



Norwegian Ministry
of Finance

Norwegian Ministry of Finance Modelling Project

Progress update

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Progress update

- Administrative:
 - We have a name: NORA – NORwegian fiscal policy Analysis model
 - Goal that SSB take over modelling project on January 1, 2020
- Modelling:
 - Focus on completing model that Ministry can start using on January 1, 2020
 - Finalize wage bargaining module
 - User interface
 - Unfinished work or further extensions to be included in model contract with SSB
 - Estimation
 - Household heterogeneity
 - Trends
- Outreach and training:
 - Workshop with Konjunkturinstitutet
 - Presentations to the Riksbank and Bundesbank. Scheduled visits to the ECB in November, and IMF and CBO, and Peterson Institute in December
 - Roundtable discussion with labor economists in Norway in September
 - Planning presentation to chief economists in commercial banks in October/November
 - Tentative plans for “launch” conference in early January

Presentation outline

- Wage formation
- Model parameterization
- Model validation
- Fiscal policy simulations



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Wage formation

The “Norwegian model of wage formation”

- Wages are determined through centralized wage bargaining between the exposed sector (“frontfaget”) and the main labor union
- Wage formation is concerned with
 - Preserving competitiveness / profitability of firms in the exposed sector (preserving capital income share)
 - High level of employment
- Wages in the rest of the economy follow wage norm set by “frontfaget”

Wage formation in traditional DSGE models

- Workers set wages so that utility over consumption and leisure is maximized, taking into account firms' labor demand
- This theory of wage formation was included in "baseline" version of model published in February 2019
- Model implications in many cases consistent with the "Norwegian model of wage formation"
 - Cobb-Douglas production function ensures constant capital income share
 - Same wage across sectors by assumption
 - But problem with some shocks, e.g. technology shock
- "Story" of how wages are set fundamentally at odds with the Norwegian model of wage formation

Modelling wage formation as the outcome of a wage bargaining process

- Nymoen (2012) shows that Norwegian model of wage formation is consistent with existing theories of wage bargaining
- Our approach builds on Hoel and Nymoen (1988), Nymoen and Rødseth (2003) and Forslund et al. (2008)
- Intuition behind wage bargaining models
 - Economic transactions (e.g. between workers and firms) generate a surplus (e.g. production)
 - Bargaining theory is about how surplus is divided between parties (e.g. wage determines split of surplus between workers and firms)
 - A Nash bargaining solution is a certain division of surplus
 - Pareto optimal (axiomatic derivation)
 - Acceptable to both parties (strategic derivation)

Wage bargaining – the theory

- Wage is determined as the Nash bargaining solution resulting from wage bargaining between union (whose payoff is union utility) and manufacturing firms (whose payoff are profits)

$$W_t^{NB} = \arg \max_W \underbrace{[V(W)]}_{\text{Payoff of union: union utility}} \underbrace{[-v_0(U_t)]}_{\text{Reference utility}} \underbrace{[\Pi_t^M(W)]}_{\text{Payoff of firm: profit}}^{1-\gamma}$$

Parameter influencing bargaining power of union

- Reference utility: utility in case of breakdown of negotiations; used to capture anything that affects wage claims by union, or affects the desire of both parties to reach an agreement, most importantly unemployment

Details on functional forms

- Union's utility is assumed to depend on the pre-tax real wage rate

$$V(W) = b^N + \frac{W^{1-\sigma^N}}{1-\sigma^N} \quad V > 0, V_w > 0, V_{ww} < 0$$

- Reference utility is assumed to fall with the logarithm of the unemployment rate

$$v_0 = v^U \log(U_t)$$

- Profits in manufacturing fall with wages

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

Predictions of wage bargaining model

- A decrease in reference utility (induced by higher unemployment) implies a lower Nash bargaining wage
- A decrease in competitiveness of firms (induced by international shocks, tax changes, etc.) implies lower Nash bargaining wage
- Results of wage bargaining model tell a story that is more in line with Norwegian setting: wage formation is concerned with preserving competitiveness of exposed sector firms and a high level of employment

