Finansdepartementet

Main Model Characteristics

Country	Developing Institution	Name	First version	Type	Size 1/	Industries 2/	Frequency	Endogenous monetary policy	Endogenous fiscal policy 3/	Model-consistent expectations 4/	Documentation
Norway	Statistics Norway	MODAG	1980s	LMM	2692/150	15/3	Annual	Yes	No	No	Boug and Dyvi (2008)
Sweden	National Institute of Economic Research	KIMOD	2004	LMM	40/5	1/1	Quarterly	Yes	Yes	Yes	Bergvall et al. (2007)
Denmark	Statistics Denmark	ADAM	1972	LMM	2500/90	11/1	Quarterly	No	No	No	Danmarks Statistik (2012)
Finland	Ministry of Finance	KOOMA	2011/12	DSGE	23/0	1/1	Quarterly	Yes	Yes	Yes	Obstbaum and Pietiläinen (2013)
The Netherlands	Central Planning Bureau	SAFFIER	2004	LMM	3000/25	1/1	Quarterly/Annual	No	No	No	Kranendonk and Verbruggen (2007)
United Kingdom	Office of Budget Responsibility	…	1970s	LMM	500/30	2/1	Quarterly	No	No	No	Office of Budget Responsibility (2013)
Canada	Ministry of Finance	CEFM	1986	LMM	560/128	1/3	Quarterly	Yes	No	No	Robidoux and Wong (1998)
New Zealand	Ministry of Finance	NZTM	2002	LMM	Unclear	1/1	Unclear	Yes	No	No	Ryan and Szeto (2009)

