Norwegian Ministry
of Finance

# Norwegian Ministry of Finance Modelling Project

Progress Update

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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

| | 2018 | | | | | | | | | | | | 2019 | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |

**Legend:** Plan · Underway · Completed · Delayed underway · Delayed not underway

**Phase I**
- Survey of existing microfounded fiscal policy models — Completed (Jan–Jun 2018)
- Starting point model programming/calibration — Completed (Jan–Feb 2018)
- Baseline model recommendation — Completed (Mar–Apr 2018)
- Baseline model programming/calibration — Completed (Apr–Dec 2018)

**Phase II**
- Empirical approach recommendation — Completed (Aug–Sep 2018)
- Parameterization/validation — Underway (Oct 2018–Dec 2019)
- Extension: non-traded sector — Completed (Oct–Nov 2018)
- Extension: expectations formation — Completed (Oct–Dec 2018)
- Extension: trends — Underway (Oct 2018–Jun 2019)
- Extension: more realistic tax module — Completed (Jan–Mar 2019)
- Extension: housing — Underway (Jan–Apr 2019)
- Extension: wage formation — Underway (Apr–Jun 2019)

**Phase III**
- Model simplification — Underway (Feb–Oct 2019)
- Usage areas/reporting — Underway (Feb–Oct 2019)
- Creation of user interface — Plan (Aug–Oct 2019)
- Documentation — Underway (Feb 2018–Dec 2019)
- Training — Plan (Oct–Dec 2019)

# A snapshot of the current version of the model
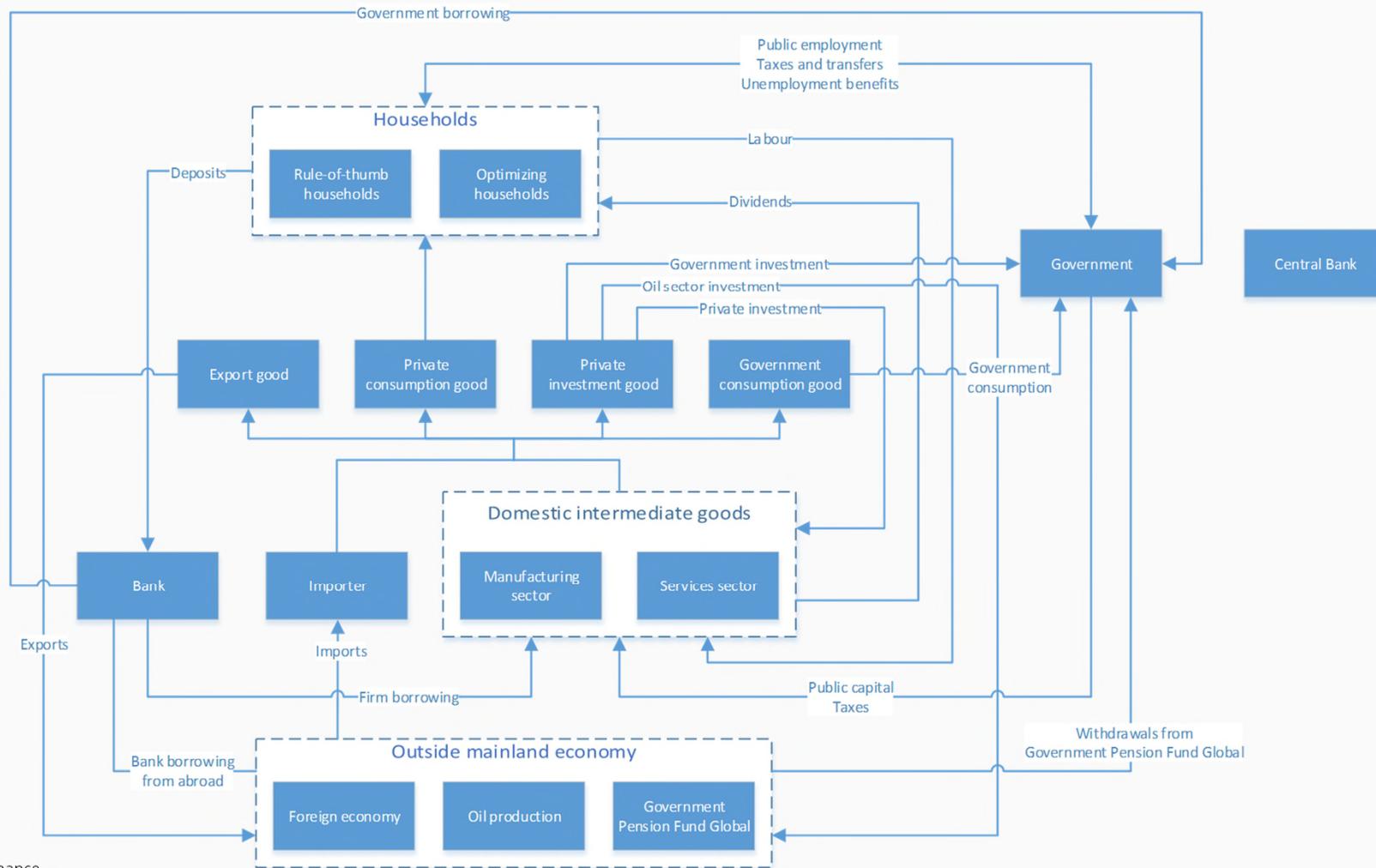
# What are some of the things we can/will be able to do with the model?