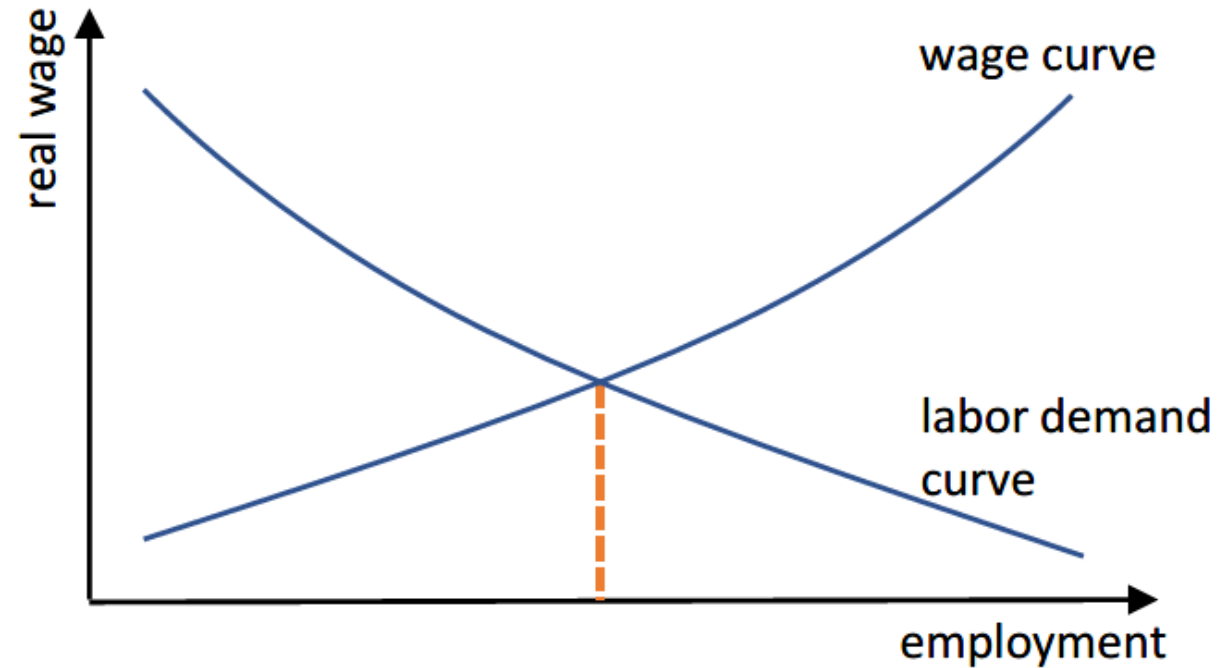
Unemployment and labor participation

- Unlike baseline model, unemployment now plays an important role in wage bargaining
- Existing theories of unemployment used in DSGE models, including Galí unemployment and search-matching proved unsatisfactory
 - Complicated and unintuitive
 - Lack of persistence in unemployment
 - Counterintuitive responses to change in labor taxes
 - Unemployment mainly determined by labor supply
- High employment (and low unemployment) over time key objective of Norwegian model of wage formation (Bjørnstad og Nymoen, 2015; Benedictow et al., 2019)
 - Existing theories of unemployment used in DSGE models treat long-run unemployment as fixed

Model of (un)employment

- The wage curve is a robust empirical relationship between the level of wages and unemployment (or employment for given level of labor force)
- Wage bargaining model gives rise to wage curve through reference utility
- Employment level is given by intersection of the wage curve and the labor demand curve
- Missing link with unemployment: model of labor force participation

Figure 2: The wage and labor demand curve



Model of labor force participation

- Lack of any convincing microfounded model of labor force participation
- Pragmatic solution: model labor force participation as in KVARTS
- Estimated equations for seven sub-populations

Participation responds positively to increases in the after-tax wage rate

$$L_t^j = f^j \left(\underbrace{U_{t-1, \dots, t-n}}_{\text{Participation responds negatively to increases in the unemployment rate}}, \underbrace{(1 - \tau_t^W) W_{t-1, \dots, t-n}}_{\text{Participation responds positively to increases in the after-tax wage rate}}, \underbrace{L_{t-1, \dots, t-n}^j}_{\text{Participation is auto-regressive}} \right)$$

Participation responds negatively to increases in the unemployment rate

Participation is auto-regressive

- Overall participation is weighted sum of sub-populations



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Model parameterization

Parameterization

- Full estimation of the model ongoing and will be completed in 2020
- Current version of model is parameterized using a two-step approach:
 - First step: set parameters that determine long-run properties of model to match targets in the data or (where this is not possible) to values used in similar models
 - Second step: set parameters that determine dynamic properties of model to match response of 10 macroeconomic variables to 5 shocks in Norges Bank's DSGE model (NEMO)

