Fiscal Stimulus and Distortionary Taxation

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January 8, 2010

Outline

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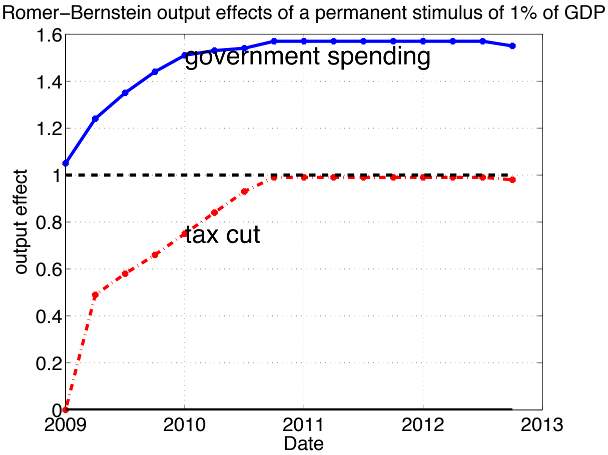
Question and Answers

Question:

- What is the effect of a fiscal stimulus as the ARRA?
- What are the resulting fiscal multipliers?

Answers: ...

Bernstein-Romer, Appendix: Multipliers



What I do:

- Build on: Cogan-Cwik-Taylor-Wieland (2009), using Smets-Wouters (CCTW-SW). Lump-sum taxes.
- **This paper**:
  - Medium-to-long term effects.
  - Distortionary labor taxation ...
  - ... plus: rule-of-thumb consumers.
  - ... plus: binding zero lower bound.

Key insights

- Output response is modest. Fiscal multipliers are typically below 1.
- Consumption response is typically negative or, at most, feebly positive.
- In the medium-to-long term:
    - Pronounced output loss due to increased tax burden.
    - Output losses large relative to initial increase.

Note: No or only moderate inflation tax on initial bond holders, i.e. no “stealing from the Chinese”.

Outline

Smets-Wouters (2007): overview

- Elaborate New Keynesian model.
- Continuum of households. They supply household-specific labor in monopolistic competition. They set wages. Wages are Calvo-sticky.
- Continuum of intermediate good firms. They supply intermediate goods in monopolistic competition. They set prices. Prices are Calvo-sticky.
- Final goods use intermediate goods. Perfect competition.
- Habit formation, adjustment costs to investment, variable capital utilization.
- Monetary authority: Taylor-type rule.

Application to ARRA

- CCWT: path for government spending. Government consumption. Perhaps additively separable in utility.
- CCWT: Fed-Funds = 0 for four quarters. "Jump" to "switched-off" Taylor rule.
- **This paper:**
  - Distortionary labor taxation, consumption taxes, capital income taxes. Steady state levels: Trabandt-Uhlig (2009).
  - Details. Eg: all of labor income or without "union profits"? The former.
  - Speed to return to steady state debt level: $\psi_\tau \in [0, 1]$.
  - ... plus: rule-of-thumb consumers: $\phi \in [0, 100\%]$.
  - ... plus: binding zero lower bound per discount shock, causing recession.

Tax rule

- Remaining deficit, prior to new debt and labor taxes ...

  $f_t =$ gov.spend.+subs.$+$old debt repaym.$-$cons.tax rev.,cap.tax rev.

- ... needs to be financed:

$$\text{lab.tax rev.} + \text{new debt} = f_t$$

- Steady state debt level, steady state taxes: $\bar{f}$.
- Tax rule:

$$\text{lab.tax rev.}_t - \overline{\text{lab.tax rev.}} = \psi_\tau (f_t - \bar{f})$$

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Extensions of Smets-Wouters (2007): Investment & Consumption

Shadow price of investment – original SW with $\tau^k = 0$:

$$\hat{Q}_t = -\hat{q}_t^b - (\hat{R}_t - \mathbb{E}_t[\pi_{t+1}]) + \frac{1}{r_*^k(1-\tau^k) + \delta\tau^k + 1 - \delta} \times$$
$$\times [r_*^k(1-\tau^k)\mathbb{E}_t(\hat{r}_{t+1}^k) + (1-\delta)\mathbb{E}_t(\hat{Q}_{t+1})], \quad (1)$$

Consumption growth – SW with $\tau^j = 0, j = l, c$ and "ex-dividend" wage w_*^h instead of w_*:

$$\hat{c}_t = \frac{1}{1+h/\mu}\mathbb{E}_t[\hat{c}_{t+1}] + \frac{h/\mu}{1+h/\mu}\hat{c}_{t-1} - \frac{1-h/\mu}{\sigma[1+h/\mu]}(\hat{q}_t^b + \hat{R}_t - \mathbb{E}_t[\hat{\pi}_{t+1}])$$
$$- \frac{[\sigma-1][w_* n_*/c_*]}{\sigma[1+h/\mu]}\frac{1-\tau^l}{1+\tau^c}(\mathbb{E}_t[\hat{n}_{t+1}] - n_t), \quad (2)$$

Extensions of Smets-Wouters (2007): Wages

Evolution of wages:

$$
\begin{aligned}
&(1+\bar{\beta}\mu)\hat{w}_t - \hat{w}_{t-1} - \bar{\beta}\mu\mathbb{E}_t[\hat{w}_{t+1}] \\
&= \frac{(1-\zeta_w\bar{\beta}\mu)(1-\zeta_w)}{\zeta_w}\left[\frac{1}{1-h/\mu}[\hat{c}_t-(h/\mu)\hat{c}_{t-1}] + \nu\hat{n}_t - \hat{w}_t + \frac{d\tau_t^l}{1-\tau_l}]\right] \\
&\qquad - (1+\bar{\beta}\mu\iota_w)\hat{\pi}_t + \iota_w\hat{\pi}_{t-1} + \bar{\mu}\mathbb{E}_t[\pi_{t+1}] + \hat{\lambda}_{w,t}, \qquad (3)
\end{aligned}
$$

In the flexible economy:

$$
\hat{w}_t = \frac{1}{1-h/\mu}[\hat{c}_t-(h/\mu)\hat{c}_{t-1}] + \nu\hat{n}_t + \frac{d\tau_t^l}{1-\tau_l}. \qquad (4)
$$