- 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
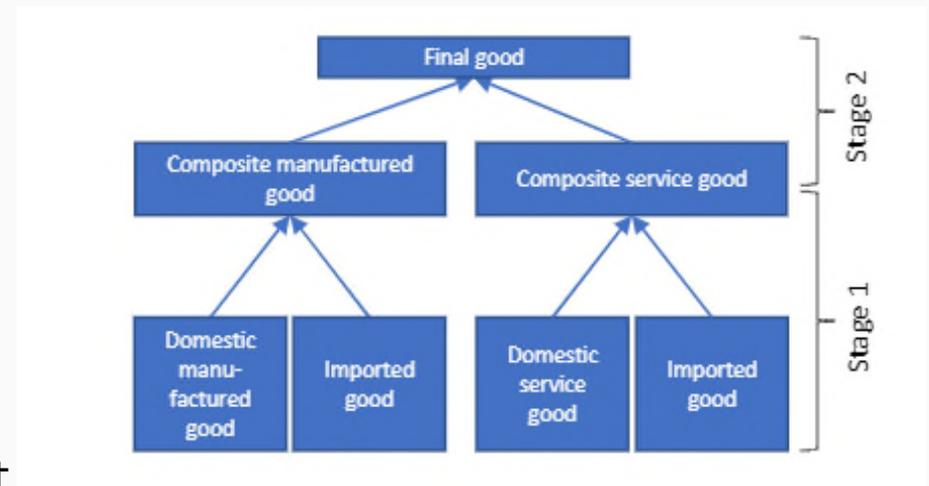
# Permanent increase in government purchases financed by lump-sum taxes
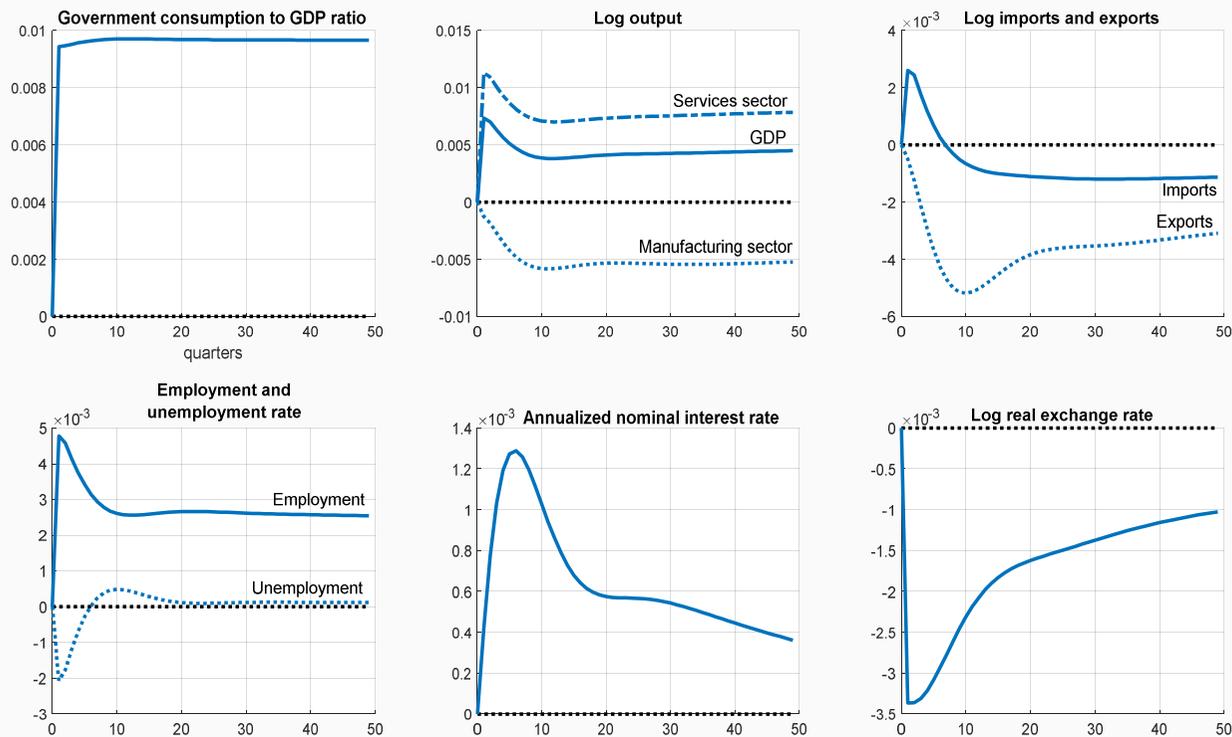
# Increasing level of detail in the tax module