Long-run calibration

- Choose parameters to match more than 40 targets in data
- Check how well model fits by comparing variables that are not matched to value in data, e.g. inventory changes, amount of oil fund withdrawals and social security tax base
- Overall model does a good job at replicating long-term averages in the data

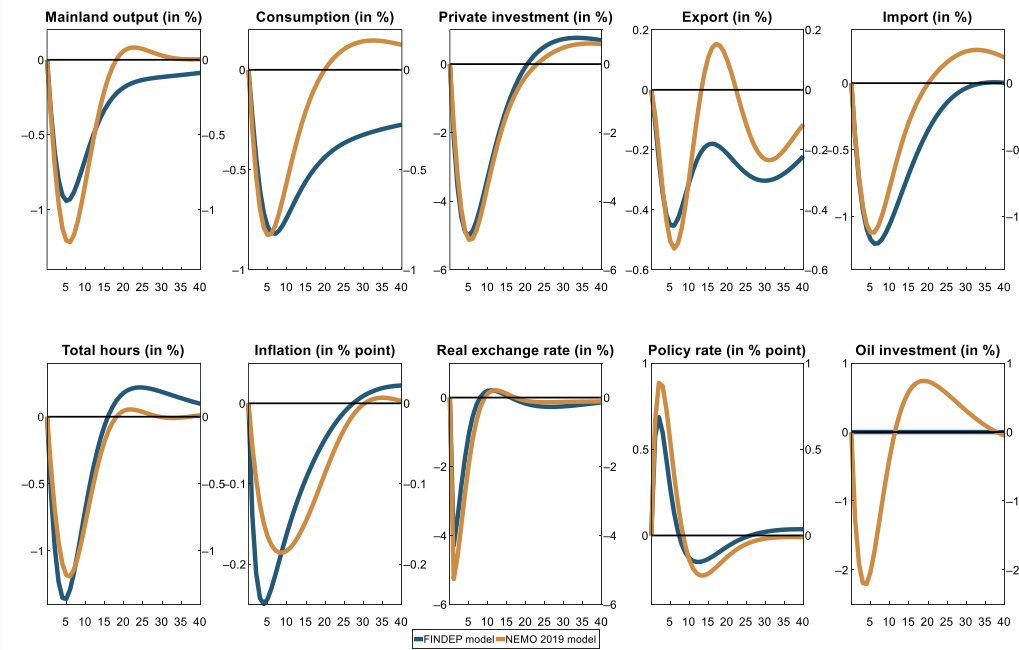
Table 3: Steady-state calibration

Description	Model	Data	Target
Monetary variables (annualized rate)			
Inflation rate Norway	1.02	1.02	Yes
Nominal interest rate Norway	1.039	1.039	Yes
Inflation rate trad. part.	1.02	1.02	Yes
Nominal interest rate trad. part.	1.039	1.039	Yes
GDP components (ratio to mainland GDP)			
Consumption	0.517	0.517	Yes
Government purchases of goods and services	0.067	0.067	Yes
Government wage bill	0.169	0.169	Yes
Public capital depreciation	0.056	0.038	No
Government investment	0.056	0.056	Yes
Private investment	0.152	0.152	Yes
Oil sector investment	0.073	0.073	Yes
Total imports	0.348	0.348	Yes
Imports by importing firms	0.276	0.276	Yes
Residual imports	0.071		No
Exports	0.224	0.224	Yes
Changes in inventory	-0.037	0.052	No
Stocks (ratio to mainland yearly GDP)			
Private capital stock	2.302	2.302	Yes
Public capital stock	0.694	0.694	Yes
Private equity	3.325	5.44	No
Net foreign debt	0.504	0.504	Yes
Government Debt	0.397	0.397	Yes
Government budget (ratio to mainland GDP unless otherwise indicated)			
Unemployment benefits	0.006	0.006	Yes
Transfers	0.196	0.196	Yes
Transfers to liquidity-constrained household	0.143		No
Transfers to Ricardian household	0.054		No
Oil fund withdrawals	0.06	0.058	No
Lump-sum taxation	0.029		No
Labor surtax tax base	0.654	0.654	Yes
Ordinary income (household) tax base	0.518	0.518	Yes
Social security rate (firms) tax base	0.464	0.479	No
Corporate profit tax base	0.124	0.124	Yes
Consumption value-added tax rate	0.191	0.191	Yes
Consumption volume fees tax rate	0.063	0.063	Yes
Ordinary income tax rate	0.205	0.205	Yes
Bracket tax rate	0.028	0.028	Yes
Social security rate (households)	0.077	0.077	Yes
Social security rate (firms)	0.150	0.150	Yes
Corporate profit tax rate	0.242	0.242	Yes
Labor market (ratio to population unless otherwise indicated)			
Total employment rate	0.685	0.685	Yes
Public sector employment rate	0.204	0.204	Yes
Private sector employment rate	0.481	0.481	Yes
Unemployment rate (percent of labor force)	0.039	0.039	Yes
Labor force participation rate	0.713	0.713	Yes
Labor income share	0.494	0.471	Yes

