



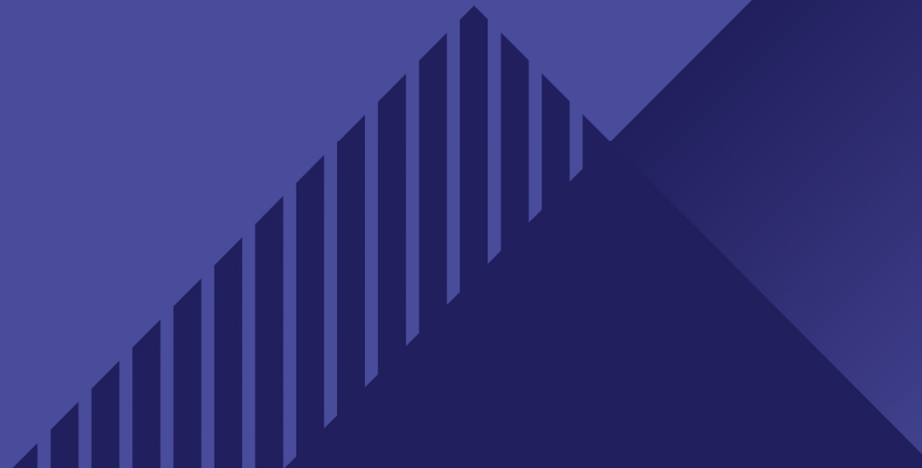
Norwegian Ministry
of Finance

Norwegian Ministry of Finance Modelling Project

Progress Update

Magnus Saxegaard

April 5, 2019

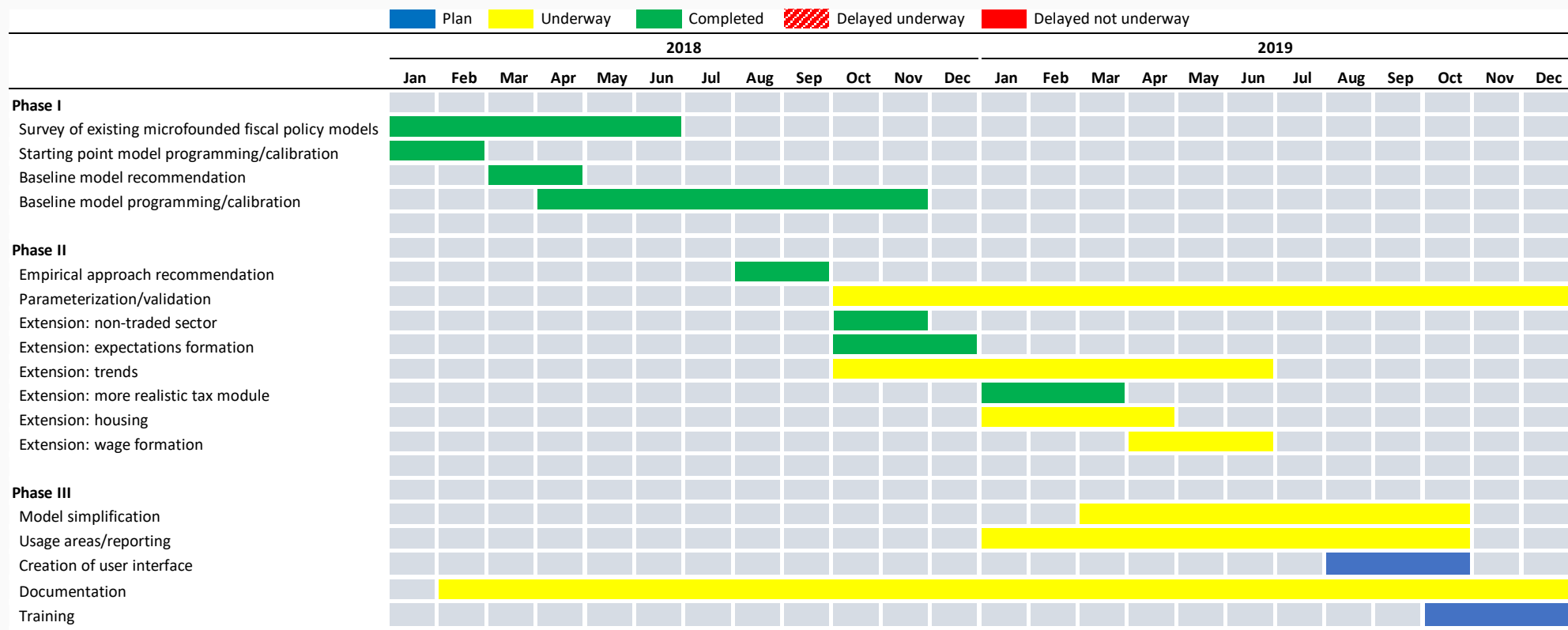


Progress update

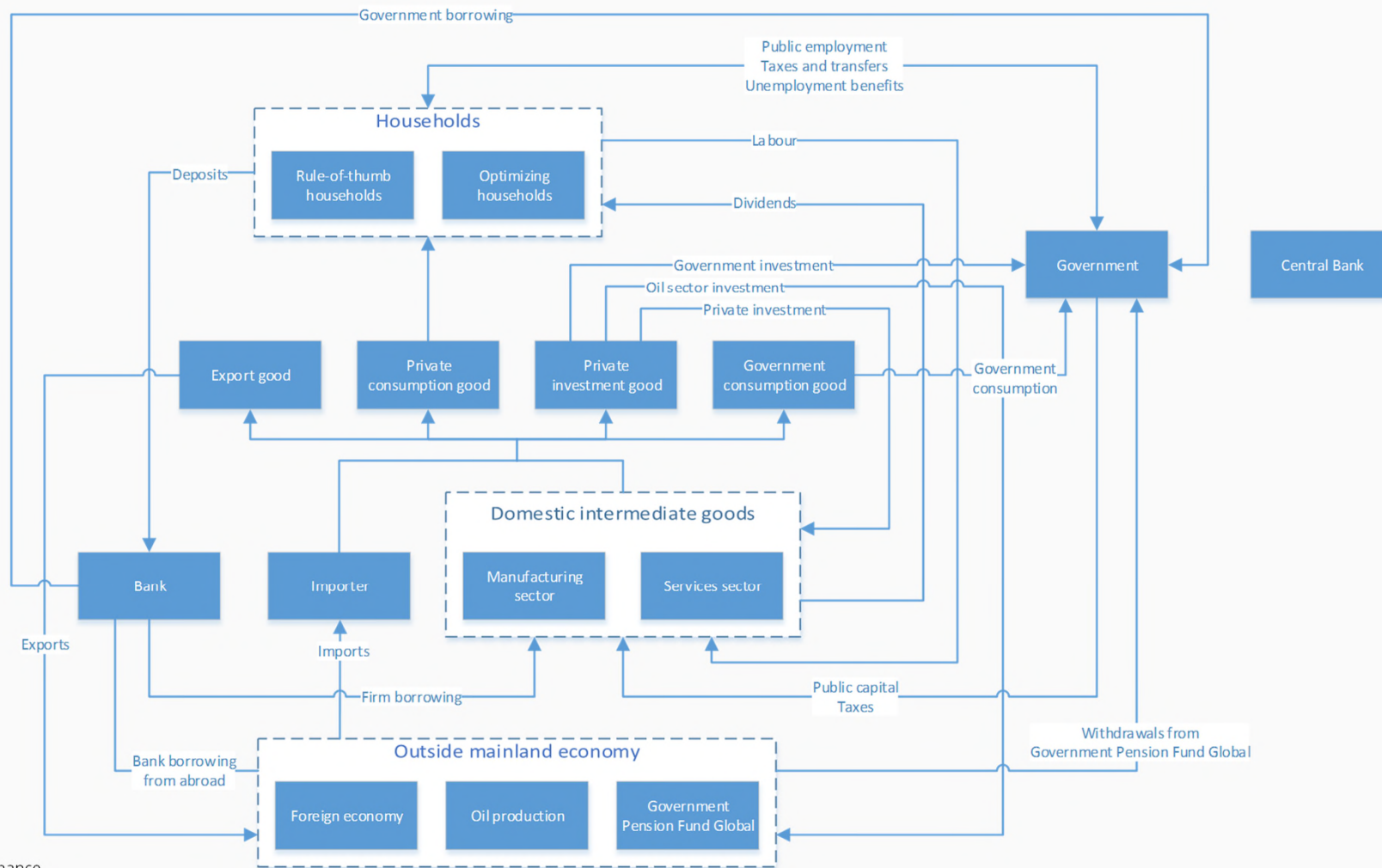
- Extensions to “baseline” model
 - Introduced non-tradable sector
 - Increased level of detail in tax module
 - Explored possibility of including a housing sector
 - Explored alternative forms of expectations formation
 - Improved the modeling of the oil fund
 - Started process of estimating model using Bayesian Maximum Likelihood
- Increased focus on integrating model in the work of the Ministry of Finance
 - Developing and showcasing “use cases” for the new model
 - Established group of “super users” at the Ministry
- Outreach
 - Published documentation of “baseline model”
 - Model simulations presented to Parliament Finance Committee in January
 - Presentation of tax module to Tax Policy Department at the Ministry of Finance



Project plan



A snapshot of the current version of the model



What are some of the things we can/will be able to do with the model?

- Simulate a variety of domestic and international shocks
- Simulate permanent shifts in fiscal policy under a variety of financing assumptions and at different stages of business cycle
- Analyze a package of policy measures
- Effects of preannouncing policy measures
- Effects of monetary accommodation
- Analysis of fiscal multipliers
- Storytelling
- Comparative statics

SNOW vs. KVARTS vs. MINFIN model

Model	KVARTS	SNOW	FIN model
Microfounded?	No	Yes	Yes
General equilibrium?	No	Yes	Yes
Disaggregation	High	High	Low
Size	Large	Large	Medium
Frictions	Yes	No	Yes
Focus	Forecasting/policy analysis	Policy analysis/welfare	Policy analysis
Parameterization	Estimation	Calibration	Estimation



