"Recent Developments in Macroeconometric Modelling for Policy Analysis".

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General Issues re Policy Oriented Models

- Three Types of Model
- Primary model used as main vehicle for forecasting and policy scenarios
- Secondary models used to cover issues that can't be covered in primary model without it becoming unwieldy
- Secondary models are used as checks on answers particularly for forecasts.

Three Stages to Primary Model Construction

- The Conceptual Model (CM)
- The Data-Adjusted Model (DAM)
- The Operational Model (OM)

The Conceptual Model

- Sets out preferred conceptual model of economy
- Incorporates enough theoretical structure to enable one to discuss a reasonable range of issues from an economic perspective.

Data-Adjusted Model

- Attempts to match past and current data
- Generally inadvisable to directly modify CM
- Need to augment CM in some way without modifying its conceptual foundations
- Clearest distinction in old approach of adding on lags to capture dynamics

Operational Model

- Modifies DAM to match information about future developments and to incorporate information that is hard to put into CM or even DAM
- Examples are survey information, policy-makers judgement and common factors in many series that are relevant to decisions

What are the New Developments in Policy Oriented Modelling?

- Academic View
- Practitioner's View (revealed preference?)

The Academic View

CEMFI SUMMER SCHOOL IN ECONOMICS AND FINANCE

A PRIMER IN THE ESTIMATION OF DYNAMIC MACROECONOMIC MODELS Jesus Fernandez-Villaverde (University of Pennsylvania)

This course aims to provide a rigorous introduction to the *formulation, estimation, and policy analysis of dynamic stochastic general equilibrium (DSGE) models*. Recent advances in economic theory, computational methods, and simulation techniques make it now possible to build and estimate models *that fit the data well and are rich enough for meaningful policy analysis*. (Italics added)

Central Issues in Macroeconometrics (all models)

- Model Design
- Model parameter estimation
- Model/Data Match

Response to This Perspective

- Return to academic perspective after looking at what has been done in this area by practitioners in policy institutes in past 40 years
- There have been four generations of models constructed by such people

Economic Model Design

- Characterize as responses to four issues
- How much tight economic theory to incorporate?
- How to introduce complex dynamics-internally or externally?
- How to ensure existence and convergence to consistent stock and flow steady states?
- Nature of expectation formation?

First Generation (1G) Models

- Loose theory- IS/LM and often filled in equations from NI identity
- Dynamics: external and Koyck/Partial Adjustment
- No stock-flow consistency. Often exploded
- Expectations backward looking

Second Generation (2G) models

- Theory: Some Optimizing Choices
- Dynamics: ECM. Model gave equilibrium relations
- Patchy Stock-flow consistency
- Expectations : Mainly backward looking

Third Generation (3G) Models

- Theory: designed models with steady state before going to data
- Dynamics: Some internal from dynamic identities but most from ECM and polynomial adjustment
- Full stock-flow consistency: Policy rules important for this
- Expectations : Both forward and backward-looking
- Most influential model was QPM of Bank of Canada