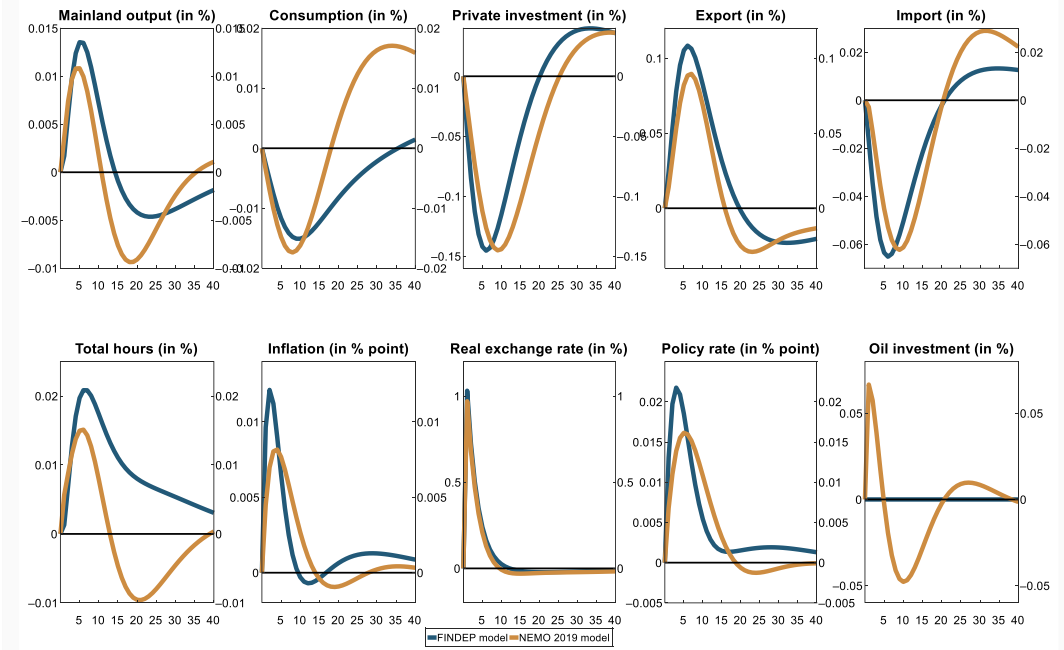
Note: Empirical targets are based on the 2010-17 mean of the relevant empirical moments we take from Statistics Norway databases. The exception is the tax base for the social security tax (households) where data is only available from 2015, and the labor surtax tax base where data is only available from 2016. Note that we set steady-state tax rates equal to the most current effective rate, i.e. the rate from 2017.

Dynamic calibration (IRF matching)