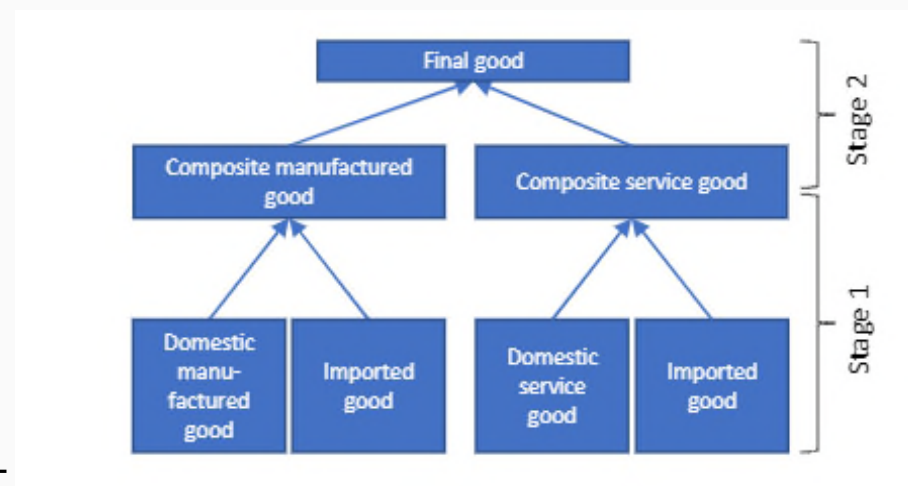


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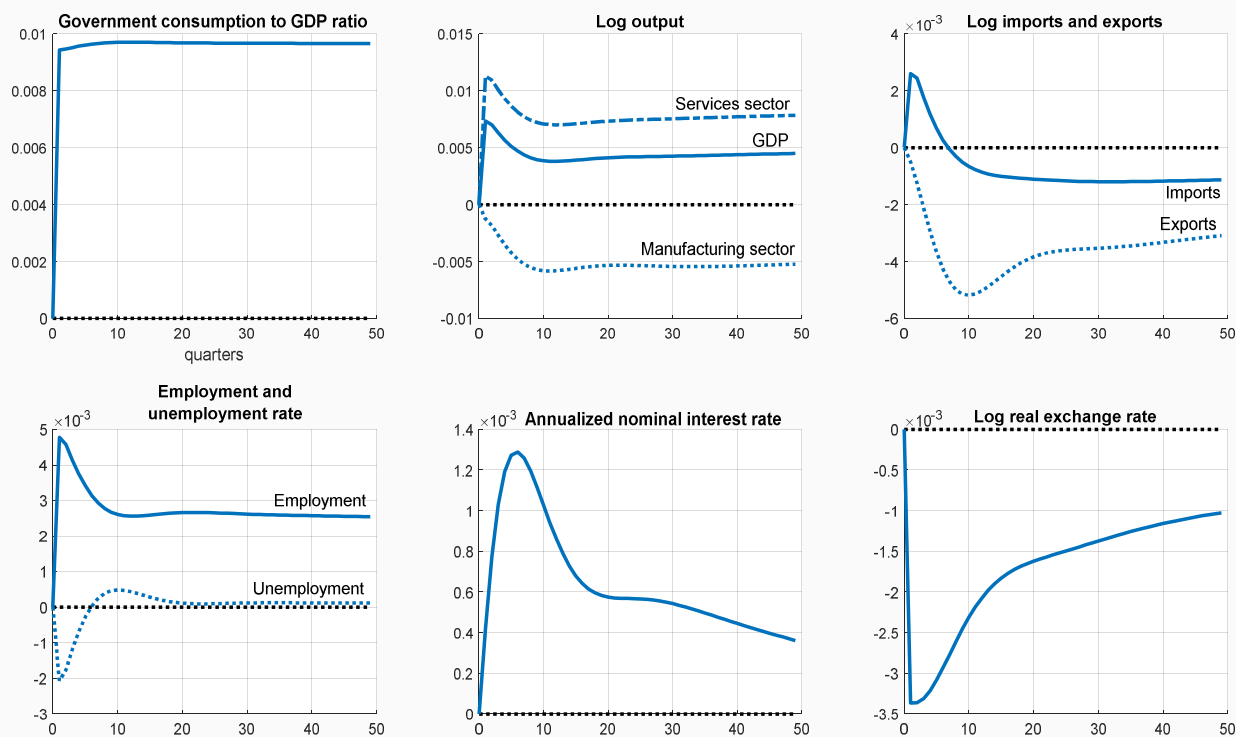
Introducing a non-tradable sector

Incorporating a non-tradable sector into the model

- Services sector as proxy for non-tradable sector
 - Less import intensive
- Four symmetric final good sectors
 - Private consumption, investment, exports, and government consumption
 - Each final good differs in their domestic vs. import and manufacturing vs. services content
- Calibrated to match national accounts



Permanent increase in government purchases financed by lump-sum taxes





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Increasing level of detail in the tax module

Increasing level of detail in tax module of the model

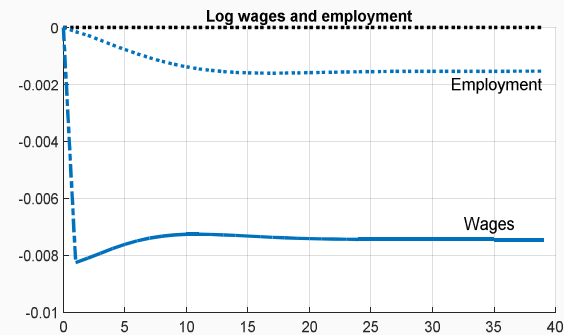
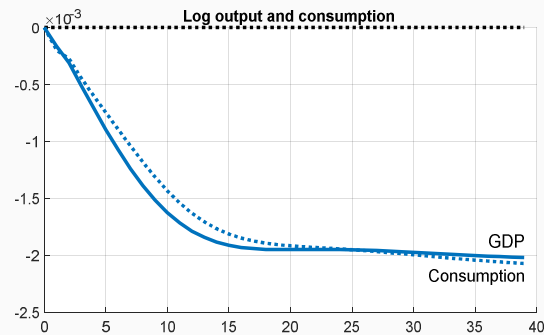
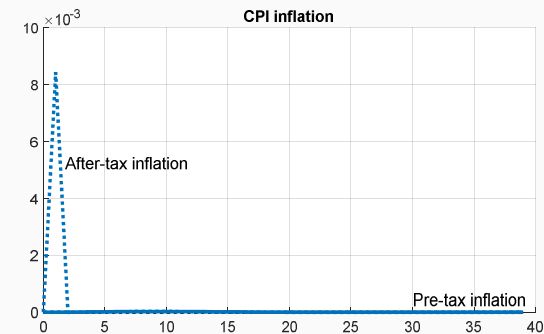
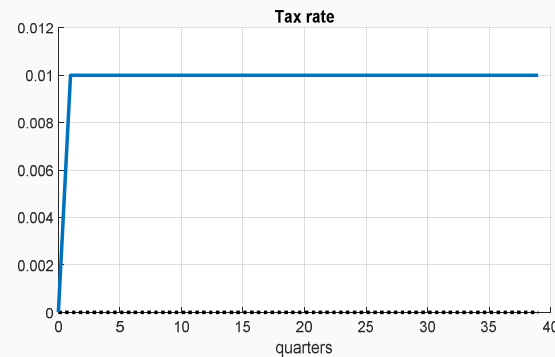
- Total government revenue is given by:

$$\begin{aligned}
 T_t = & \underbrace{T_t^L}_{\text{Lump-sum tax}} + \underbrace{C_t(\tau_t^C + f_t^C/P_t)}_{\text{Consumption taxes and fees}} + \underbrace{(w_t N_t^P + w_t^G N_t^G) \tau_t^{SS,F}}_{\text{Social security contributions of employers}} \\
 & + \underbrace{(w_t N_t^P + w_t^G N_t^G + U B_t(L_t - N_t) + T R_t)(\tau_t^{OI,H} + \tau_t^{BT} + \tau_t^{SS,H})}_{\text{Taxes on Labor income and transfers}} \\
 & + \underbrace{(\Pi^{M,TB} + \Pi^{S,TB}) \tau_t^{OI,F}}_{\text{Corporate income taxation}} + \underbrace{\left[\frac{1}{\pi_t} D P_{t-1} (R_{t-1} - 1) \right] \tau_t^{OI,H}}_{\text{Tax on returns to deposits}} \\
 & + \underbrace{\left(DIV_t + AV_t - RRA_t (P_t^{e,M} + P_t^{e,S}) \right) \alpha_t^{OI,H} \tau_t^{OI,H}}_{\text{Dividend and capital gains tax}}.
 \end{aligned}$$

Value-added tax (mva)

- Tax base: final private consumption (one homogenous good)
- Effective tax rate: [19.1](#) percent
- Main transmission channels from an increase in VAT:
 - Increase in post-tax price level
 - Negative income and wealth effect for households
 - Substitution between consumption and leisure: lower consumption and labor supply
 - Tradeoff between consumption today and tomorrow (if VAT time-varying)
- Excises and fees in the model operate through a similar channel
- To be explored: Firms instead of households paying VAT to the government

Permanent increase in VAT rate financed by lower lump-sum taxes



Ordinary income tax on households

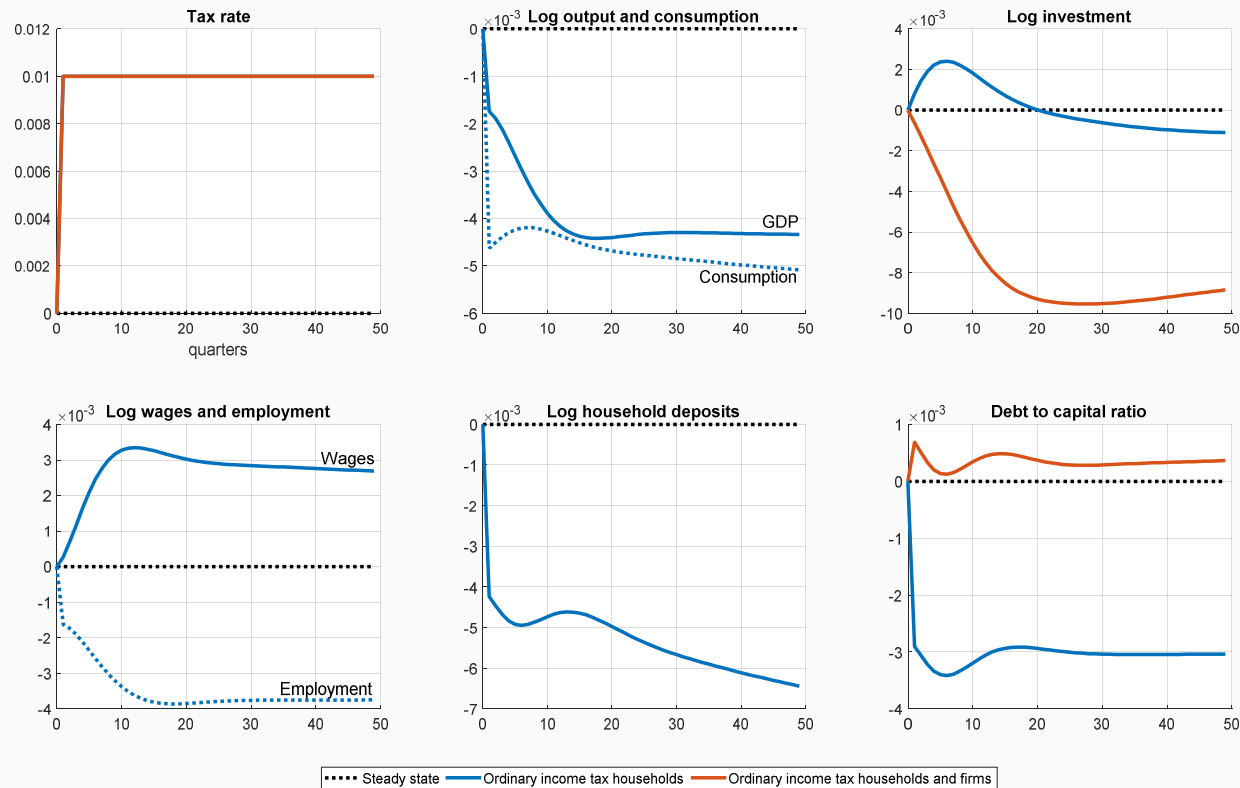
- Tax base: household ordinary income:

$$OI_t^o = \underbrace{LI_t^o}_{\text{labor income}} + \underbrace{UB_t(L_t^o - N_t^o)}_{\text{unemployment benefits}} + \underbrace{TR_t^o}_{\text{transfers}} + \underbrace{DIV_t^{M,o} S_{t-1}^{M,o} + DIV_t^{S,o} S_{t-1}^{S,o}}_{\text{dividends}} + \underbrace{\frac{P_{t-1}}{P_t} DP_{t-1}^o (R_{t-1} - 1)}_{\text{return on deposits}}.$$

$$OI_t^{o,TB} = LI_t^o + UB_t(L_t^o - N_t^o) + TR_t^o + (DIV_t^{M,o} + AV_t^{M,o} - RRA_t \frac{P_{t-1}^{E,M}}{P_t}) S_{t-1}^{M,o} \alpha_t^{OI,H} + (DIV_t^{S,o} + AV_t^{S,o} - RRA_t \frac{P_{t-1}^{E,S}}{P_t}) S_{t-1}^{S,o} \alpha_t^{OI,H} + \frac{P_{t-1}}{P_t} DP_{t-1}^o (R_{t-1} - 1).$$