# Increasing level of detail in tax module of the model

- Total government revenue is given by:

$$T_t = \underbrace{T_t^L}_{\text{Lump-sum tax}} + \underbrace{C_t(\tau_t^C + f_t^C/P_t)}_{\text{Consumption taxes and fees}} + \underbrace{(w_t N_t^P + w_t^G N_t^G)\tau_t^{SS,F}}_{\text{Social security contributions of employers}}$$

$$+ \underbrace{(w_t N_t^P + w_t^G N_t^G + UB_t(L_t - N_t) + TR_t)(\tau_t^{OI,H} + \tau_t^{BT} + \tau_t^{SS,H})}_{\text{Taxes on Labor income and transfers}}$$

$$+ \underbrace{(\Pi^{M,TB} + \Pi^{S,TB})\tau_t^{OI,F}}_{\text{Corporate income taxation}} + \underbrace{\left[\frac{1}{\pi_t}DP_{t-1}(R_{t-1} - 1)\right]\tau_t^{OI,H}}_{\text{Tax on returns to deposits}}$$

$$+ \underbrace{\left(DIV_t + AV_t - RRA_t(P_t^{e,M} + P_t^{e,S})\right)\alpha_t^{OI,H}\tau_t^{OI,H}}_{\text{Dividend and capital gains tax}}.$$

# 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
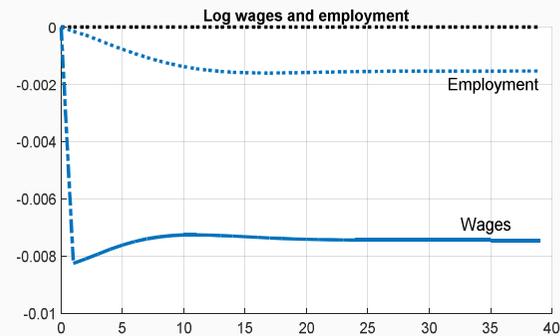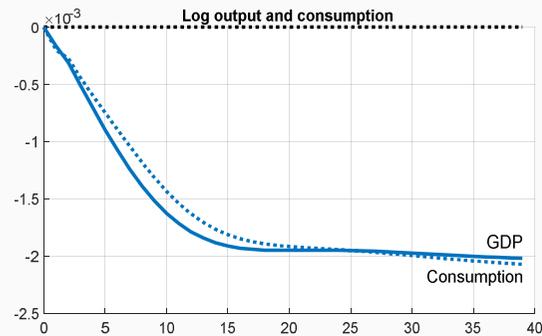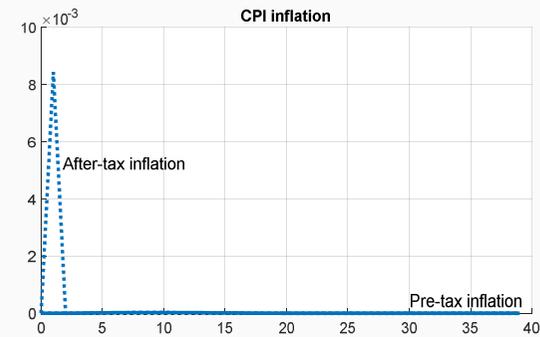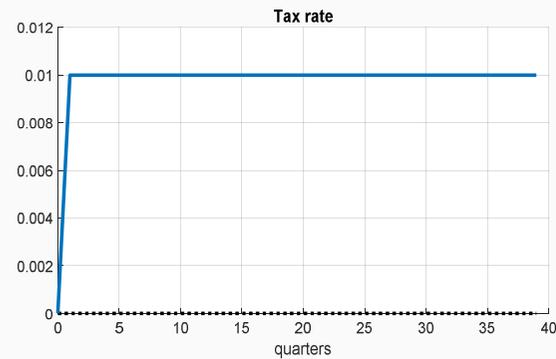
# Ordinary income tax on households