Extensions of Smets-Wouters (2007): Tax rate and gov't deficit

Financing the current deficit:

$$
\begin{aligned}
&\tau^l \frac{w_* n_*}{c_*} \frac{c_*}{\bar{Y}} \left[\frac{d\tau_t^l}{\tau_l} + \hat{w}_t + \hat{n}_t \right] + \epsilon_t^\tau \\
&= \frac{\psi_\tau}{\mu} \left[\mu[\hat{g}_t^a + \hat{g}^s] + \frac{b_*}{\bar{Y}} \frac{\hat{b}_{t-1} - \hat{\pi}_t}{\pi_*} - \mu\tau_c \frac{c_*}{\bar{Y}} \hat{c}_t - \tau^k [r_*^k r_t^k + (r_t^k - \delta)\hat{k}_{t-1}^p] \frac{k_*}{\bar{Y}} \right]
\end{aligned}
$$

Budget:

$$
\begin{aligned}
\hat{g}_t + \frac{1}{\mu\pi_*} \frac{b_*}{\bar{Y}} [\hat{b}_{t-1} - \hat{\pi}_t] &= \frac{1}{R_*} \frac{b_*}{\bar{Y}} [\hat{b}_t - \hat{R}_t - \hat{q}_t^b] + \tau_c \frac{c_*}{\bar{Y}} \hat{c}_t + \\
&+ \tau^l \frac{w_* n_*}{c_*} \frac{c_*}{\bar{Y}} \left[\frac{d\tau_t^l}{\tau_l} + \hat{w}_t + \hat{n}_t \right] + \tau^k [r_*^k r_t^k + (r_t^k - \delta)\hat{k}_{t-1}^p] \frac{k_*}{\mu \bar{Y}}. \quad (6)
\end{aligned}
$$

Unchanged SW equations: Cost and pricing equations

$$\widehat{mc}_t = (1-\alpha)\hat{w}_t + \alpha \hat{r}_t^k - \gamma_t, \tag{7}$$

$$(1+\bar{\beta}\mu\iota_p)\hat{\pi}_t = \iota_p\hat{\pi}_{t-1} + \bar{\beta}\mu\mathbb{E}_t[\hat{\pi}_{t+1}] + A\frac{[1-\zeta_p\bar{\beta}\mu][1-\zeta_p]}{\zeta_p}\widehat{mc}_t + \hat{\lambda}_{p,t}. \tag{8}$$

$1-\zeta_p$ is the probability of (potential) price adjustment.

Unchanged SW equations: Capital services and Capital Stock

Cost minimization yields:

$$\hat{k}_t = \hat{w}_t - \hat{r}_t^k + \hat{n}_t. \tag{9}$$

From the FOC with respect to capacity utilization:

$$r_*^k \hat{r}_t^k = a''(1)\hat{u}_t \qquad \Rightarrow \hat{u}_t \equiv \frac{1-\psi_u}{\psi_u}\hat{r}_t^k. \tag{10}$$

The law of motion for capital implies:

$$\hat{k}_t^p = \left[1 - \frac{x_*}{k_*^p}\right]\hat{k}_{t-1}^p + \frac{x_*}{k_*^p}\hat{q}_t^x + \frac{x_*}{k_*^p}\hat{x}_t. \tag{11}$$

Unchanged SW equations: Investment and FedFunds

The FOC for investment implies:

$$\hat{x}_t = \frac{1}{1+\bar{\beta}\mu}\left[\hat{x}_{t-1} + \bar{\beta}\mu\mathbb{E}_t(\hat{x}_{t+1})\right] + \frac{1}{\mu^2 S''(\mu)}[\hat{Q}_t^k + \hat{q}_t^x], \qquad (12)$$

The interest rate rule:

$$\hat{R}_t = \rho_R \hat{R}_{t-1} + [1-\rho_R][\psi_1\hat{\pi}_t + \psi_2(\hat{y}_t - \hat{y}_t^{flex})] + \psi_3[\hat{y}_t - \hat{y}_{t-1} + - (\hat{y}_t^{flex} - \hat{y}_{t-1}^{flex})] + ms_t, \qquad (13)$$

Here: Introduce wedge between $\hat{R}_t$ and the relevant interest rate for the private sector for first periods.

Unchanged SW equations: Production and Expenditure

The production technology for final goods:

$$\hat{y}_t = \frac{\bar{Y} + \Phi}{\bar{Y}} [\alpha \hat{k}_t + (1 - \alpha)\hat{n}_t + \gamma_t], \tag{14}$$

Spending identity with costs of capacity utilization:

$$\hat{y}_t = \hat{g}_t + \frac{c_*}{\bar{Y}} \hat{c}_t + \frac{x_*}{\bar{Y}} \hat{x}_t + \frac{r_*^k k_*}{\bar{Y}} \hat{u}_t. \tag{15}$$

Outline

Parameters: Estimated SW parameters I

Parameter	Value	Description
δ	0.025	depreciation rate
λ_w	1.5	markup labor market
g	0.18	exogenous gov't spending/GDP
μ	$1 + \frac{0.4312}{100}$	trend growth rate
β	$\frac{100}{0.1657+100}$	discount factor
π_*	$1 + \frac{0.7869}{100}$	inflation rate
α	0.1901	capital share in production
σ	1.3808	1/intertemporal elasticity of substitution
$\frac{\bar{Y}+\Phi}{\bar{Y}} = \lambda_p$	1.6064	fixed cost and goods market markup
	0.5187	net exports/gov't exp. reaction to techn.
$S''(\mu)$	5.7606	investment adjustment cost
h	0.7133	habit persistence
Ξ_w	0.7061	calvo parameter labor market

Parameters: Estimated SW parameters II

Parameter	Value	Description
ν	1.8383	labor supply elasticity
Ξ_p	0.6523	calvo parameter goods market
ι_w	0.5845	indexation labor market
ι_p	0.2432	indexation goods market
	0.5462	capital utilization elasticity
ψ_1	2.0443	Taylor rule reaction to inflation
ρ_R	0.8103	Taylor rule interest rate smoothing
ψ_2	0.0882	Taylor rule long run reaction to output gap
ψ_3	0.2247	Taylor rule short run reaction to output gap

