84
Transport	15.53	14.19
Communications	2.35	3.50
Recreation and culture	11.14	7.23
Education	0.80	1.6
Restaurants and hotels	5.45	14.38
Miscellaneous goods and services	8.01	5.83

Firms - Retailers

In T sector: demand for H and F produced traded variety i

$$
\begin{aligned}
Y_{H,t}(i) &= (1-\omega)\left(\frac{P_{H,t}(i)}{P_{H,t}}\right)^{-\epsilon}\left(\frac{P_{H,t}}{P_{T,t}}\right)^{-\varphi} Y_{T,t} \\
Y_{F,t}(i) &= \omega\left(\frac{P_{F,t}(i)}{P_{F,t}}\right)^{-\epsilon}\left(\frac{P_{F,t}}{P_{T,t}}\right)^{-\varphi} Y_{T,t}
\end{aligned}
$$

where

$$
P_{T,t} = \left[(1-\omega)P_{H,t}^{1-\varphi} + \omega P_{F,t}^{1-\varphi}\right]^{\frac{1}{1-\varphi}} \quad , \quad P_{H,t} = \left(\int_0^1 P_{H,t}(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}} ,
$$

$$
P_{F,t} = \left(\int_0^1 P_{F,t}(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}}
$$

In N sector: demand for variety i

$$
Y_{N,t}(i) = \left(\frac{P_{N,t}(i)}{P_{N,t}}\right)^{-\epsilon} Y_{N,t} \quad \text{where} \quad P_{N,t} = \left(\int_0^1 P_{N,t}(i)^{1-\epsilon} di\right)^{\frac{1}{1-\epsilon}}
$$

Firms - intermediate goods producers (N)

Monopolistically competitive, set prices to maximise

$$\max_{P_{N,t}(i)} \mathbb{E}_t \sum_{k=0}^{\infty} \theta^k Q_{t,t+k} \left[Y_{N,t+k}(i) P_{N,t}(i) - W_{t+k} L_{N,t+k}(i) \right]$$

given a linear production function:

$$Y_{N,t}(i) = \exp(Z_{N,t}) L_{N,t}(i)$$

where $Z_{N,t}$ is stochastic

Market clearing

Market clearing conditions for labour, goods and bonds are

$$
\begin{aligned}
Y_{T,t} &= C_{T,t} \\
Y_{N,t} &= C_{N,t} + G_t \\
L_t &= \int_0^1 L_{T,t}(i) + L_{N,t}(i) di \\
B_t &= -B_t^*
\end{aligned}
$$

Closing the model:
Debt elastic interest rate à la Schmitt-Grohé and Uribe (2003)

IRFs - Technology shock (T)

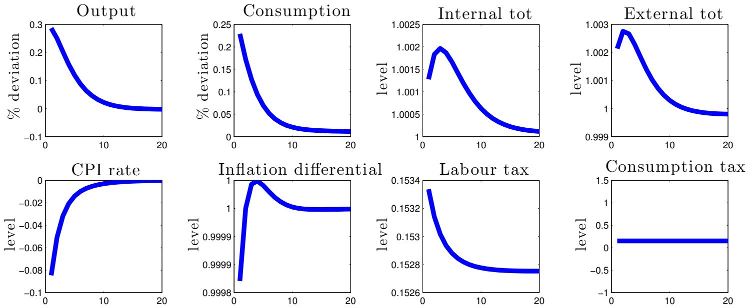
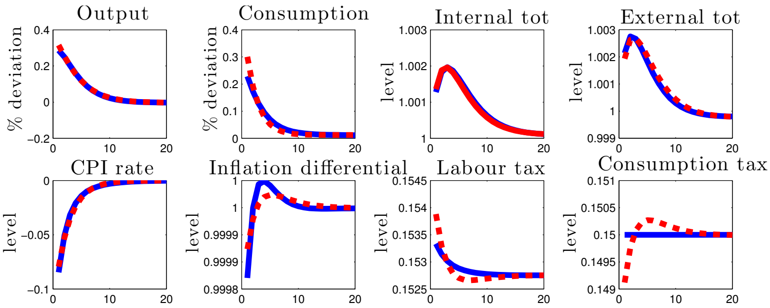