1/ Number of endogenous variables/estimated equations. For the UK both endogenous and exogenous variables are included as the exogenous variables (the exact number of which is unclear) are included in the code with their own equation.
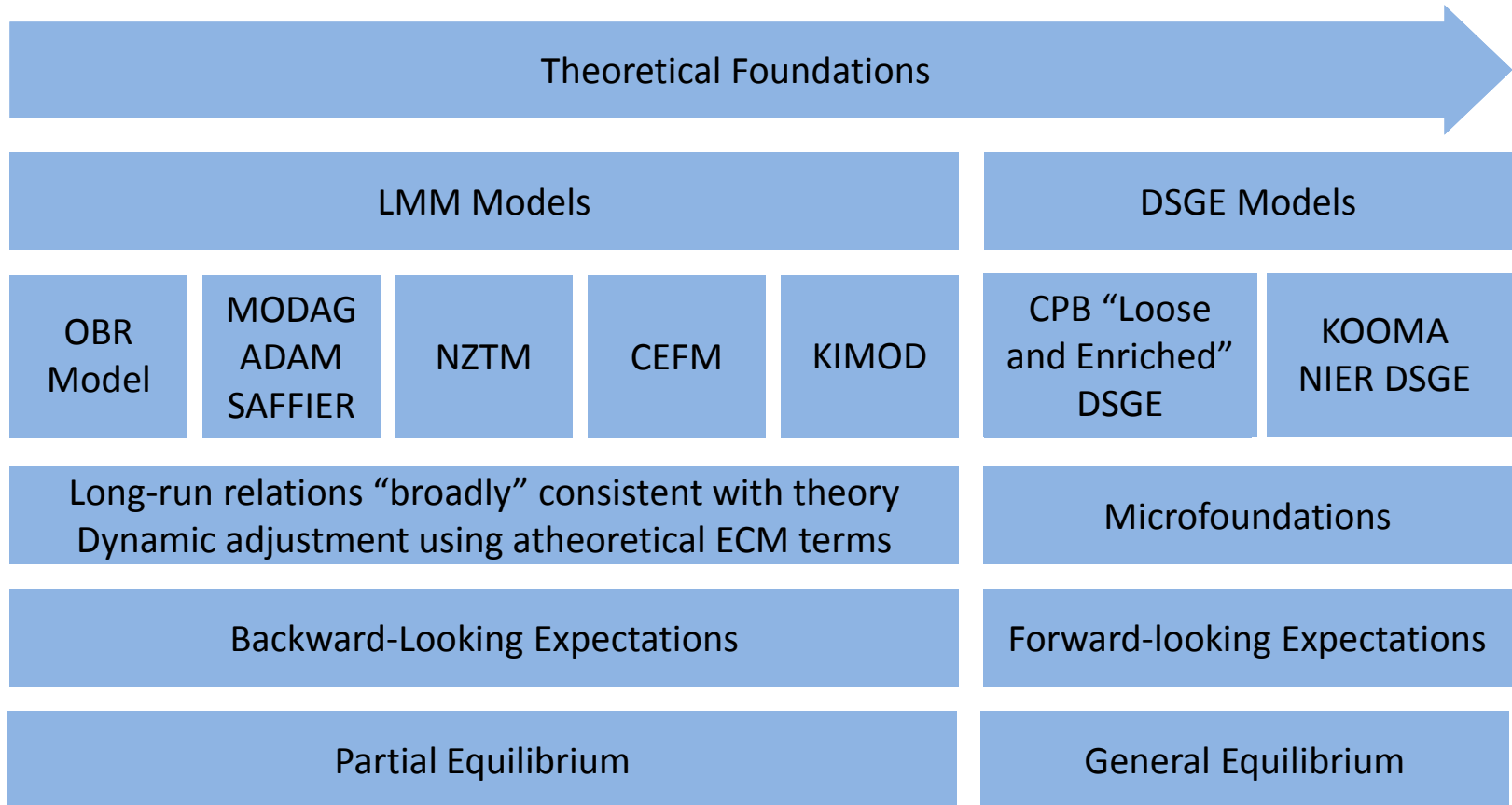2/ Private/public sector.
3/ SAFFIER includes a set of dummies that allows it to be used either in "balanced budget mode" (endogenous fiscal policy) or with exogenous fiscal policy.
4/ The term "model-consistent" is used instead of forward-looking as several of the LMM models surveyed in this report including forward-looking expectations that are proxied using current and past values of variables or using survey data.
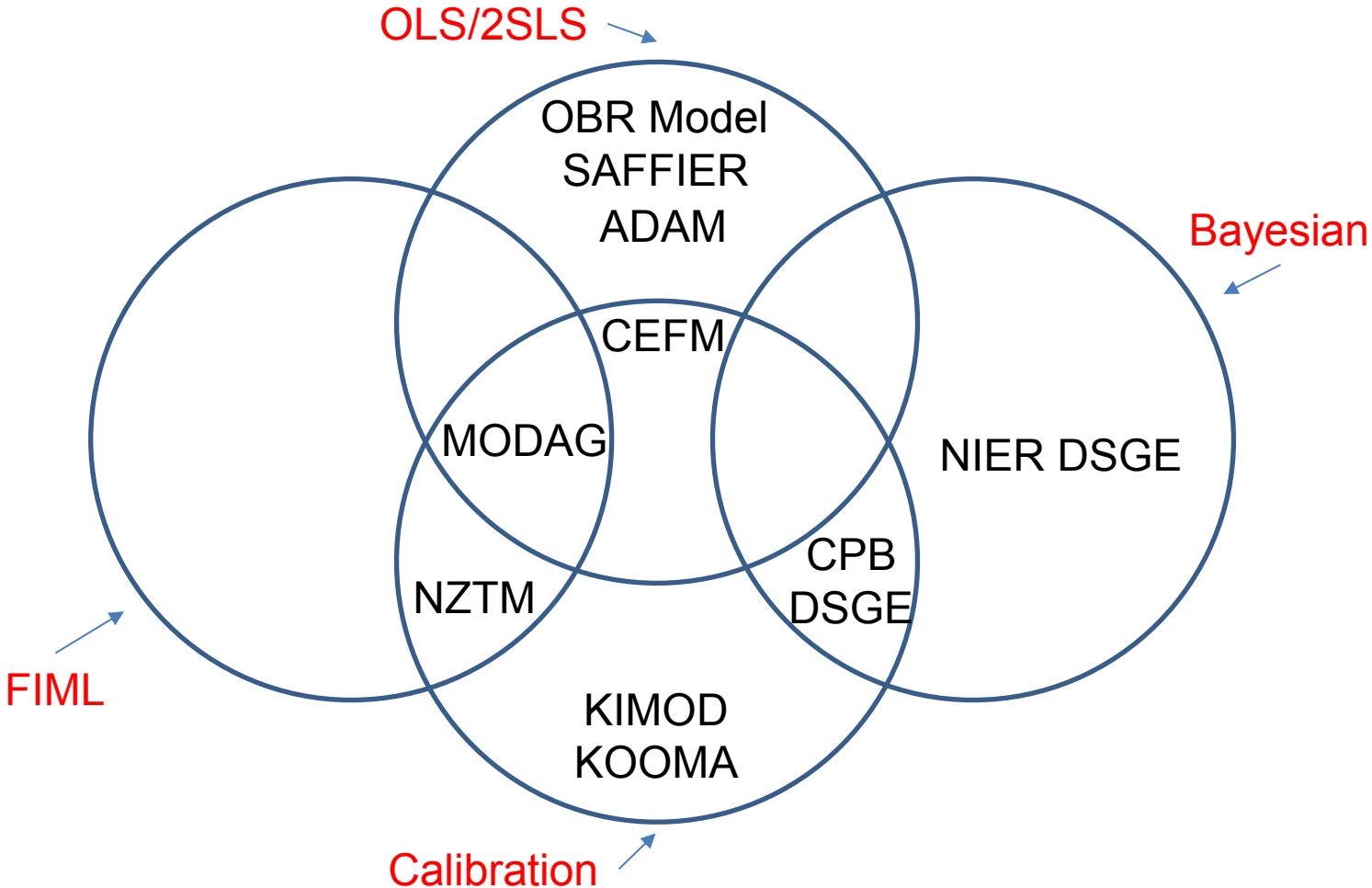
Theoretical Foundations