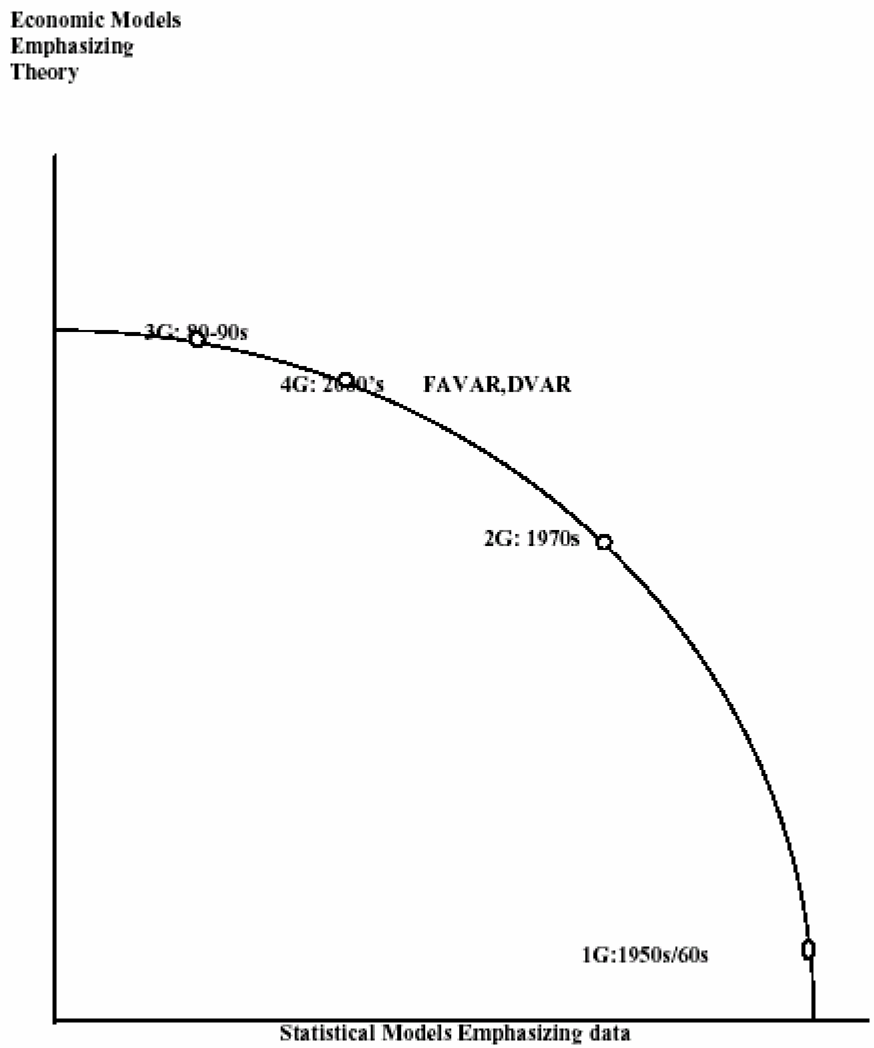
Fourth Generation (4G) Models

- Emerging class TOTEM (Bank of Canada), BEQM (Bank of England), NAWM (New Area Wide Model, ECB), GEM (IMF), NEMO (Bank of Norway) etc
- Basically 3G+

4G Model Features

- Theory: Many intermediate goods. Emphasis on heterogeneity of firms, agents to enable non-competitive structures. Aggregate relations have “heterogeneity parameters”
- Dynamics: Mostly internal from Optimization
- Heterogeneity brings in micro evidence
- Dynamics from habit persistence, adjustment costs, capital utilization, staggered price setting, contractual arrangements

Generations of Models



Can we use a small Model as a CM?

- Two approaches in academia
- DSGE models- tight theory
- SVAR models – loose Theory

DSGE Models

- Theory: Similar to 4G models but less complex since much smaller. GE models like 4G since markets clear
- Dynamics (D) as in 4G models but extra source from stochastics (S) since shocks driving these are assumed to be autoregressive processes
- Much of 4G model structures came out of DSGE models
- Not unexpected. Central banks unlikely to (should not?) be at frontier. Use things that have been shown to work.

4G and DSGE Differences?

- Scale. Biggest DSGE less than ½ the size of 4G models. Villaverde comment that "*models are rich enough for meaningful policy analysis*" seems overly optimistic
- Policy requires information on many variables
- DSGE models assume stationary processes but data is often not like that, particularly in transition economies
- To date parameter estimation is informal with 4G (calibration). DSGE is increasingly Bayesian
- Role of shocks in the models seem to be different

Should 4G Modellers use Bayesian Estimation (as for DSGE)?

- Nothing wrong with the idea
- Problem is whether one gets a false sense of precision with it
- This may be due to fact that data sets are short or not that informative about some parameters and the priors dominate
- Would be o.k. if "hard priors" but most are soft

Table 3: Posterior estimates using two independent 1.5 m

	Prior mean	5%	95%	Post mean	Post Std
h	0.50	0.13	0.87	0.92	0.02
σ	1.00	0.37	1.92	0.39	0.12
η	1.00	0.38	1.92	0.85	0.15
ϕ	1.00	0.38	1.92	1.83	0.56
θ_H	0.50	0.06	0.94	0.75	0.02
θ_F	0.50	0.06	0.94	0.72	0.02
ϕ_1	1.50	1.05	2.03	1.44	0.10
ϕ_2	0.25	0.09	0.48	0.41	0.07
ρ_r	0.50	0.13	0.87	0.72	0.03
ρ_{rst}	0.50	0.13	0.87	0.83	0.03
ρ_a	0.50	0.13	0.87	0.98	0.01
λ_1	0.50	0.13	0.87	0.78	0.05
σ_a	0.53	0.32	0.88	0.80	0.20
σ_s	0.53	0.32	0.88	9.16	0.86
σ_q	0.53	0.32	0.88	6.07	0.86
σ_{π_H}	0.51	0.40	0.65	1.57	0.17
σ_{π_F}	1.04	0.70	1.55	3.39	0.40
σ_r	1.04	0.70	1.55	0.77	0.08
σ_{y*}	2.38	1.04	5.32	0.69	0.07
σ_{r*}	1.04	0.70	1.54	0.54	0.05

Summary?