- Tax base: household ordinary income:

$$OI_t^o = \underbrace{LI_t^o}_{\text{labor income}} + \underbrace{UB_t(L_t^o - N_t^o)}_{\text{unemployment benefits}} + \underbrace{TR_t^o}_{\text{transfers}} + \underbrace{DIV_t^{M,o} S_{t-1}^{M,o} + DIV_t^{S,o} S_{t-1}^{S,o}}_{\text{dividends}}$$

$$+ \underbrace{\frac{P_{t-1}}{P_t} DP_{t-1}^o (R_{t-1} - 1)}_{\text{return on deposits}}.$$

$$OI_t^{o,TB} = LI_t^o + UB_t(L_t^o - N_t^o) + TR_t^o$$

$$+ (DIV_t^{M,o} + AV_t^{M,o} - RRA_t \frac{P_{t-1}^{E,M}}{P_t}) S_{t-1}^{M,o} \alpha_t^{OI,H}$$

$$+ (DIV_t^{o,S} + AV_t^{S,o} - RRA_t \frac{P_{t-1}^{E,S}}{P_t}) S_{t-1}^{S,o} \alpha_t^{OI,H}$$

$$+ \frac{P_{t-1}}{P_t} DP_{t-1}^o (R_{t-1} - 1).$$

- 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
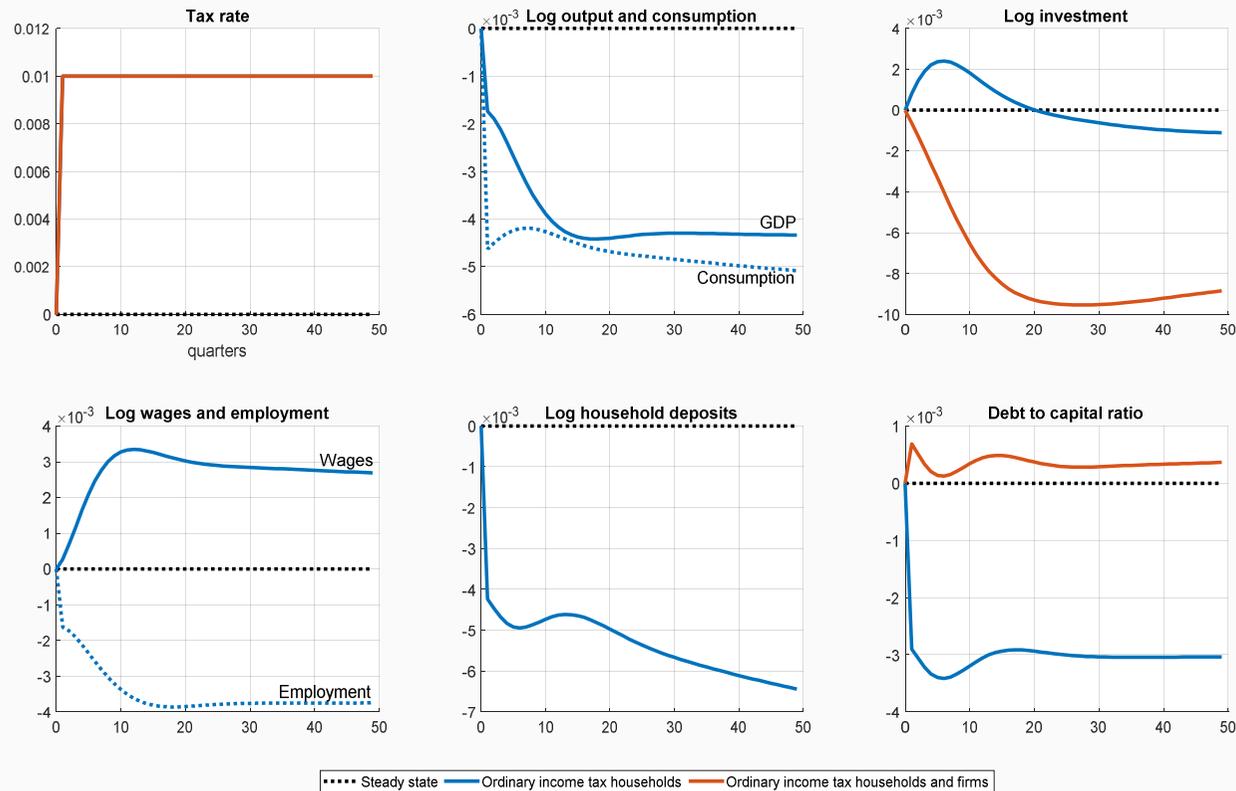
# Bracket tax