Theoretical Foundations →		

LMM Models					DSGE Models	
OBR Model	MODAG ADAM SAFFIER	NZTM	CEFM	KIMOD	CPB "Loose and Enriched" DSGE	KOOMA NIER DSGE
Long-run relations "broadly" consistent with theory Dynamic adjustment using atheoretical ECM terms					Microfoundations	
Backward-Looking Expectations					Forward-looking Expectations	
Partial Equilibrium					General Equilibrium	

Theoretical Foundations (cont.)

- Lucas critique
  - Highlighted by Finnish Ministry of Finance and the CPB as reason for moving to DSGE
  - Is it relevant in practice?

- Forward-looking Expectations
  - Highlighted by CPB as weakness of SAFFIER
  - Are expectations based on surveys, market data, or empirical VAR models more realistic than rational expectations?

- General equilibrium
  - Captures interaction of different markets and agents in the model
  - Complexity rises exponentially with size and precludes "level of detail required by our customers" (CPB)
  - Resulting lack of flexibility is a drawback (Statistics Denmark, CPB)

- Structural shocks
  - Highlighted by Swedish MinFin, NIER, and the CPB as reason for moving to DSGE
  - Do we know what the shocks mean? Paul Romer's "imaginary forces"

- Forecasting
  - Trade-off between theoretical consistency and forecast accuracy (CPB)
  - DSGE models time-consuming to use for forecasting (NIER)

Empirical Foundations

OLS/2SLS

Bayesian

OBR Model
SAFFIER
ADAM

CEFM

MODAG

NIER DSGE

NZTM

CPB
DSGE

FIML

KIMOD
KOOMA

Calibration

Empirical Foundations (cont.)