- The weaker the data available upon which to base one's conclusion, the greater the precision which should be quoted in order to give the data authenticity

Role of Unobserved Shocks

- Shocks can be explanatory or exploratory (or both)
- In 4G models observed shocks e.g. world developments are explanatory and exploratory but unobserved e.g. technology are only exploratory
- In DSGE models unobserved shocks are explanatory
- It seems as if the fact that they are assumed to be autoregressive means they explain a lot.
- May be uncomfortable with that

More on Shocks

- DSGE assumes shocks u_t are autoregressive (AR) processes
- Policy oriented models generally specify a path for u_t
- Enables one to use perfect foresight algorithms
- Can make these the same
- But not quite DSGE as can also make different paths

"DSGE Models Fit the Data Well "(Villaverde)

- Seems very generous
- Little serious evaluation of these models
- Tracking ability is overstated as much comes from the autocorrelated shocks
- 4G model evidence is also scant. Often claimed one wants to match only some gross features but hard to see that as a good objective

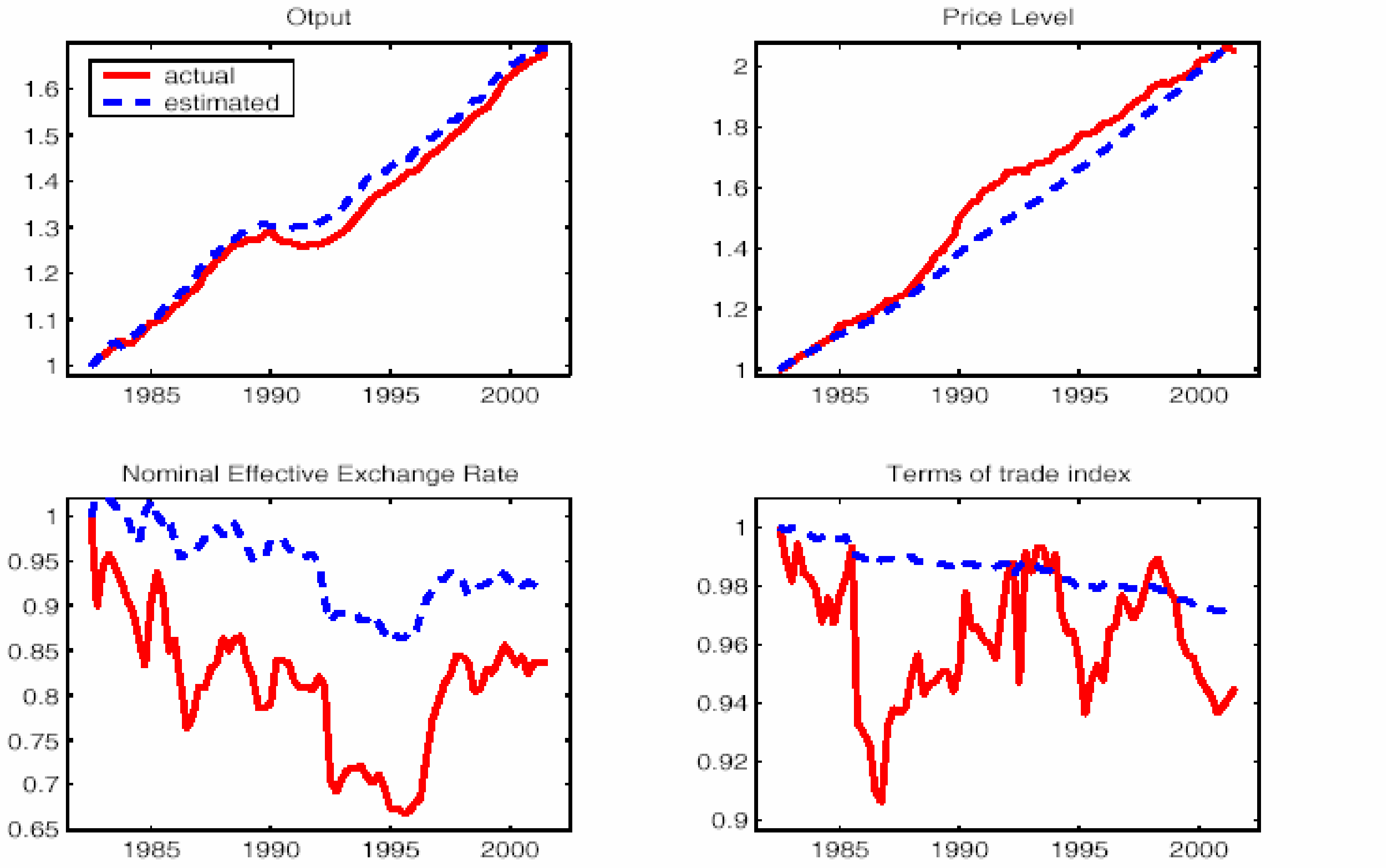

Otput
actual
estimated
1.6
1.5
1.4
1.3
1.2
1.1
1
1985
1990
1995
2000
Price Level
2
1.8
1.6
1.4
1.2
1
1985
1990
1995
2000
Nominal Effective Exchange Rate
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
1985
1990
1995
2000
Terms of trade index
1
0.98
0.96
0.94
0.92
0.9
1985
1990
1995
2000

Figure 3:

Secondary (auxiliary) Models

- Sometimes CGE type models (particularly in fiscal agencies)
- Sometimes VAR models of varying size
- Could we just use a VAR (actually a structural VAR) as a primary rather than secondary model? Sometimes suggested

Can VAR Models Capture Impulse Responses in Actual Economies?

- Simulate data from a 4G type model of the UK (described in Kapetanios/Pagan/Scott)
- Has around 54 variables
- Simulate pseudo-data from impulse responses
- Fit VAR(4),VAR(7),VAR(10)
- Do for 200 and 30000 observations

Also use 500 samples of 30000 observations

fit the VAR for selected p.

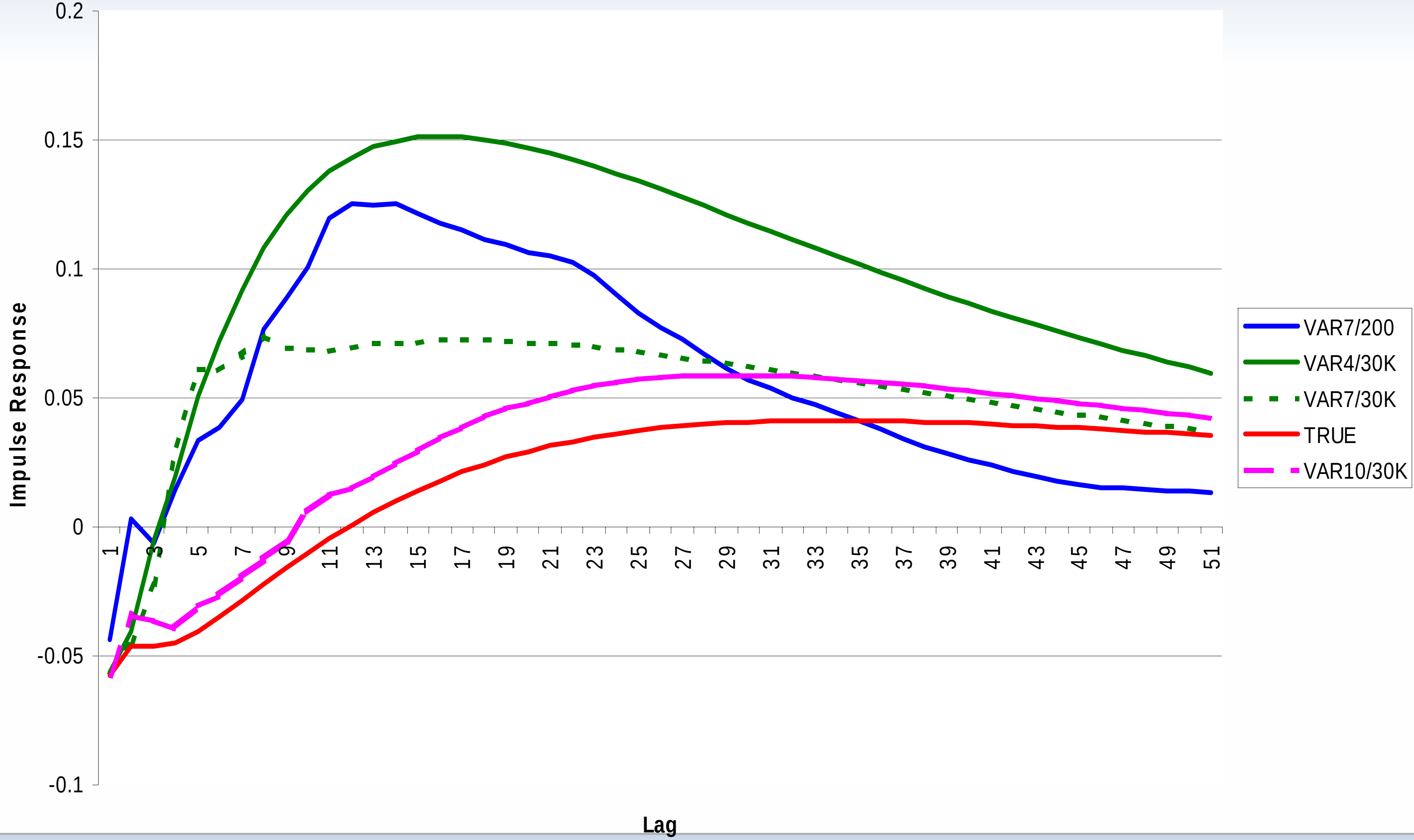
$VARj/30K$.