Parameters: Calibration and Implications

Parameter	Value	Description
$\frac{b}{\bar{Y}}$	0.63	Debt to GDP ratio
τ_k	0.36	capital tax
τ_l	0.28	wage tax rate
τ_c	0.05	consumption tax rate
	0.1059	implied transfer payment
	0.0097	Interest payments relative to GDP
	0.2268	Labor tax revenue relative to GDP
	0.0335	Capital tax revenue relative to GDP
	0.0353	Consumption tax revenue relative to GDP

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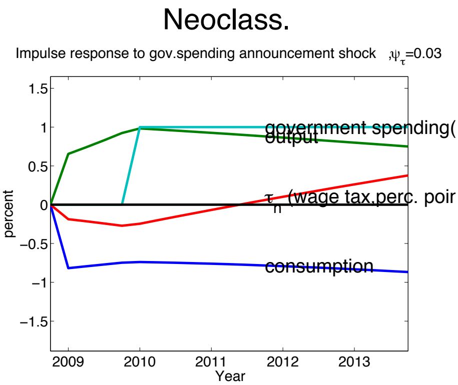
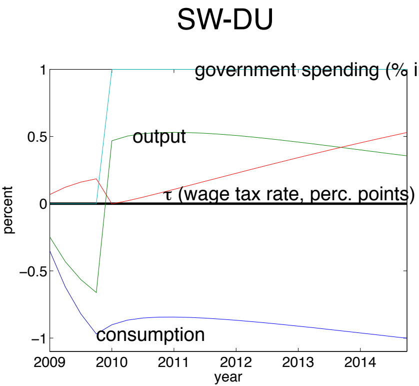
A neoclassical growth model

Comparison to a neoclassical growth:

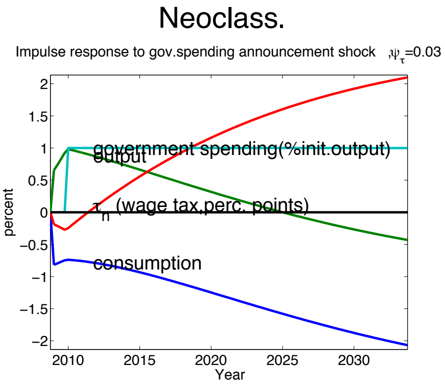
- standard, but ..
- ... add distortionary labor taxes, capital income taxes, consumption taxes.
- Frisch elasticity: 1.
- Calibration: Trabandt-Uhlig (2009).
- Consider an anticipated permanent increase in government spending.

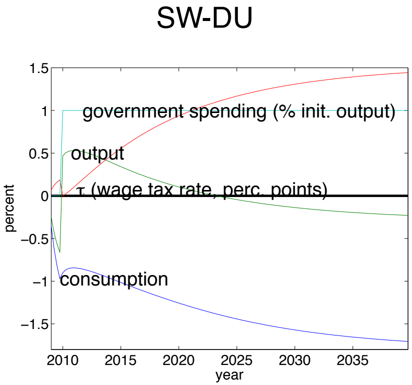
Neoclass. vs SW-DU: announced, $\psi_\tau = 0.03$.





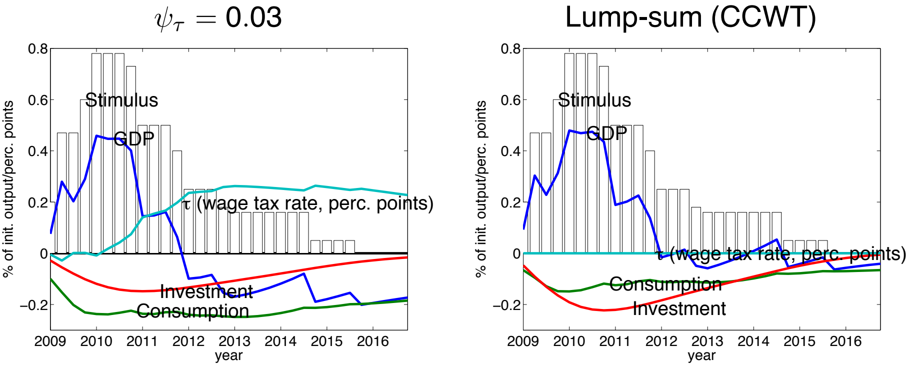
Neoclass. vs SW-DU: perm., ann., $\psi_\tau = 0.03$. Long run.



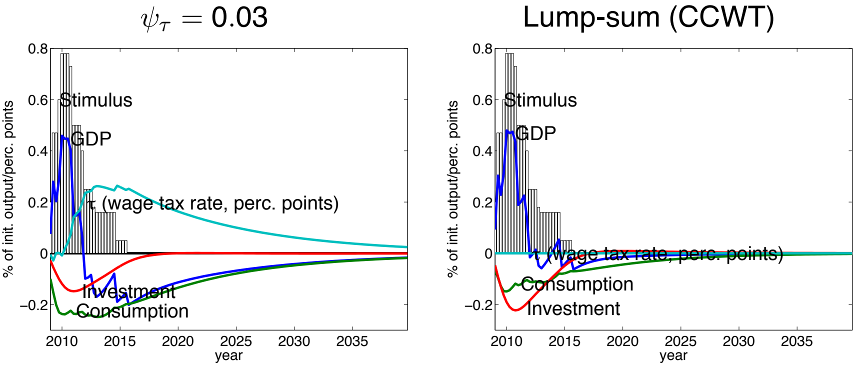


Outline

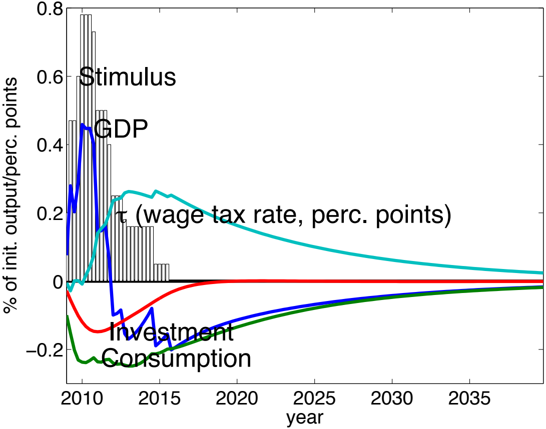
Short-run. $\psi_\tau = .03$ vs lump-sum.