Monetary policy shock



External risk premium shock



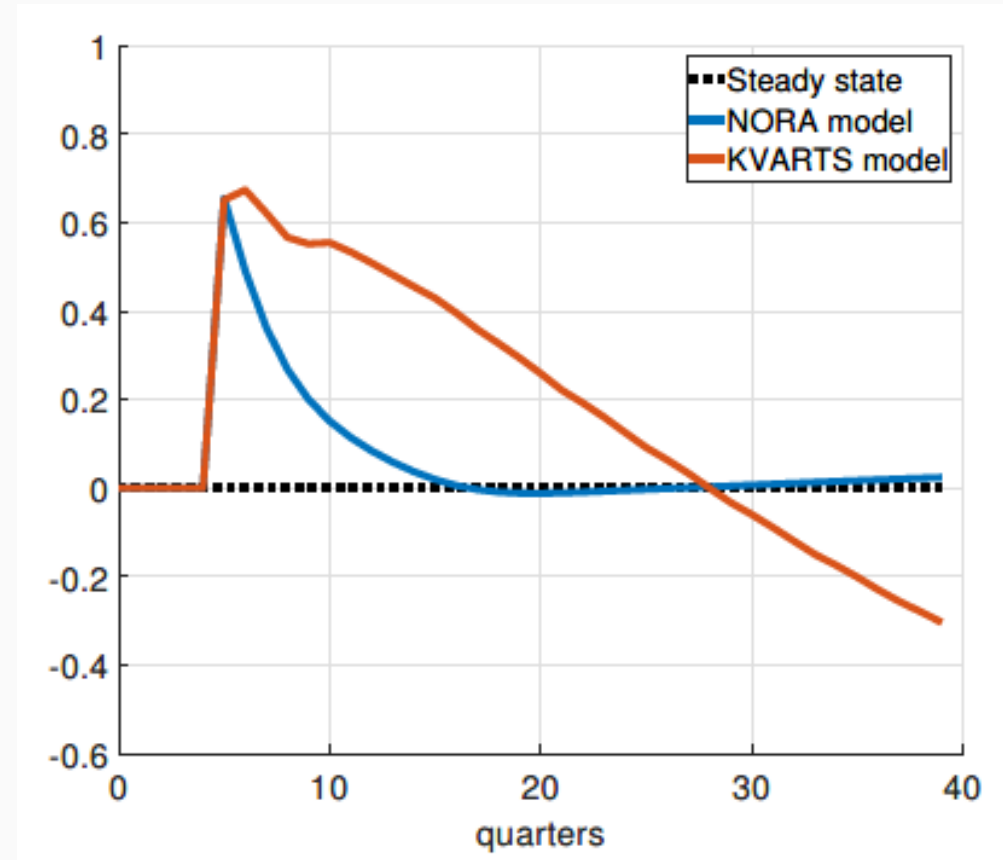


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Model validation

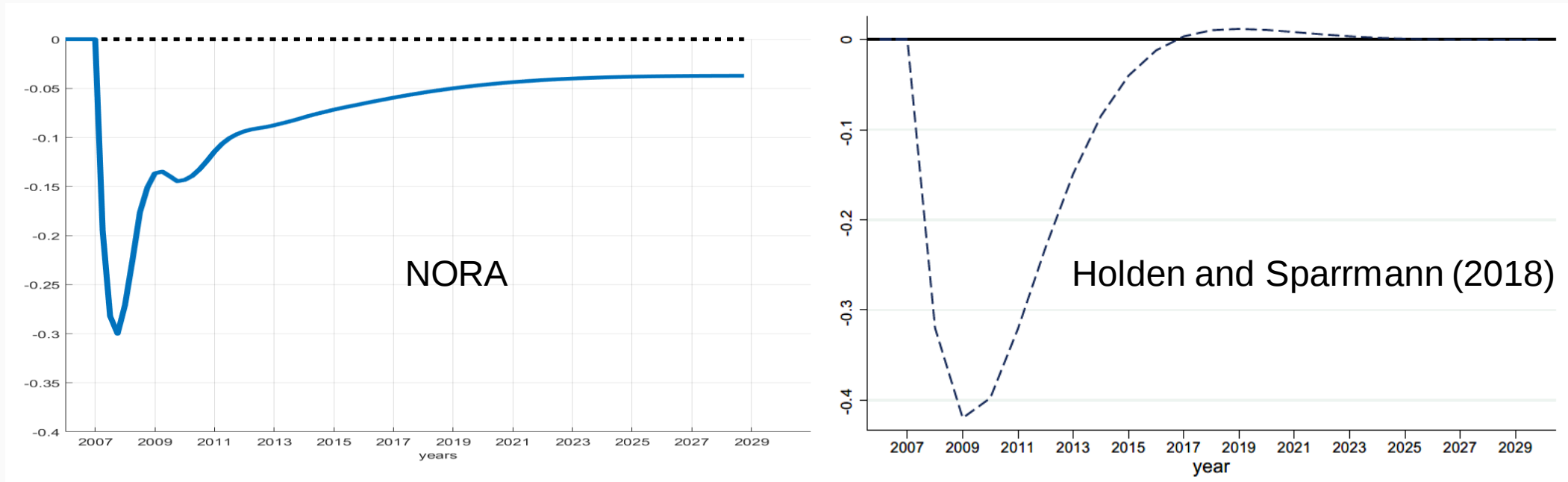
Comparison with fiscal multiplier following permanent government purchases shock in KVARTS