Figure: Impulse-response functions to a 1% point increase in Z_T

IRFs - Technology shock (T) with fiscal rule



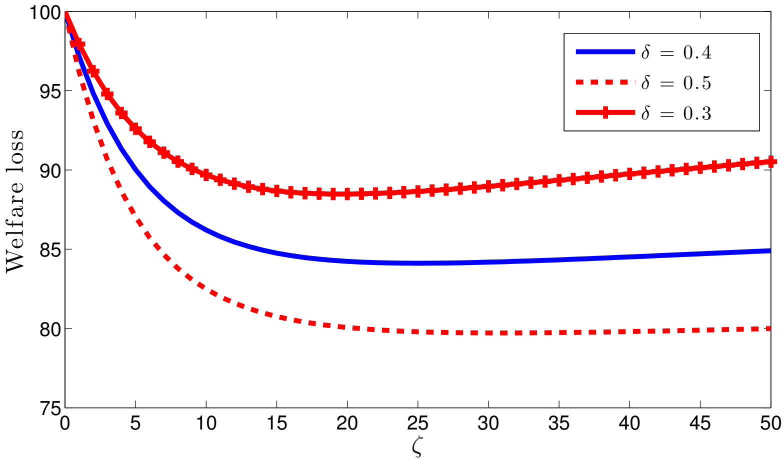
Welfare decomposition

Given the utility function the composition reads

$$
\begin{aligned}
v_{meanC} &= \bar{C}^{\sigma-1}\bar{C}^{-\sigma}\mathbb{E}[C_t - \bar{C}] \\
v_{meanL} &= -\bar{C}^{\sigma-1}\bar{L}^{\kappa}\mathbb{E}[L_t - \bar{L}] \\
v_{volatilityC} &= -\frac{\sigma}{2}\bar{C}^{\sigma-1}\bar{C}^{-\sigma-1}\mathbb{E}[C_t - \bar{C}]^2 \\
v_{volatilityL} &= -\frac{\kappa}{2}\bar{C}^{\sigma-1}\bar{L}^{\kappa-1}\mathbb{E}[L_t - \bar{L}]^2
\end{aligned}
$$

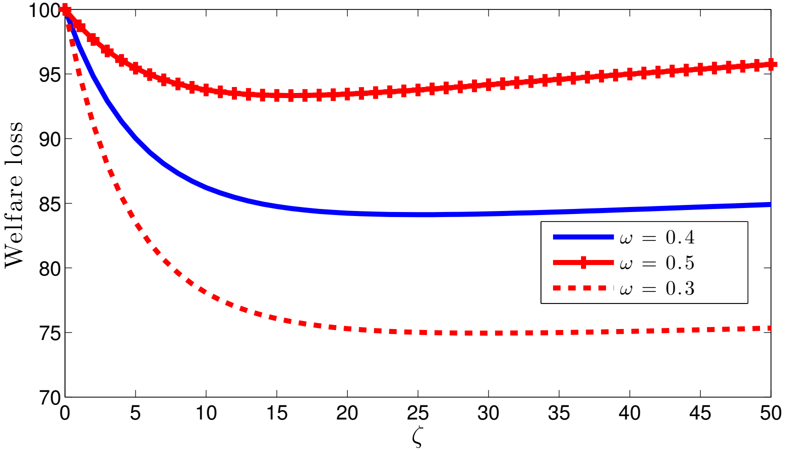
bar-variables denote the deterministic steady state

Robustness of the results - δ



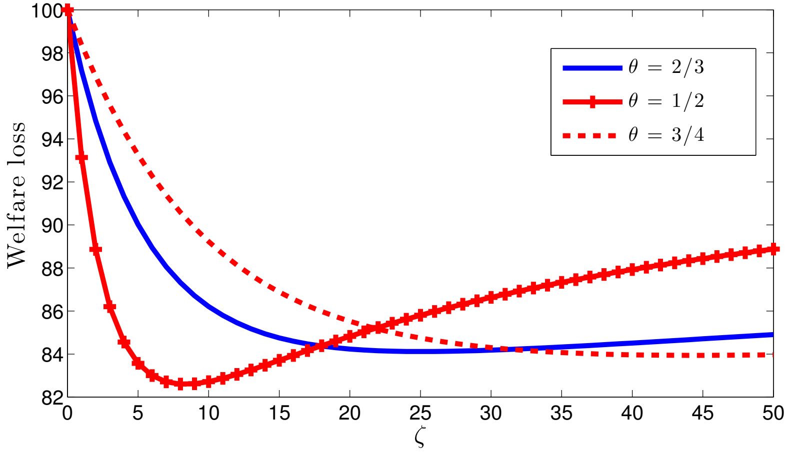
→ gains in welfare increase in δ (higher δ increases scope for inflation differentials)

Robustness of the results - ω



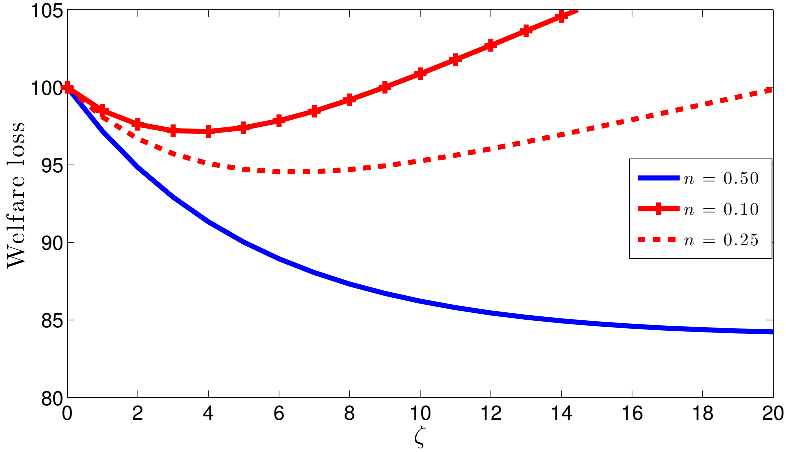
→ gains in welfare increase the smaller ω (smaller ω increases scope for inflation differentials)

Robustness of the results - θ



$\rightarrow$ θ governs the persistence of price dispersion, larger θ make large sensitivities more beneficial

Robustness of the results - size of the home economy



⇒ the smaller the asymmetry in size across the two countries the larger the gain from the responsive fiscal rule

Robustness of the results - Unilateral policy

Figure: Welfare loss for different ζ relative to constant consumption taxes under symmetry (blue line) and constant foreign consumption taxes (red dotted line)