- Effective tax rate: [20.5](#) percent
- Main transmission channel from an increase in the ordinary income tax rate on households:
 - Tradeoff between consumption and leisure: lower labor supply and consumption
 - Tradeoff between consumption today and tomorrow: less saving and more consumption
 - Negative income and wealth effect for households
 - Increase attractiveness of equity investments relative to debt investments

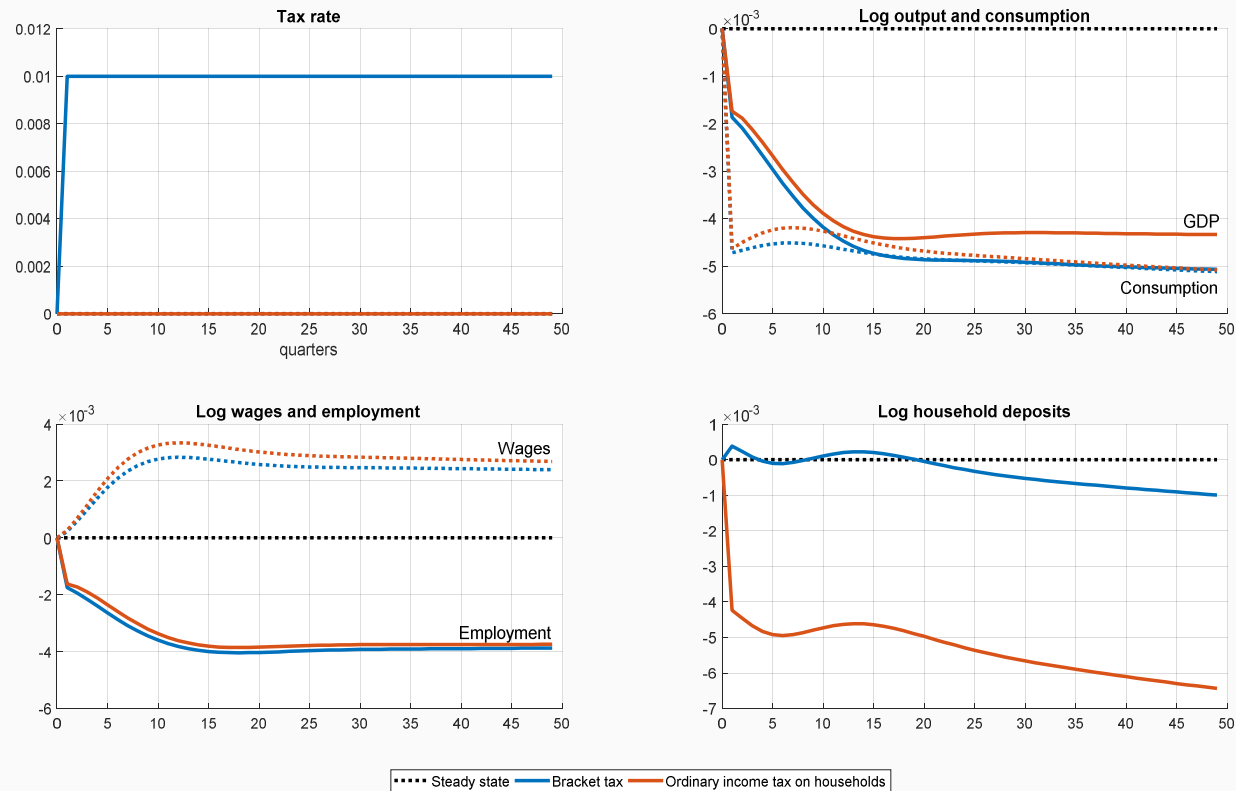
Permanent increase in ordinary income tax on households financed by lower lump-sum taxes



Bracket tax

- Tax base: labor income, unemployment benefits, and transfers
- Effective tax rate: [2.8](#) percent
- Main transmission channels from an increase in bracket taxes:
 - Tradeoff between consumption and leisure: lower labor supply and less consumption
 - Negative income and wealth effect for households
 - Note lower saving but only to help smooth decline in consumption
- Social security contributions by workers operate through same channel

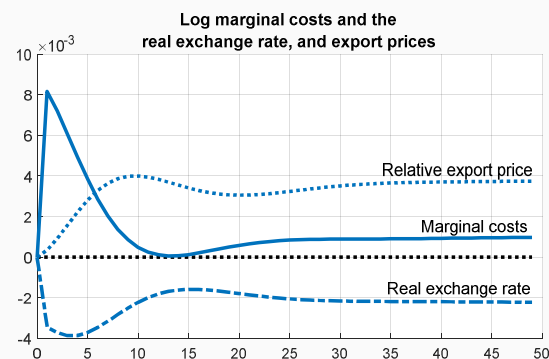
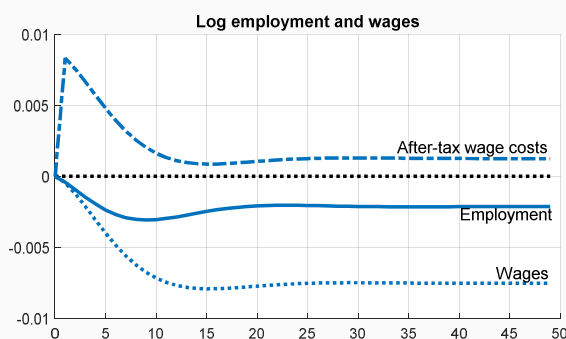
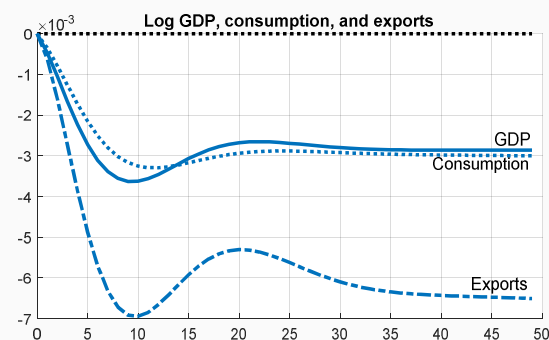
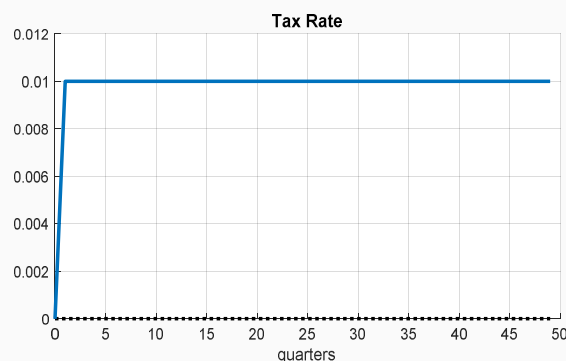
Permanent increase in bracket taxes financed by lower lump-sum taxes