- 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
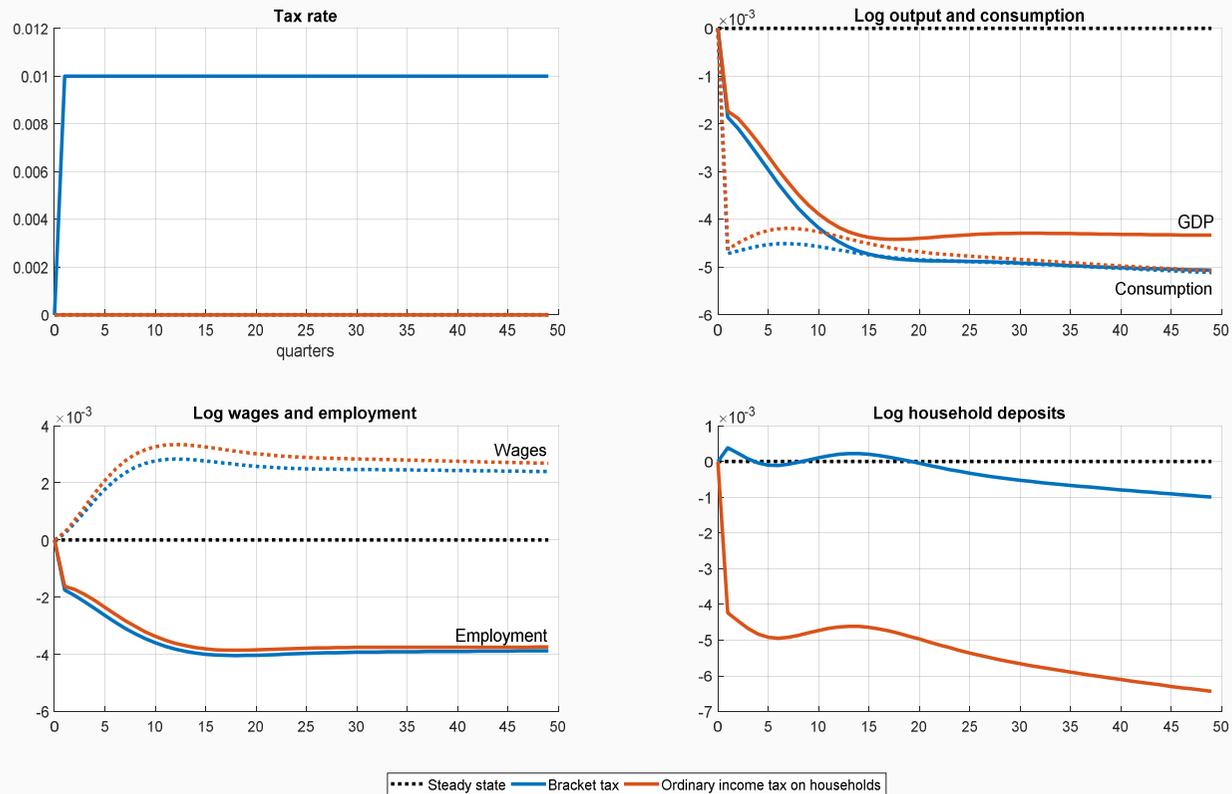
# Social security contributions by firms

- 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
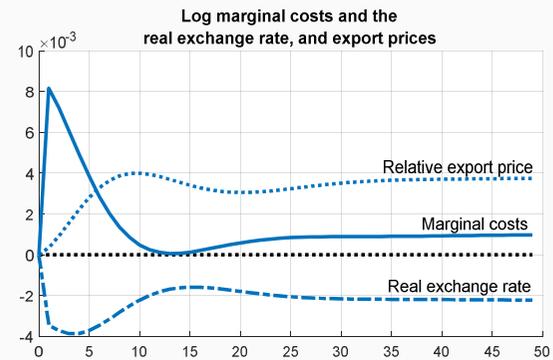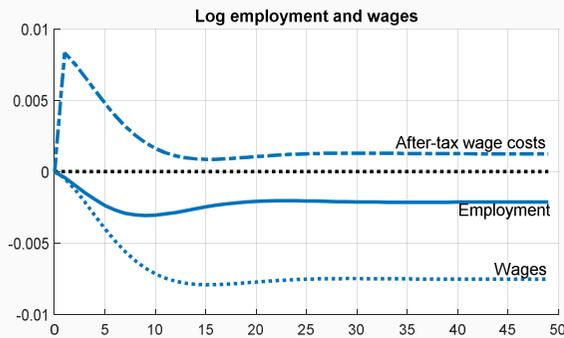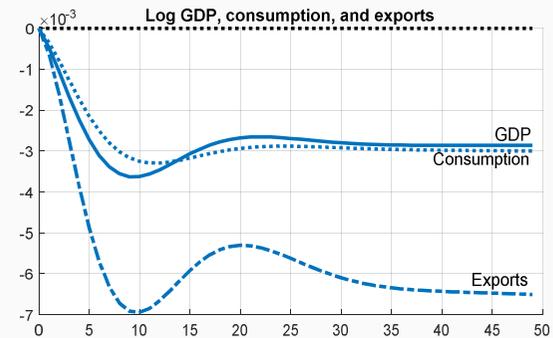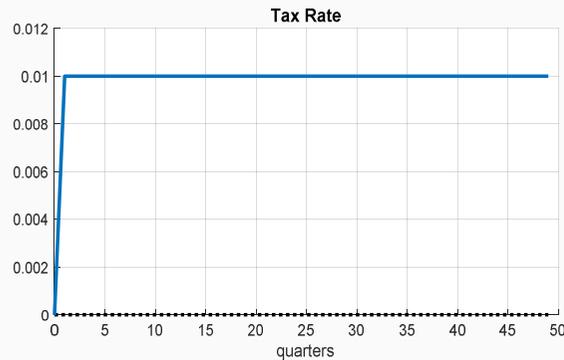
# Corporate taxation