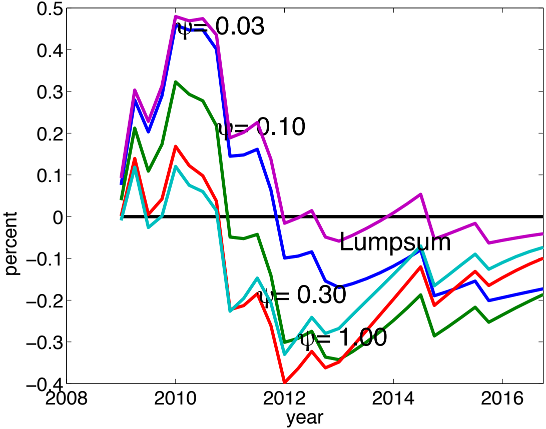
Medium-run. $\psi_\tau = .03$ vs lump-sum.



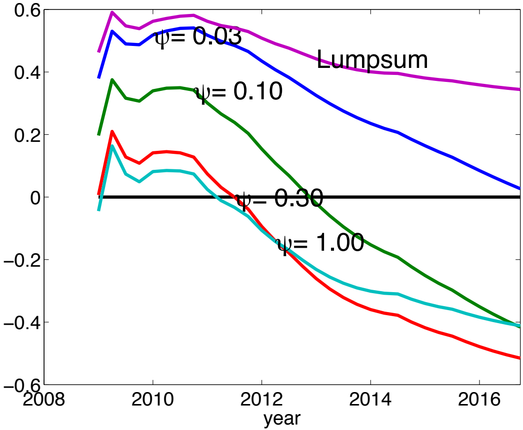
Fiscal stimulus: medium run. $\psi_\tau = 0.03$.



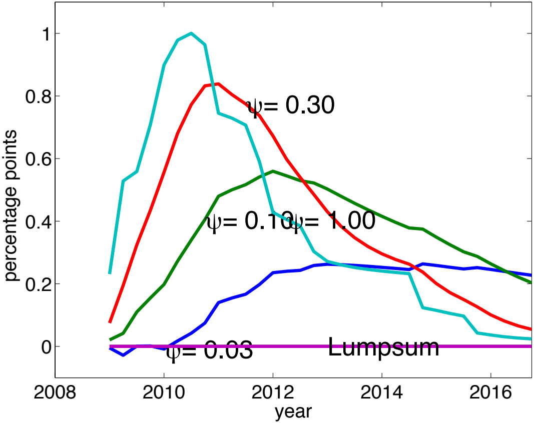
Spending increase, short-run output dynamics: various ψ_τ.



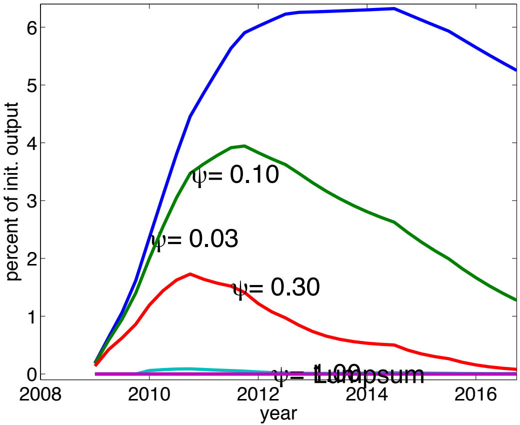
Spending increase, short-run fiscal multipliers



Spending increase, short-run tax dynamics: various ψ_τ.



Spending increase, short-run debt dynamics: various ψ_τ.



Outline

Consumption of the two agents

Modify consumption Euler equation to account for Rational Agents only:

$$\hat{c}_t^{RA} = \frac{1}{1+h/\mu}\mathbb{E}_t[\hat{c}_{t+1}] + \frac{h/\mu}{1+h/\mu}\hat{c}_{t-1} - \frac{1-h/\mu}{\sigma[1+h/\mu]}(\hat{q}_t^b + \hat{R}_t - \mathbb{E}_t[\hat{\pi}_{t+1}]) - \frac{[\sigma-1][w_* n_*/c_*^{RA}]}{\sigma[1+h/\mu]}\frac{1-\tau^l}{1+\tau^c}(\mathbb{E}_t[\hat{n}_{t+1}] - n_t), \quad (16)$$

The consumption of the Rule-of-Thumb consumer is determined from their budget constraint:

$$\hat{c}_t^{RoT} = (1-\tau^l)\frac{w_* n_*}{c_*^{RoT}}\left[\hat{w}_t + \hat{n}_t - \frac{d\tau^l}{1-\tau^l}\right], \quad (17)$$

using $\hat{n}_t = \hat{n}_t^{RoT} = \hat{n}_t^{RA}$ and $n_* = n_*^{RoT} = n_*^{RA}$.

Aggregating consumption

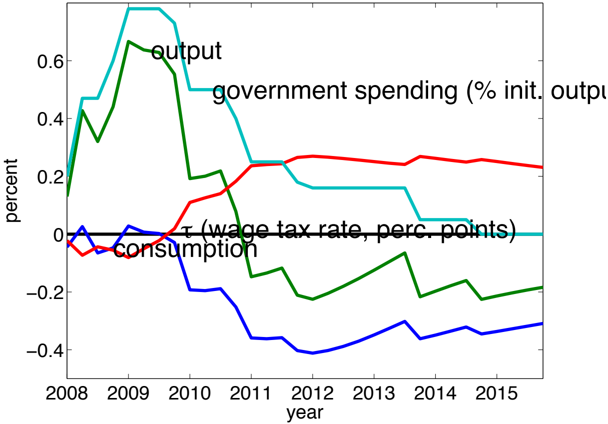
Aggregate consumption:

$$\hat{c}_t = \frac{c_*^{RA}}{c_*}(1-\phi)\hat{c}_t^{RA} + \frac{c_*^{RoT}}{c_*}\phi\hat{c}_t^{RoT}, \tag{18}$$