- Work ongoing to compare properties of KVARTS and NORA in more detail
- KVARTS typically suggests that shocks have a longer impact on the economy than NORA (and theory-models in general)



Comparison with Holden and Sparrman (2018)

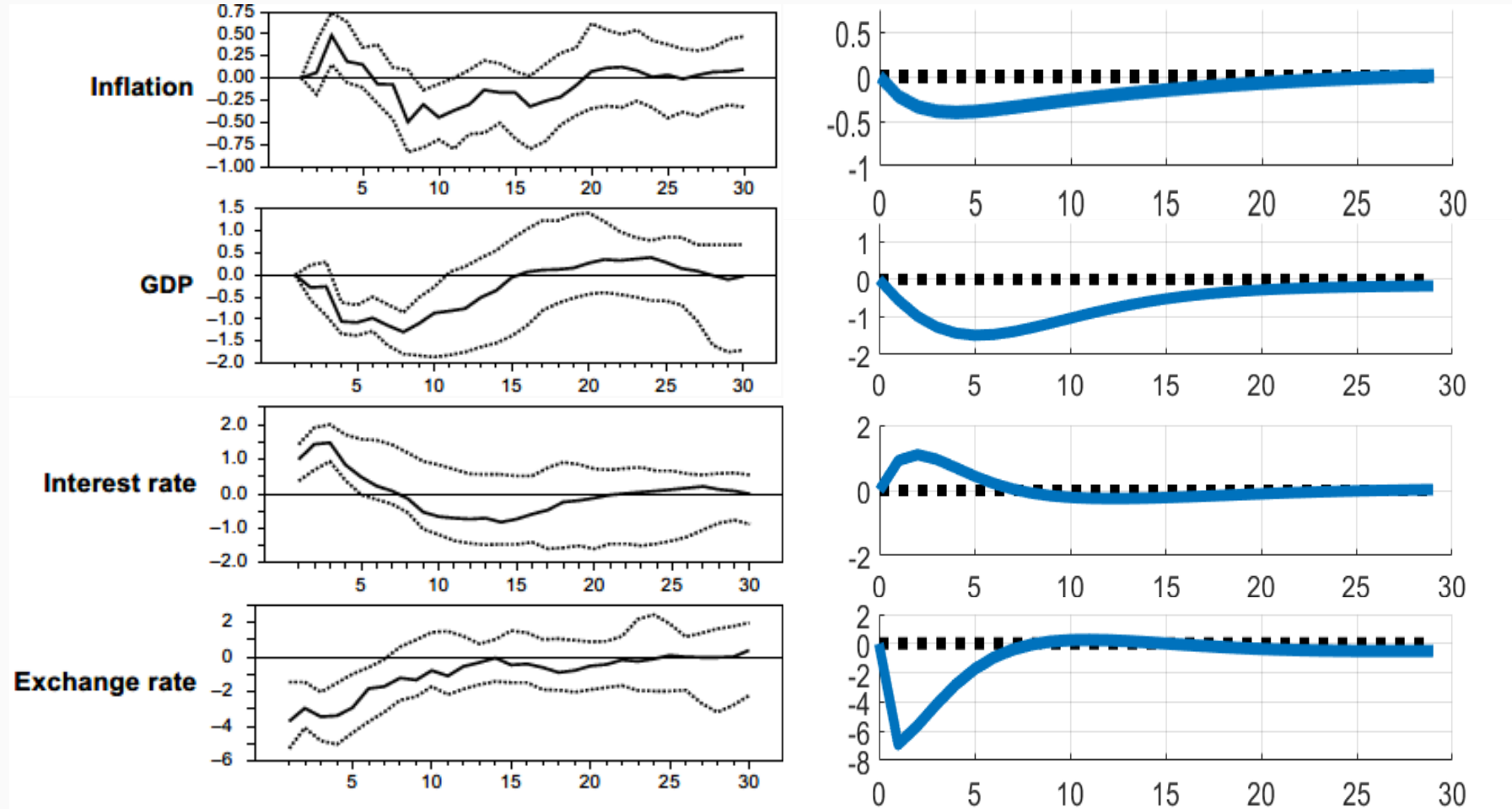
Simulated unemployment rate following a permanent 1 percent of GDP increase in government purchases



Source: Holden, S. and V. Sparrmann (2018), "Do government purchases affect unemployment?", Scandinavian Journal of Economics, Vol. 120(1)