- 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
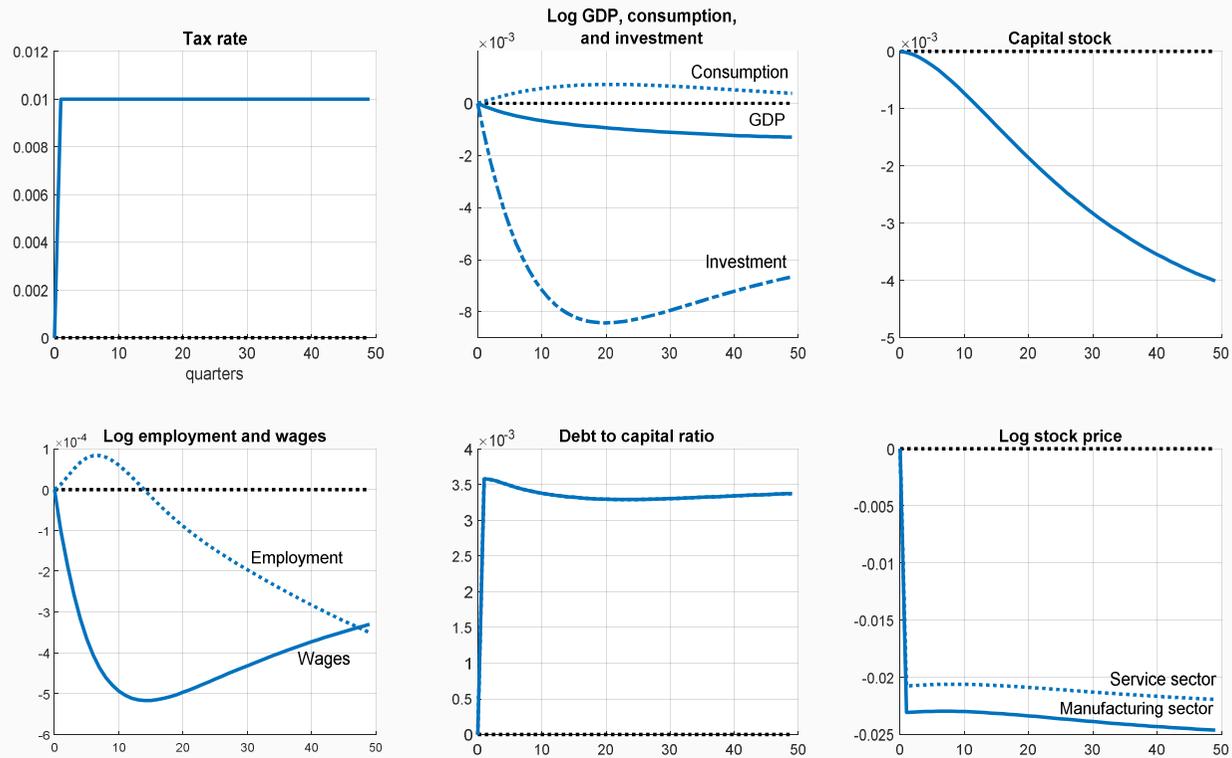
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# Alternative methods of forming expectations