Dinstinguishes between approx error and sample size

Inadequacy of VAR?

- Model economy has many more variables than used in typical VAR analysis
- Even if the 54 variables in the model economy follow (say) a VAR(1) if one just uses (say) 6 variables in fitting a VAR then model economy can imply an infinite order VAR for the 6 variables
- Happens with most DSGE models once one eliminates the capital stock
- Brings in question of how serious the approximation errors caused by using a reduced number of variables is.

Fig 3 Impulse Responses of Real Exchange Rate to a Fiscal Policy Shock: VAR7(T=200), VAR4, VAR7,VAR10 for 30K Observations and True Values



What do we Do about This?

- The choice of variables is important
- Never eliminate variables from VAR set that are very persistent – capital stock is a good example
- Use methods that can handle large numbers of variables in a parsimonious way
- Emerging literature on factors augmented VARs (FAVAR) (Forni et al, Boivin/Giannoni, Bernanke et al) seems to be useful way of handling this.

Operational Model Issues

- Is steady state a constant (Ratios are rarely constant in the data)
- How do we improve the dynamic fit?
- How do we bring in off-model information?
- Core/non-core distinction in BEQM seems useful

Augmenting the Model

- Base Model (CM) produces y_t^*
- Data will be y_t
- Define $\xi_t = y_t - y_t^*$
- ξ_t can be written as functions of co-integrating errors in data and in model plus Δy_{t-j}
- Augment this relation with extra variables, factors
- Basically core/non-core distinction in BEQM

Need to be able to get y_t^* i.e. model solution.

Not so easy if unobserved shocks

4G models don't seem to have them in operational mode.

Shocks used mainly for exploration rather than explanation

Models Outside Central Banks

- Fiscal agencies increasingly concerned with longer run and allocative issues e.g. taxation design, ageing, longer-term budget balance.
- Don't need to focus so much on dynamics and shocks
- Appropriate models are more OLG, CGE and micro-simulation models

Conclusion

Macroeconometric modelling steady progression away from

1. Single equation
2. Large
3. Data dominated

towards

1. Complete
2. Small systems
3. Strong on economics

Issues with 4G models

- Tracking information rarely supplied
- “Long-run disconnect problem”. Often only gaps are emphasized and deviation is from “long-run” that is not model based. Unsatisfactory.
- When estimated shocks are often AR(1) with parameter .99. Treating as stationary seems ridiculous.
- Often off-model augmentation is to correct for long-run problems

Requirements of Policy Models

- Do we want a good economic story?
- **Or** the ability to effectively utilize a lot of numbers?
- 2G models good at latter. Story quite confused at times
- 3G, 4G, DSGE models strong on story but is this at expense of flexibility?
- Need to be able to adapt to policy makers changing preferences and incorporate opinions and attitudes

Will 4G/DSGE Models Become More Popular

- Depends a lot on nature of institution
- Partly training of policy makers and advisers
- Partly about reporting requirements. If fan charts are required and detailed defence of position then tend to see greater use of CMs close to DSGE