Social security contributions by firms

- Tax base: labor costs
- Tax rate: [13.4](#) percent
- Main transmission channels from higher social security contributions:
 - Lower demand for labor reduces employment and wages
 - Higher marginal costs increases prices
 - Higher marginal costs reduce competitiveness

Permanent increase in firm social security rate financed by lower lump-sum taxes



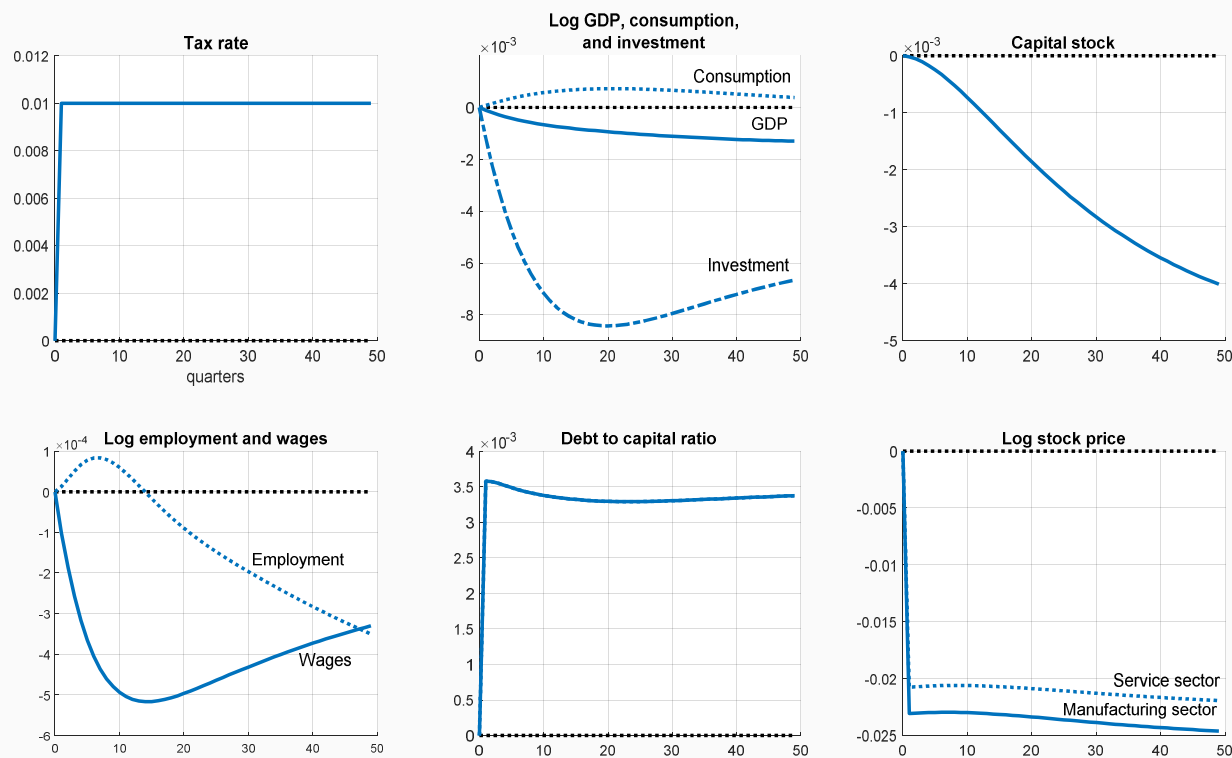
Corporate taxation

- Tax base: firm ordinary income:

$$\underbrace{P_t^m(i)Y_t^M(i)}_{\text{sales}} - \underbrace{(1 + \tau_t^{SS,F})w_tN_t^M(i)}_{\text{labor costs}} - \underbrace{\delta P_t^i K_t^M(i)}_{\text{depreciation costs}} \\ - \underbrace{(R_{t-1}^L \phi_{t-1}^m - 1) \frac{B_{t-1}^M(i)}{\pi_t}}_{\text{interest on dom. borrowing}} - \underbrace{(AC_t^M(i) + \gamma_t^K(i))}_{\text{Adj. costs}}$$

- Effective tax rate: 24.2 percent
- Main transmission channels from an increase in the ordinary income tax rate on firms:
 - Fall in after-tax profits dampens investment
 - Lower expected future dividends results in lower share price
 - Full deductibility of interest costs increases attractiveness of debt financing for firms

Permanent increase in firm ordinary income tax rate financed by lower lump-sum taxes





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Alternative methods of forming expectations