# 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)
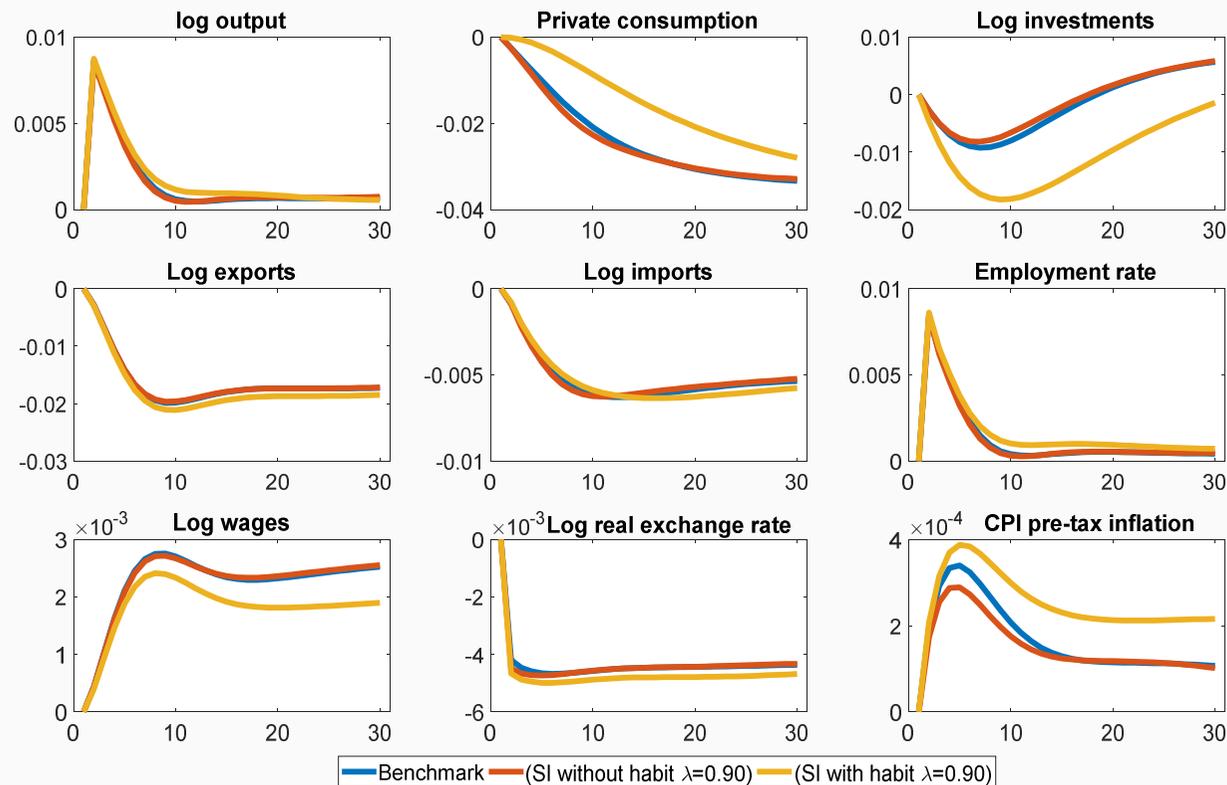
# Wage stickiness and sticky information
(Government consumption shock financed by higher VAT)
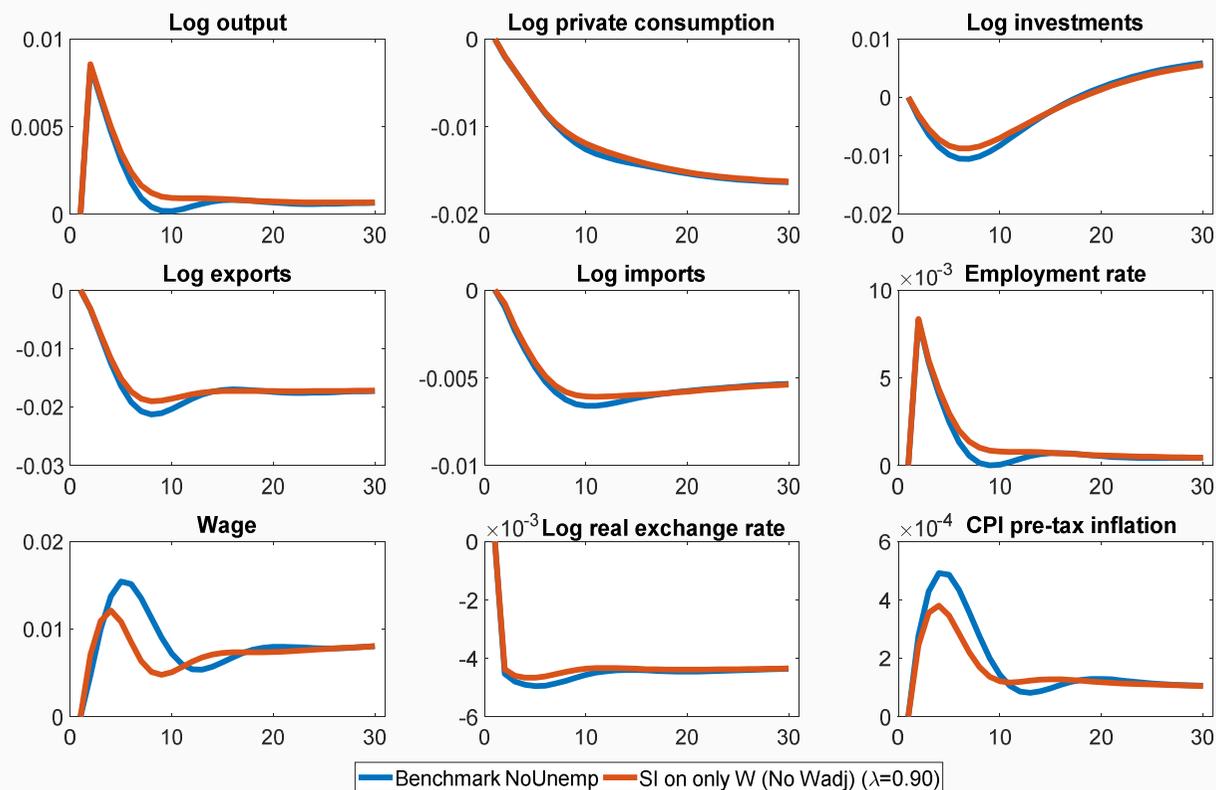
# Price stickiness and sticky information
(Government consumption shock financed by higher VAT)
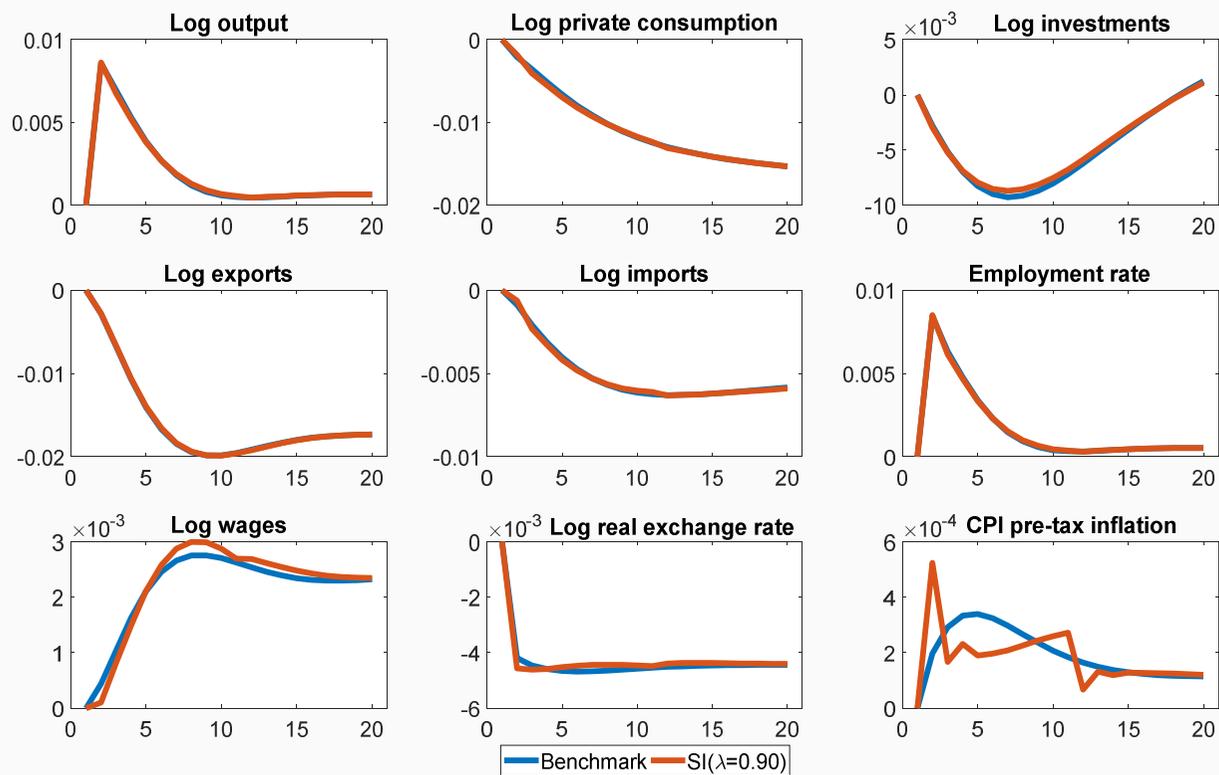
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# Thank you!