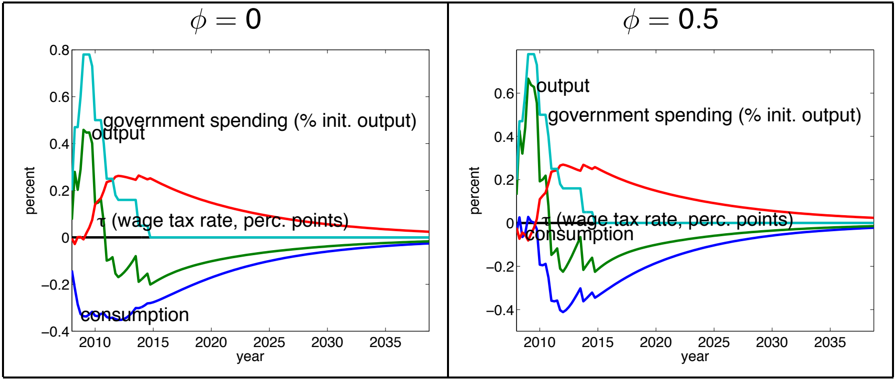
where

$$c_*^{RoT} = \frac{w_* n_* (1-\tau^l) + s_*}{1+\tau^c},$$
$$c_*^{RA} = \frac{c_* - \phi c_*^{RoT}}{1-\phi}.$$

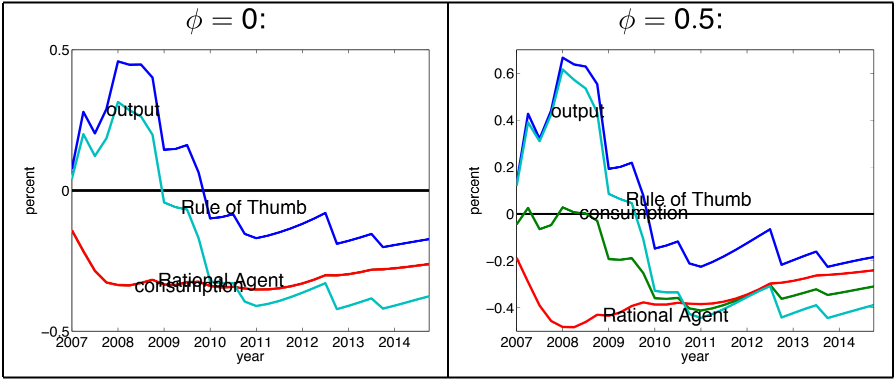
Distorting taxation and Rule-of-Thumb Consumers: $\psi_\tau = 0.03$, $\phi = 0.50$.



Medium run.

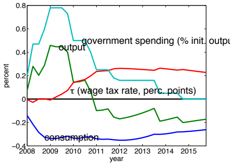

$\phi = 0$
0.8
0.6
0.4
0.2
0
−0.2
−0.4
percent
government spending (% init. output)
output
τ (wage tax rate, perc. points)
consumption
2010
2015
2020
2025
2030
2035
year
$\phi = 0.5$
0.6
0.4
0.2
0
−0.2
−0.4
percent
output
government spending (% init. output)
τ (wage tax rate, perc. points)
consumption
2010
2015
2020
2025
2030
2035
year

Comparing consumption patterns, $\psi_\tau = 0.03$.

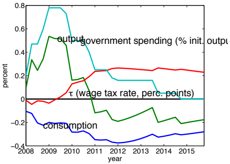


Short run: $\psi_\tau = 0.03$, vary rules-of-thumb fraction ϕ.

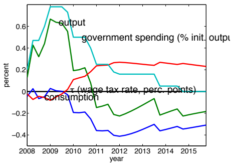
$\psi_\tau = 0.03, \phi = 0$:



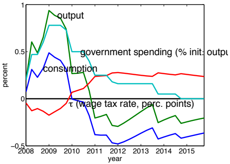
$\psi_\tau = 0.03, \phi = 0.25$:



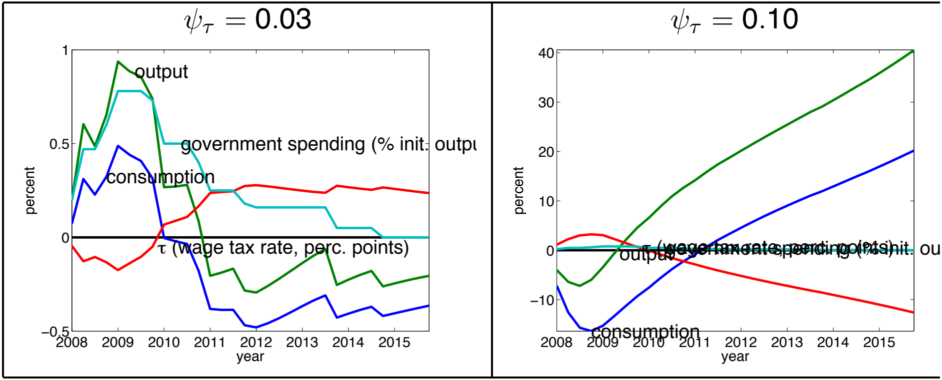
$\psi_\tau = 0.03, \phi = 0.50$:



$\psi_\tau = 0.03, \phi = 0.75$:



Short run: $\phi = 0.75$, vary ψ_τ.



Outline

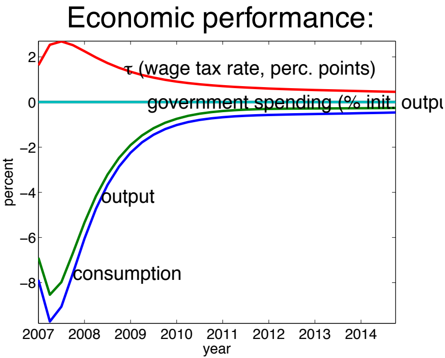
Zero nominal interest rates

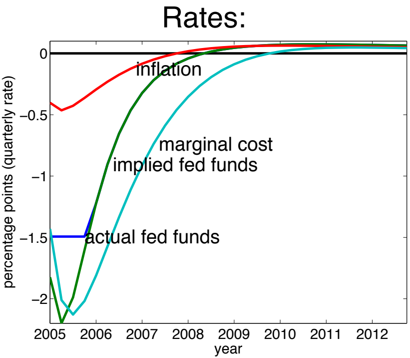
- Before (and following CCWT): for four quarters, “switch off” Taylor rule and set nominal interest rate to zero instead.
- SW/CCWT: steady state quarterly nominal interest rate is 1.55%
- Now: recession per bond-premium-shock $\hat{q}_t^b$: Consumers want to save more at any given interest rate (Christiano, Eichenbaum and Rebelo (2009)). Increase half-life of shock to one period (SW: <0.5 periods).
- Zero lower bound becomes binding with a bond-premium shock of 0.165, implying a (quarterly) change in GDP of -5.46%.
- Assume shock of 0.20.