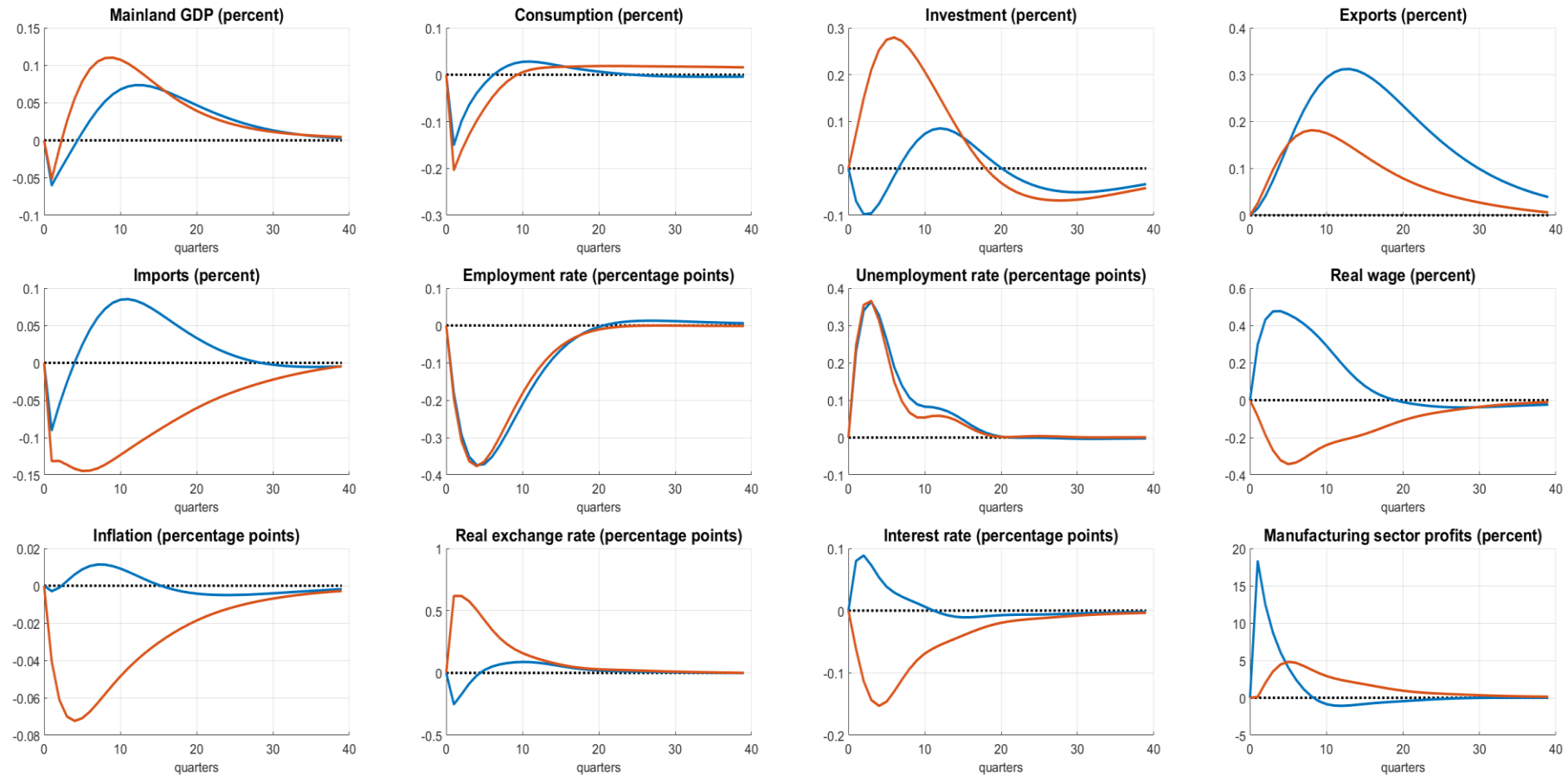
Comparison with Bjørnland and Halvorsen (2014)

Simulated response to a temporary 1 percentage point increase in the monetary policy rate



Source: Bjørnland, H. C. and J. I. Halvorsen (2014), "How does monetary policy react to exchange rate movements? New international evidence", Oxford Bulletin of Economics and Statistics, Vol. 76(2)