# Variable and parameter names

| Variable | Description | applied to |
|---|---|---|
| $\tau_t^C$ | Value-added tax on consumption | Households |
| $f_t^C$ | nominal consumption fee | Households |
| $\tau_t^{OI,H}$ | HH's ordinary income tax | Households |
| $\alpha_t^{OI,H}$ | Scale-up of dividend taxation | Households |
| $RRA_t$ | Allowance on return on shares | Households |
| $\tau_t^{OI,F}$ | Firm's ordinary income tax | Firms |
| $\tau_t^{BT}$ | Bracket tax | Households |
| $\tau_t^{SS,H}$ | HH's Social security tax | Households |
| $\tau_t^{SS,F}$ | Firm's Social security tax | Firms |
| $T_t^L$ | Lump-sum tax | Households |

| Variable | Description |
|---|---|
| $C_t$ | aggregate consumption |
| $w_t$ | real wage rate |
| $N_t^P, N_t^G$ | private and public employment rate |
| $L_t, N_t$ | Labor participation rate, total employment rate |
| $UB_t$ | unemployment benefit per unemployed |
| $TR_t$ | transfers |
| $\Pi^{M,TB}$ | Profit tax base in M sector |
| $DP_t$ | Deposits held by optimizers |
| $R_t$ | Nominal gross interest rate on deposits |
| $DIV_t^M$ | 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 |
| $\phi_t^m$ | Firm borrowing risk premium in M sector |
| $B_t^M$ | Debt held by firms in M sector |