System Estimation

- Respects all cross-restrictions in model
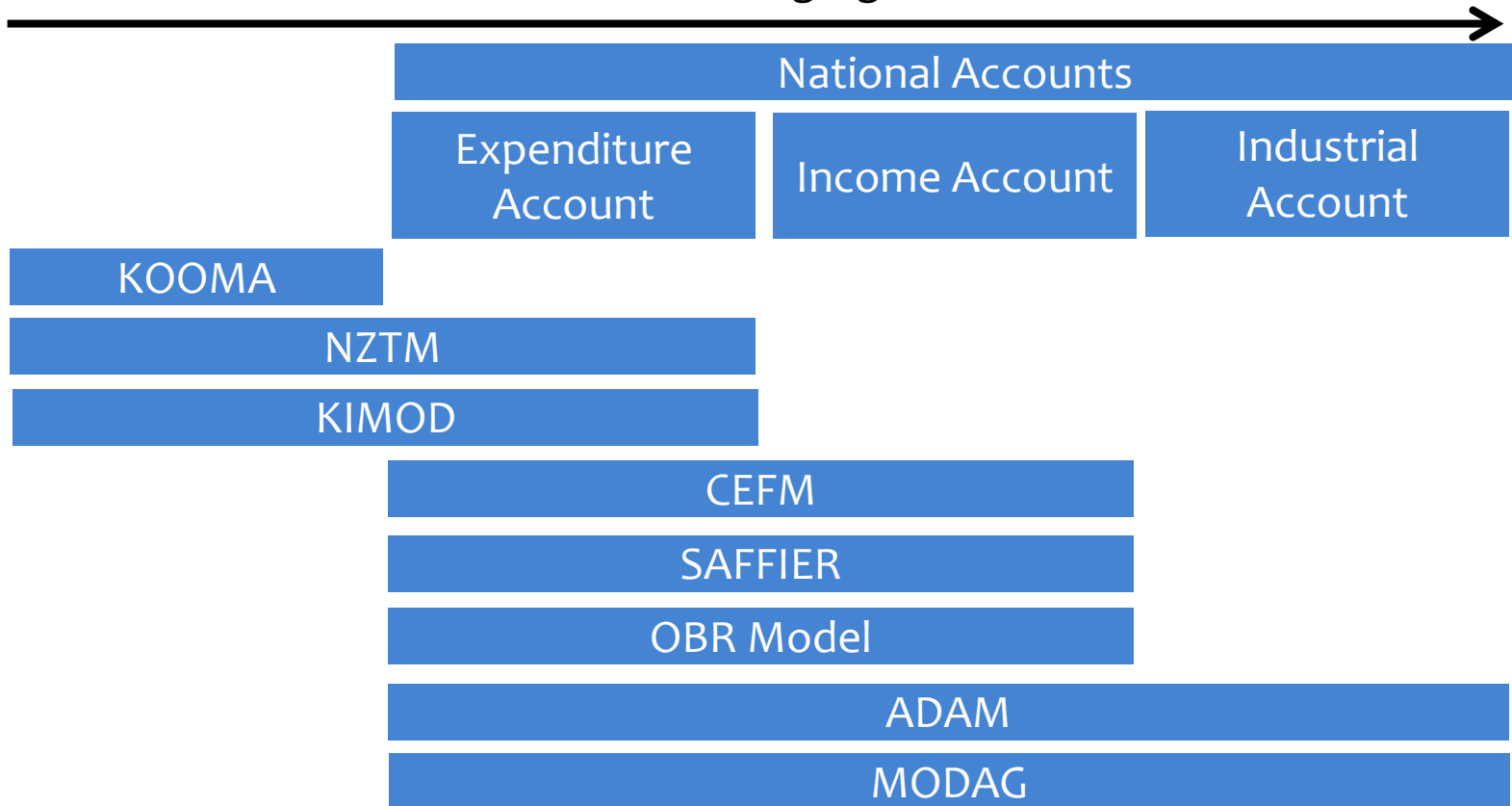
Bayesian Estimation

- Models often have multimodal/flat likelihood functions; data often uninformative about many parameters (Chari et al.)
- Requires tight prior distributions that can drive results and undermine empirical foundations (Blanchard)

Equation-by-Equation Estimation

- Computationally easier
- Statistical implications of combining sub-systems unclear (Johansen); Dynamics of individually estimated equations can be at odds with system (Blanchard)
- Protects against misspecification in other parts of model (Eitrheim et al.)
- Danger of misspecified model greater than danger of simultaneity bias (Eitrheim et al.)
- "Tweak" estimation till system performs satisfactorily (Statistics Denmark)

Comprehensiveness

Greater Dissagregation →

National Accounts		
Expenditure Account	Income Account	Industrial Account

KOOMA

NZTM

KIMOD

CEFM

SAFFIER

OBR Model

ADAM

MODAG

Comprehensiveness (cont.)

- Disaggregation makes it possible to identify how aggregate or industry-specific shocks are transmitted through the economy (Dyvi et al.)

- Disaggregation necessary for full description of how economic conditions determine government income and expenditure (Dyvi et al.; OBR)

- Industry level projections less accurate and hard to interpret; but impact projections in future years so can't be ignored (Dyvi et al.; Canadian Department of Finance)

- Greater disaggregation reduces transparency (CPB)

- High degree of disaggregation unnecessary as (KIMOD) forecast not used as direct input into public financial calculations (NIER); industry-level breakdown unnecessary as budget does not involve decision about which industry to tax or spend in (Canadian Department of Finance)

Fiscal Policy

Model	Government Spending			Disaggregated Government Revenues	Marginal Tax Rates	Government Employment	Government Financing	Endogenous Fiscal Policy 1/
	Consumption	Investment	Transfers					
MODAG	√	√	√	√	√	√		
KIMOD	√	√	√			√	√	√
ADAM	√	√	√	√	√	√		
KOOMA	√		√				√	√
SAFFIER	√	√	√			√		
OBR Model	√	√	√	√		√		
CEFM	√	√	√	√	√			
NZTM	√	√	√			√		

1/ SAFFIER includes a set of dummies that allows it to be used either in "balanced budget mode" (endogenous fiscal policy) or with exogenous fiscal policy.