Results

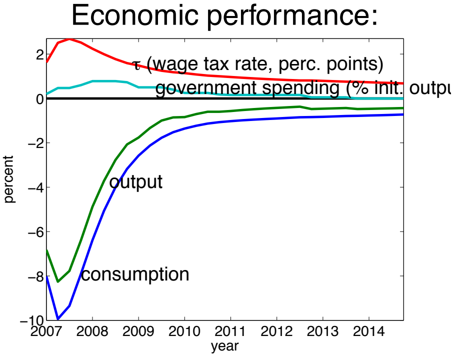
- Extreme scenario.
- Examine differences between “with” and “without” stimulus.
- Results are practically the same as before.
- Erceg-Lindé, 2009.

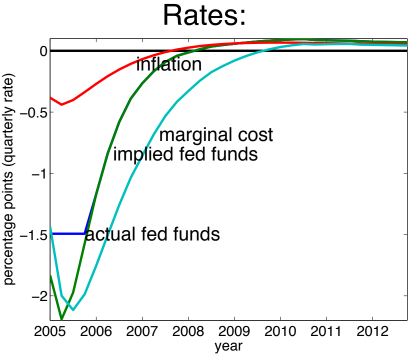
Without stimulus, $\psi_\tau = 0.03$.



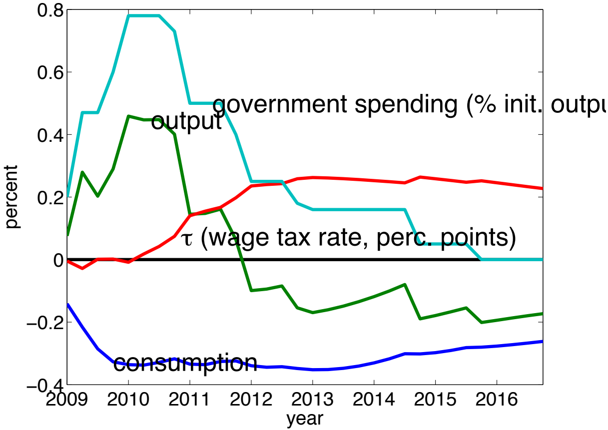


With stimulus, $\psi_\tau = 0.03$.

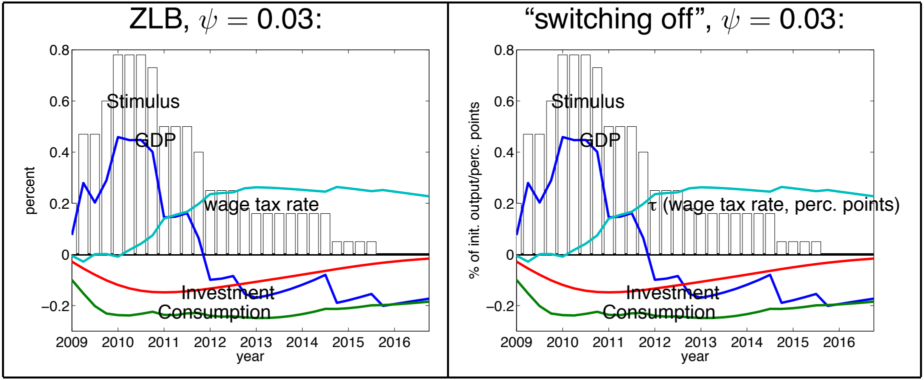




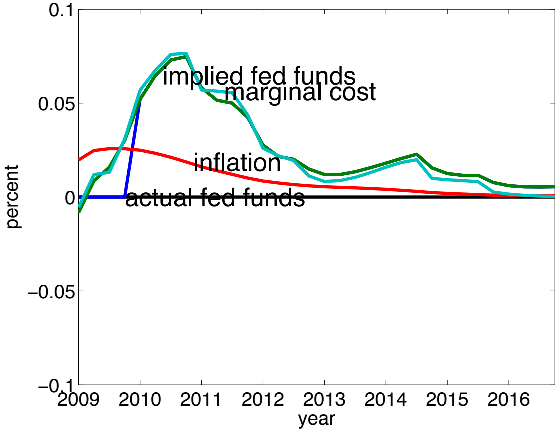
Difference between with and without stimulus.



SW-DU, Bondpremium-Shock with binding ZLB: Difference, compared to “switching off”.

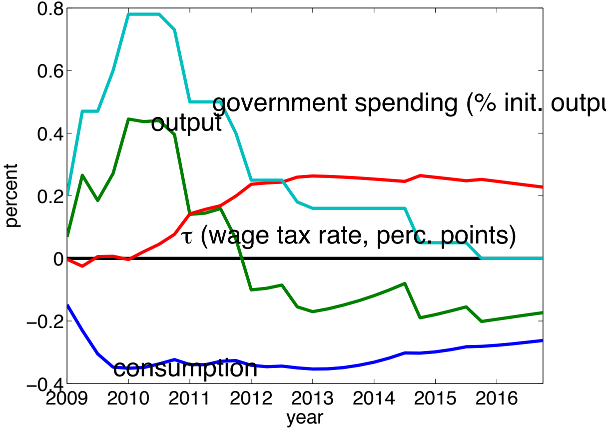


Rates: Difference between with and without stimulus.