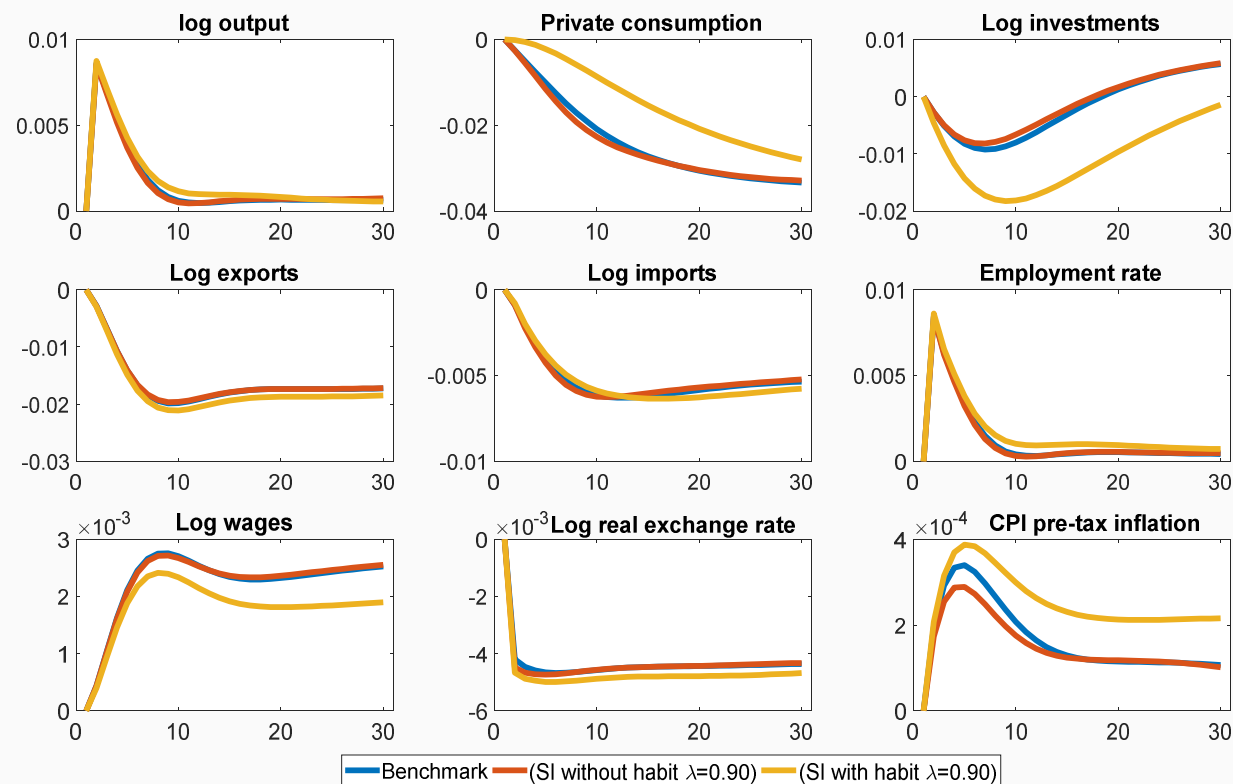
Sticky information

- Mankiw and Reis (2002, 2007), Reis (2009)
- Only a fraction λ of agents update their information every period due to the cost of acquiring, absorbing, and processing information
- Alternative to sticky prices in new-Keynesian models
- Explored differences between sticky prices/wages and sticky information in price/wage setting, and between sticky information and consumption habits
- Conclusions:
 - Sticky prices/wages and consumption habits yields similar results to sticky information
 - Conceptually possible to combine consumption habits and sticky information to generate additional persistence in consumption
 - Sticky information will not be included as an option in the final model, but findings will be presented as evidence that results are robust to this alternative method of forming expectations



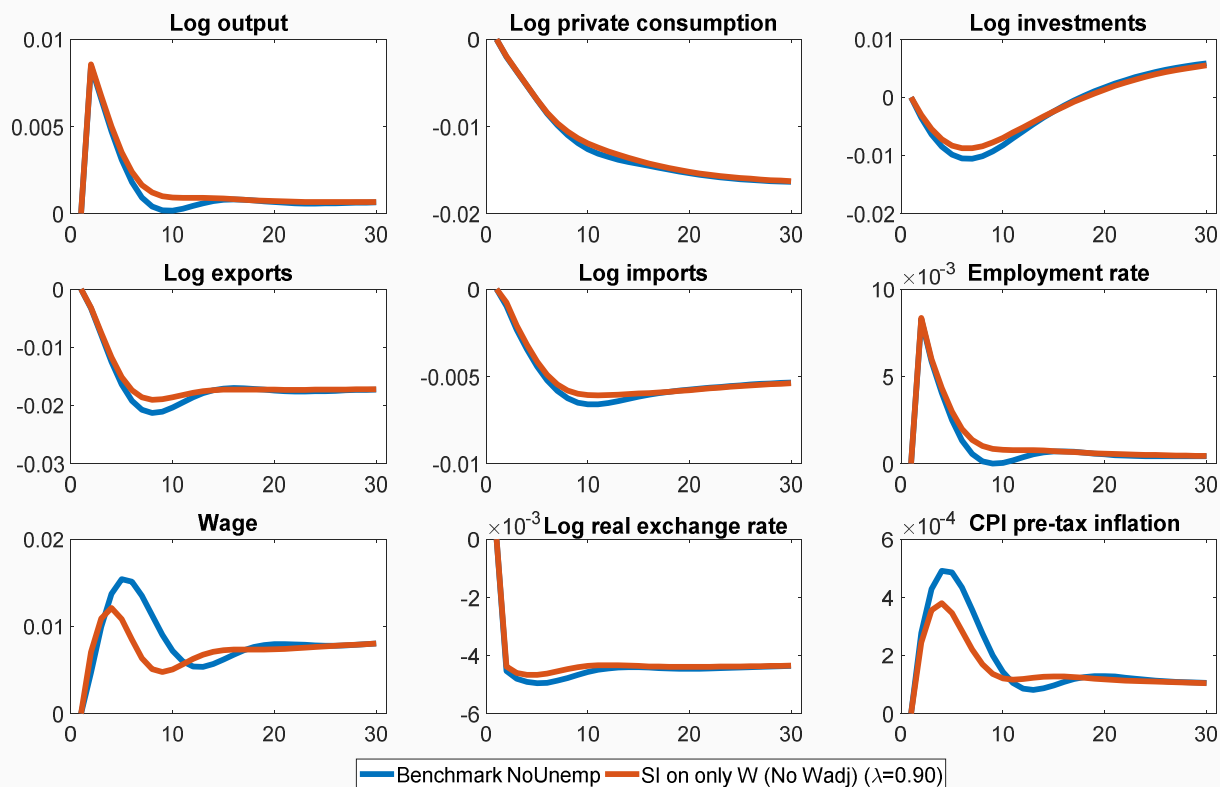
Consumption habits and sticky information