Model Use
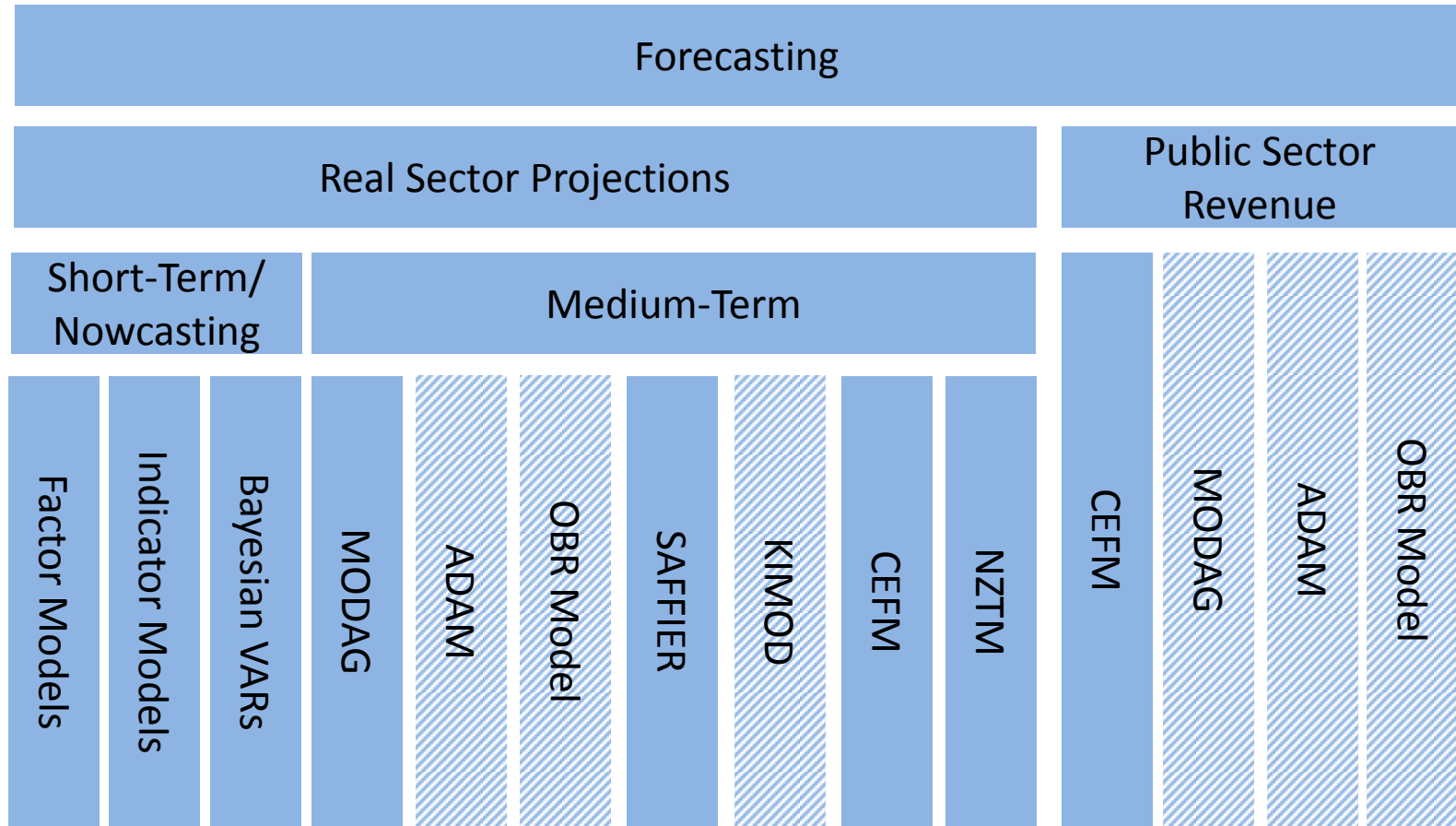
Model Use

- Policy Scenario Analysis
  - All models except OBR Model
  - DSGE (and KIMOD) models particularly well suited given microfoundations (Lucas critique)
  - Challenge of implementing permanent policy/structural reform shocks in DSGE models (NIER, CPB)
- Drivers of historical data/forecast
  - Weakness of LMM models that can't be used for full historical/forecast decomposition (CPB, NIER)
  - Compare outcome and model forecast (OBR; NIER)
  - In LMM models analyze individual equations (Dyvi et al., CPB, OBR)
  - "Turn off" certain parts of model (e.g. monetary policy) to identify drivers
- Uncertainty
  - OBR, SAFFIER, and MODAG all used to give sense of uncertainty based on past forecast errors