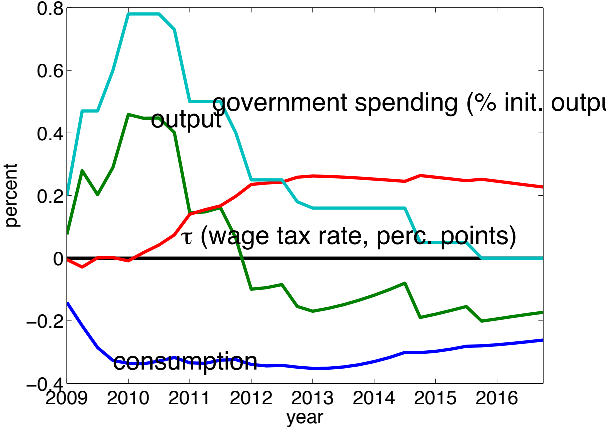


Outline

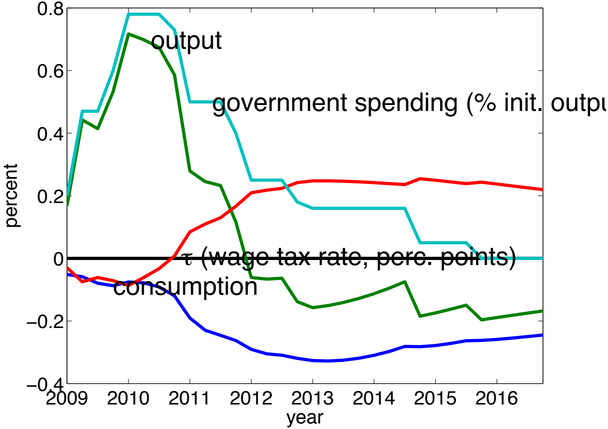
$i = 0$ for 0 quarters ($\psi_\tau = 0.03$).



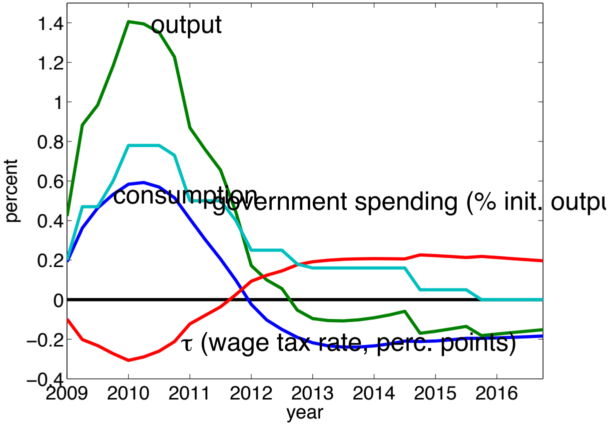
$i = 0$ for 4 quarters ($\psi_\tau = 0.03$).



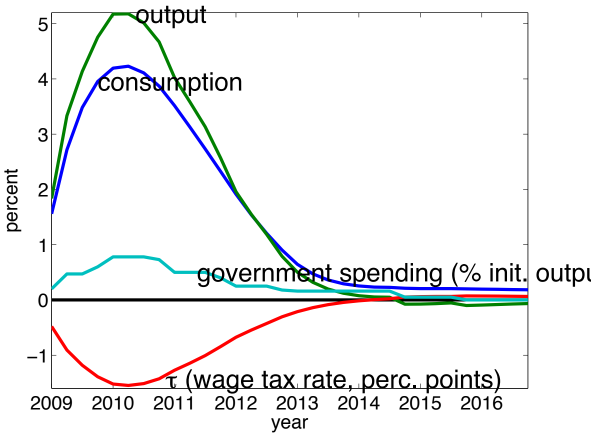
$i = 0$ for 8 quarters ($\psi_\tau = 0.03$).



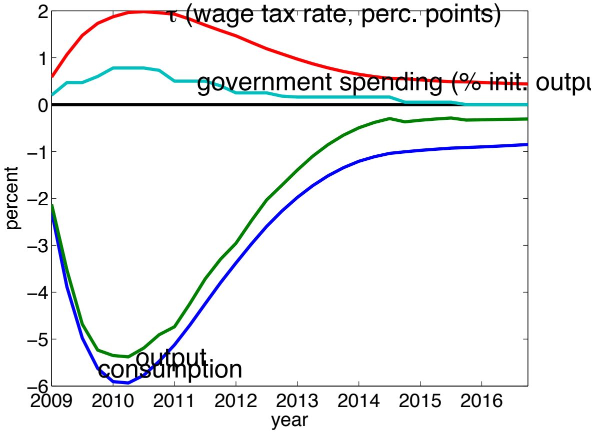
$i = 0$ for 12 quarters ($\psi_\tau = 0.03$).



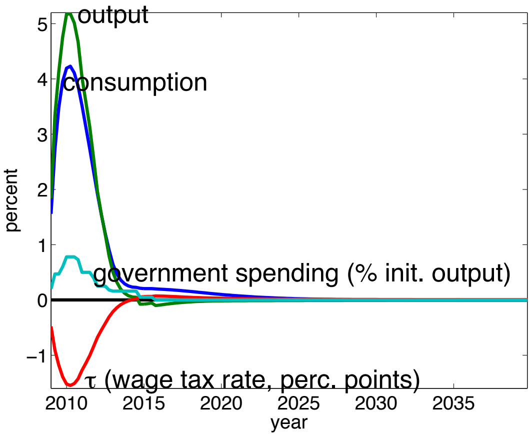
$i = 0$ for 16 quarters ($\psi_\tau = 0.03$).



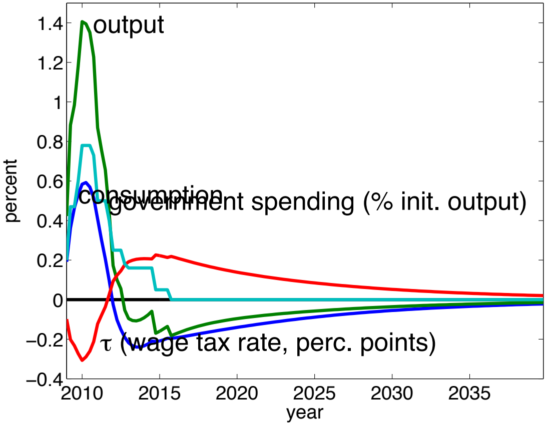
$i = 0$ for 20 quarters ($\psi_\tau = 0.03$).