(Government consumption shock financed by higher VAT)



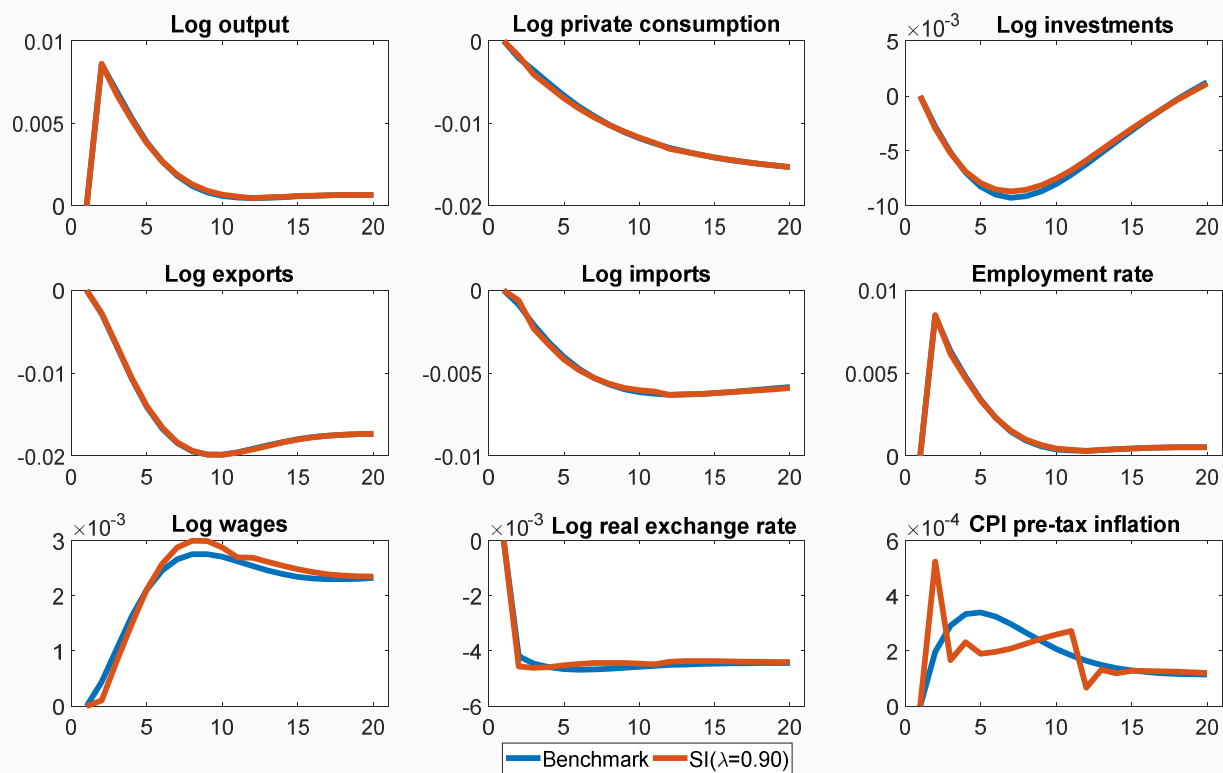
Wage stickiness and sticky information

(Government consumption shock financed by higher VAT)



Price stickiness and sticky information

(Government consumption shock financed by higher VAT)





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Thank you!

Variable and parameter names

Variable	Description	applied to	Variable	Description
τ_t^C	Value-added tax on consumption	Households	C_t	aggregate consumption
f_t^C	nominal consumption fee	Households	w_t	real wage rate
$\tau_t^{OI,H}$	HH's ordinary income tax	Households	N_t^P, N_t^G	private and public employment rate
$\alpha_t^{OI,H}$	Scale-up of dividend taxation	Households	L_t, N_t	Labor participation rate, total employment rate
RRA_t	Allowance on return on shares	Households	UB_t	unemployment benefit per unemployed
$\tau_t^{OI,F}$	Firm's ordinary income tax	Firms	TR_t	transfers
τ_t^{BT}	Bracket tax	Households	$\Pi^{M,TB}$	Profit tax base in M sector
$\tau_t^{SS,H}$	HH's Social security tax	Households	DP_t	Deposits held by optimizers
$\tau_t^{SS,F}$	Firm's Social security tax	Firms	R_t	Nominal gross interest rate on deposits
T_t^L	Lump-sum tax	Households	DIV_t^M	Dividends per M sector stock held
			AV_t	Capital gains per stock
			RRA_t	Risk-free return allowance per stock
			$P_t^{e,M}$	Price of M sector stocks
			$S_t^{M,o}$	Number of M sector stocks
			P_t^m	Price of M sector output
			Y_t^M	M sector output
			P_t^i	Price of capital good
			K_t^M	Capital stock in M sector
			ϕ_t^m	Firm borrowing risk premium in M sector
			B_t^M	Debt held by firms in M sector