Temporary increase in total-factor productivity



Comparison with Holden III commission

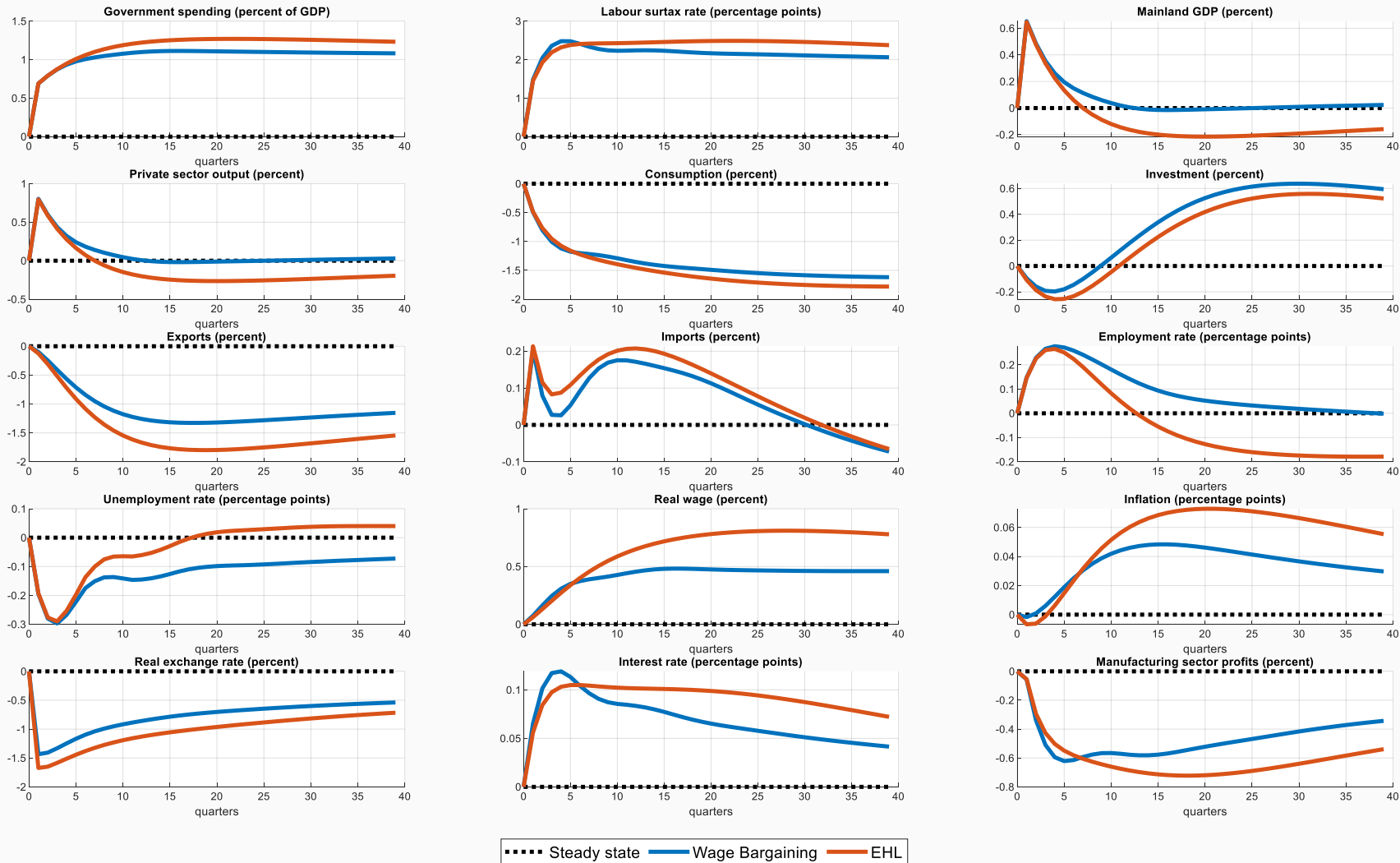
	Productivity shock in M sector		Productivity shock in S sector	
	Holden III	NORA	Holden III	NORA
M sector profitability	↑	↑	↑	↑
Wage growth	↑	↑	↑	↓
Inflation	↑	↑	↓	↓
Interest rate	↑	↑	↓	↓
Exchange rate	↓	↓	↑	↑
Unemployment	?	↑	?	↑



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Fiscal policy simulations

Permanent increase in government purchases financed by labor taxes





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Issues for discussion

Issues for discussion

- How well does the new wage bargaining setup capture the “Norwegian model of wage formation”?
- What further changes are necessary for the Ministry of Finance to start using the model in their work?



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Thank you!