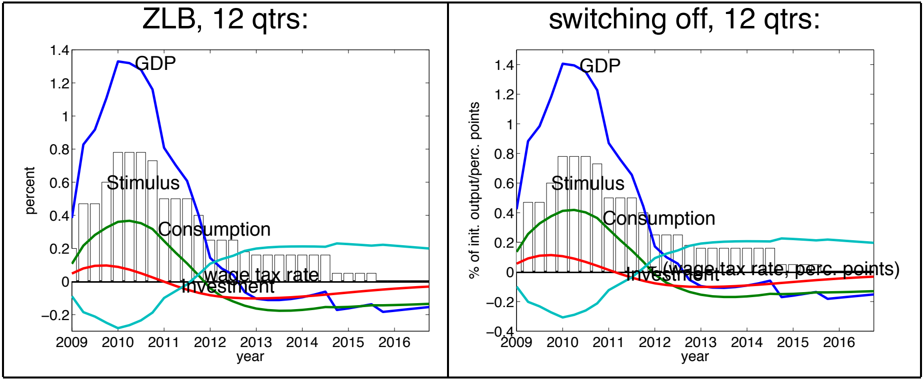
$i = 0$ for 16 quarters ($\psi_\tau = 0.03$). Long run



$i = 0$ for 12 quarters ($\psi_\tau = 0.03$). Long run

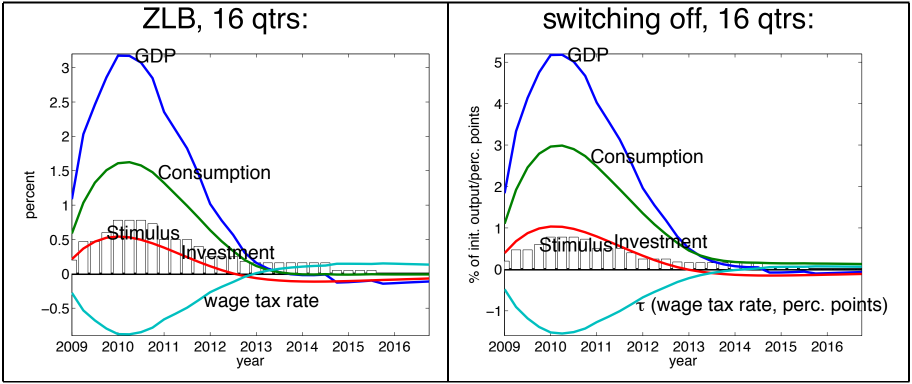


Comparing binding ZLB, “switching off” with proper ZLB. 12 quarters



($\psi_\tau = 0.03$, scaling the interest rate down to 2/3 of actual value in interest rate rule. High persistence, $\rho_b = 0.9$. Shocks: 2.38% for 16 qtrs, 2.02% for 12 qtrs, 1.57% for 8 qtrs, 1.43% for 5 qtrs.)

Comparing binding ZLB, “switching off” with proper ZLB. 16 quarters



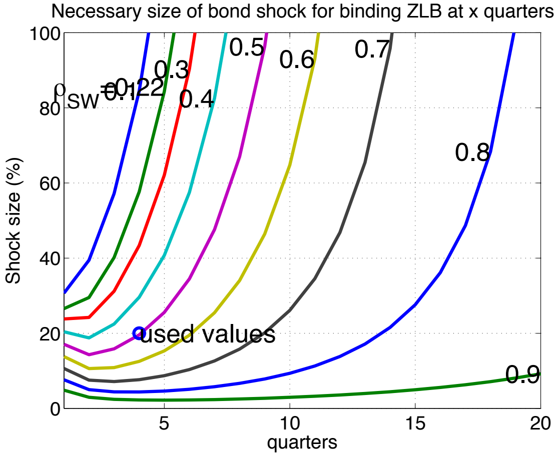
($\psi_\tau = 0.03$, scaling the interest rate down to 2/3 of actual value in interest rate rule. High persistence, $\rho_b = 0.9$. Shocks: 2.38% for 16 qtrs, 2.02% for 12 qtrs, 1.57% for 8 qtrs, 1.43% for 5 qtrs.)

Evaluation

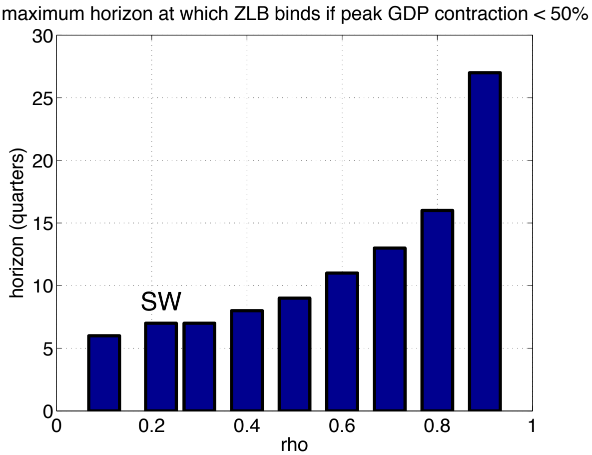
What does it take for the ZLB to bind?

Disclaimer: based on linear extrapolation of the case of a non-binding ZLB. This is a problem because it neglects the feedback – since the recession is stronger if the ZLB binds, a smaller shock is needed for a given decline in interest rates.

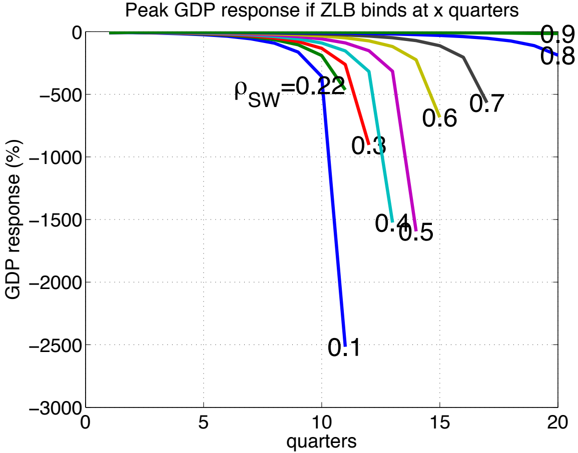
Necessary initial bond premium shock to make ZLB exactly binding at x quarters



With a maximal contraction of 50%, ZLB of x quarters obtains for ...



Generating a binding ZLB at x horizons leads to...



Outline

Conclusions

In the context of this model, the impact of a government spending stimulus ...

- ... is very sensitive to assumptions about taxes.
- ... on output is rarely larger than the government spending increase
- ... is a comparatively larger output loss later on, due to the increased tax burden.

Furthermore,

- Consumption declines.
- Rules-of-thumb agents do not change the results much. Consumption may be feebly positive, the increase in output is somewhat larger.
- Binding zero lower bound: does not change the results much, if temporary, and is extreme and fragile, if longer.

Therefore: tax considerations and medium-term impacts merit much more attention!