Institutional Framework

	Development	Maintenance	Operation
MODAG	Statistics Norway		Ministry of Finance
KIMOD	NIER		Ministry of Finance
ADAM	Statistics Denmark		Ministry of Finance
SAFFIER	CPB		
OBR Model	OBR/HM Treasury		OBR
CEFM	Department of Finance		
NZTM	New Zealand Treasury		
KOOMA	Ministry of Finance		

Institutional Framework

- In-house development/maintenance/operation
  - Increases human capital (Finnish Ministry of Finance, Canadian Department of Finance, Swedish Ministry of Finance)
  - Makes it easier to preserve/transfer knowledge (Finnish Ministry of Finance, Canadian Department of Finance)
  - More likely that model matches requirements of the Ministry of Finance?
  - Harder to shield resources for modelling?
- Outsource development/maintenance/operation
  - Usually for institutional reasons (CPB, OBR)
- Outsource development and maintenance
  - Useful to outsource to statistical agency if model close to national accounts (Dyvi)
  - Makes modelers in Ministry of Finance part of an external community (Dyvi)
  - Reflects lack of capacity in ministries of finance (NIER)
  - Facilitates recruitment (NIER)
  - Can pose communication challenges (Dyvi)

Resource Costs and Knowledge Management

- Cost to develop LMM models unclear
  - KIMOD 2 years (policy analysis); 5 years (forecasting)
  - Other larger LMM models likely more
- Cost to develop DSGE models around 2-4 years with resources ranging from 3 FTEs (Norges Bank) to 7 FTEs (Bank of England – includes full suite of models)
- Maintenance costs vary depending on how often redeveloped/re-estimated
  - MODAG/Kvarts 5FTEs in Statistics Norway
  - CEFM 2/3 employees at Department of Finance
  - KOOMA 2 employees at Finnish Ministry of Finance

"the fact that an existing model has existed for a long time may be reason enough to ensure that it is still used – simply because it takes time and resources to develop a new one" (NIER)

Resource Costs and Knowledge Management

- Model complexity and resulting overreliance on key individuals major risk for model survival (Swedish Ministry of Finance, CPB, NIER)
- Can be mitigated with strict documentation routines (OBR), clear and transparent programming (Dyvi), and user-friendly software (OBR)

- Limited resources argues for choosing model that makes it easier to draw on external "community" (NIER)
- Choosing model type actively used in academia facilitates recruitment and reduces risk of overreliance on key individuals (NIER)

# Development of a new model for fiscal policy

Objective

- Develop new model for medium-term fiscal policy analysis

- Aim is to complement existing models in use at the Ministry, with a focus on fiscal policy analysis

- The macroeconometric model KVARTS will remain the Ministry's primary tool for medium-term forecasting

The Ministry has a suite of different models

- KVARTS: forecasting and policy analysis

- Empirical models for short-term forecasting

- DEMEC: demographics, economy, and public finances

- MSG/SNoW: emissions projections, climate change policy

- MOSART and LOTTE: microsimulation models
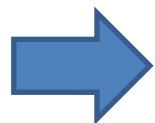
➡ Existing suite of models works well and has contributed to the Ministry's reputation for high-quality policy analysis

Why develop a new model?

- A model that can be used by a broader range of the economists at the Ministry

- Alternative perspective on fiscal policy

- Capacity building

The model strategy includes broad guidelines for the new model

- The new model should:
  - Include a role for fiscal policy over the business cycle
  - Describe the behavior of agents in a general equilibrium setting, so that both demand and supply effects of fiscal policy, as well as the impact of different sources of financing, are taken into account
  - Include a role for forward-looking expectations
  - Be parameterized on Norwegian data
  - Be relatively easy to interpret in light of economic theory
  - Be limited to what is necessary to analyze the impact of the most important fiscal policy instruments on the economy
- Theoretical consistency is a useful starting point, but must be weighed against empirical relevance and user friendliness

Many unanswered questions

Starting point model

Usage areas

Expectations

Model type

Household heterogeneity

Sectors

User interface

Collaboration with others

Fiscal policy

Labor market

Parameterization methodology