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A New Comparative Approach to Macroeconomic Modelling and Policy Analysis

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****Disclaimer: Willem Duisenberg Research Fellow. The views expressed should not be attributed to the European Central Bank or its staff.***

Quantitative models for macroeconomic policy

- Economy-wide dynamic stochastic models that may be used by
  - ➔central banks and finance ministries for designing monetary and fiscal stabilization policies that help reduce macroeconomic fluctuations.
  - ➔business economists to assess macroeconomic fluctuations and likely policy responses, as an input for decision analysis by asset managers, banks, other large enterprises.

Research agenda: Develop a platform for easy model comparison

- All models wrong. Some biased. But to beat a model, you need one. Competition is good.
- Create a public archive of macroeconomic models on a common platform (use *Dynare* model solution software for *Matlab*).
  - ➔ comparative instead of insular approach to model-based analysis.
  - ➔ Policy advice on stimuli and rules for central banks/treasuries by comparing models.
  - ➔ comparative assessments of macro shocks and policy reactions for asset managers, banks, etc.

Earlier Model Comparison Projects

- Brookings Institution
  - ➔ Bryant, Currie, Frenkel, Masson, Portes, (eds.) (1989)
  - ➔ Bryant, Hooper, Mann (eds) (1993) (Taylor rule)
- NBER
  - ➔ Taylor (ed.) (1999)
- Earlier comparison projects involved teams of researchers, each team working with its own model.
- We aim to create a platform that puts the whole range of models in the hands of individual researchers at large, and create a self-sustaining process for adding models to the database.

Overview: Current Projects/Papers

„**A New comparative approach to macroeconomic policy analysis**“, Taylor, Wieland, Cwik, Müller, Schmidt, Wolters, (2009 draft): Exposition of model base.

„**Surprising comparative properties of monetary models: Results from a new model base**“, Taylor-Wieland, (2009), paper distributed. Robustness analysis: U.S. monetary policy.

„**Model-based assessments of monetary transmisssion in the U.S. and the Euro area**,“ Cwik, Müller, Wieland, Wolters, (2009), in preparation.

„New Keynesian versus old Keynesian government spending multipliers“, Cogan, Cwik, Taylor, Wieland (2009), available next week.

Other papers in preparation: „Real-time perspectives on the output gap“, Wolters&Wieland, „The role of the exchange rate in monetary policy design“ „Euro area fiscal stimulus“. Cwik&Wieland.

Outline

Focus today on: *Surprising comparative properties of 3 new-Keynesian monetary models of the U.S. economy*

- Taylor (1993), Christiano, Eichenbaum, Evans (2005), Smets and Wouters (2007)
- A look at the beta version of the model base
- What is the effect of a Fed policy change? How does an effective and robust decision rule look like?

Advertisement: *Old-Keynesian versus new Keynesian government spending multipliers*

- What is the likely impact of the 2009 American Reconstruction and Re-Investment Act.

Surprising comparative properties of 3 new Keynesian monetary models

Taylor (1993) model: early estimated multi-country model with rational expectations and nominal rigidities

Christiano, Eichenbaum, Evans (JPE 2005) and **Smets and Wouters (AER 2007)**: the 2 best-known current new Keynesian models of U.S. economy with additional microfoundations.

➔ Over 15 years of additional research and new data. Did the monetary transmission mechanism change? Did the recommendations for monetary policy change?

Interesting Differences

- Structure:
  - CEE 2005 and SW 2007 contain additional micro-foundations (i.e. enforce all cross-equation restrictions from optimizing behavior of representative households/ firms.) Also: Taylor versus Calvo contracts, indexation, technology shocks.
- Estimation periods and methods:
  - Taylor (1993): 1971-86, GMM and Max.lik., CEE (2005) 1959-2001, match SVAR impulse response of monetary shock, SW(2007), 1966-2004, Bayesian estimation.

Did U.S. monetary transmission change according to these models?

- Method: systematic component of monetary policy is described by an interest rate rule, add an unanticipated innovation to the rule and investigate effect on U.S. real GDP.
  - ➔SW 07 rule:

$$i_t = 0.81 i_{t-1} + 0.39\pi_t + 0.97 y_t - 0.90 y_{t-1} + \varepsilon_t^i$$

  - ➔CEE05 / CGG02 rule:

$$i_t = 0.80 i_{t-1} + 0.3 E_t \pi_{t+1} + 0.08 y_t + \varepsilon_t^i$$


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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
Dynare Model Base
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1. Small Calibrated Models
   1.1. NK RW97: Simple NewKeynesian model as in Woodford & Rotemberg (1997)
   1.3. NKHy CGG99: Hybrid NK model  as in Clarida, Gali, Gertler (1999)
   1.4. NK2C CGG02: Two-Country NK model as in Clarida, Gali, Gertler (2002)
2. Estimated US Models
   2.1. US FM95:  Small US model by Fuhrer & Moore (1995)
   2.2. US MSR04: Small US model by FRB Monetary Studies, Orphanides & Wieland (2004)
   2.3. US FRB03: FRB-US model linearized by Levin, Wieland, Williams (2003)
   2.4. US FRB08: FRB-US model 08 linearized by Laubach (2008)
   2.5. US FRB08mx: FRB-US model 08 mixed expectations, linearized by Laubach (2008)
   2.6. US SW07:  US optimization-based model by Smets & Wouters (2007)
   2.7. US ACEL05: Small US model by Altig, Christiano, Eichenbaum & Linde (2004)
   2.8. US ACEL05_2: without variable ordering
   2.9. US ACEL05_3: without variable ordering & without wage bill in advance financi
3. Estimated Euro Area Models
   3.1. EA CW05ta: Small Euro area model/Taylor-contracts by Coenen & Wieland (2005)
   3.2. EA CW05fm: Small Euro area model/Fuhrer-Moore contr. by Coenen  & Wieland (20
   3.3. EA ECBAWM:  ECB Area Wide model linearized as in Kuester & Wieland (2005)
   3.4. EA SW03: Euro area optimization-based model by Smets and Wouters (2003)
4  Estimated/calibrated Multi-Country Models
   4.1. G7 TAY93 :  model of the G7 economies by Taylor (1993)
   4.2. G3 CW03:  model of the G3 economies by Coenen and Wieland (2002)
   4.3. NK GEM03: Small open economy model by Laxton & Pesenti (2003)
   4.4. NK Sigma07: SIGMA: Two-country Model by Erceg, Guerrieri, Gust (2007)
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Small, calibrated models

US: FRBUS, ACEL,SW, ...

EUR: AW-ECB, CW, SW ...

Multi-Country: Taylor, CW
GEM-IMF, SIGMA-Fed

Solving 3 US models

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Currently Solving: US ACEL05
No Fiscal Policy Shock is available for Model: US
Elapsed time is 3.266117 seconds.
Elapsed cputime is 1.7725 seconds.

Currently Solving: US SW07
Elapsed time is 2.428042 seconds.
Elapsed cputime is 2.0329 seconds.

Currently Solving: G7 TAY93
Elapsed time is 22.986525 seconds.
Elapsed cputime is 22.4122 seconds.
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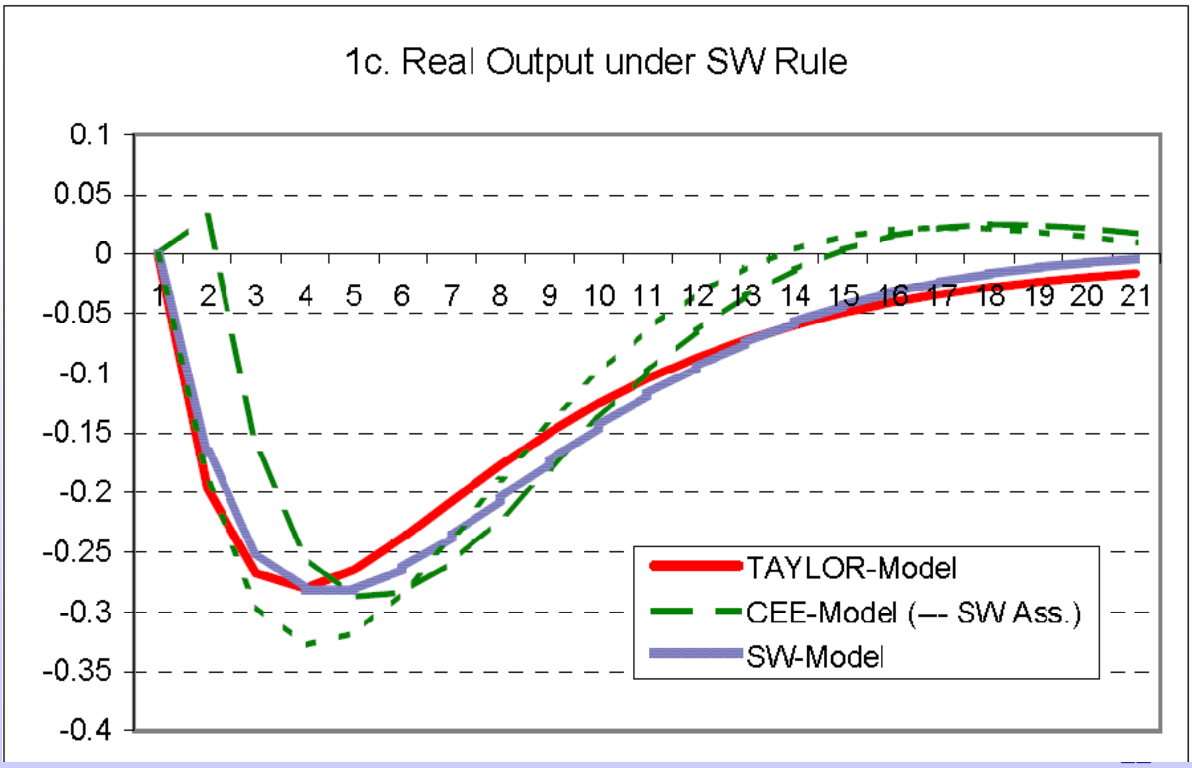
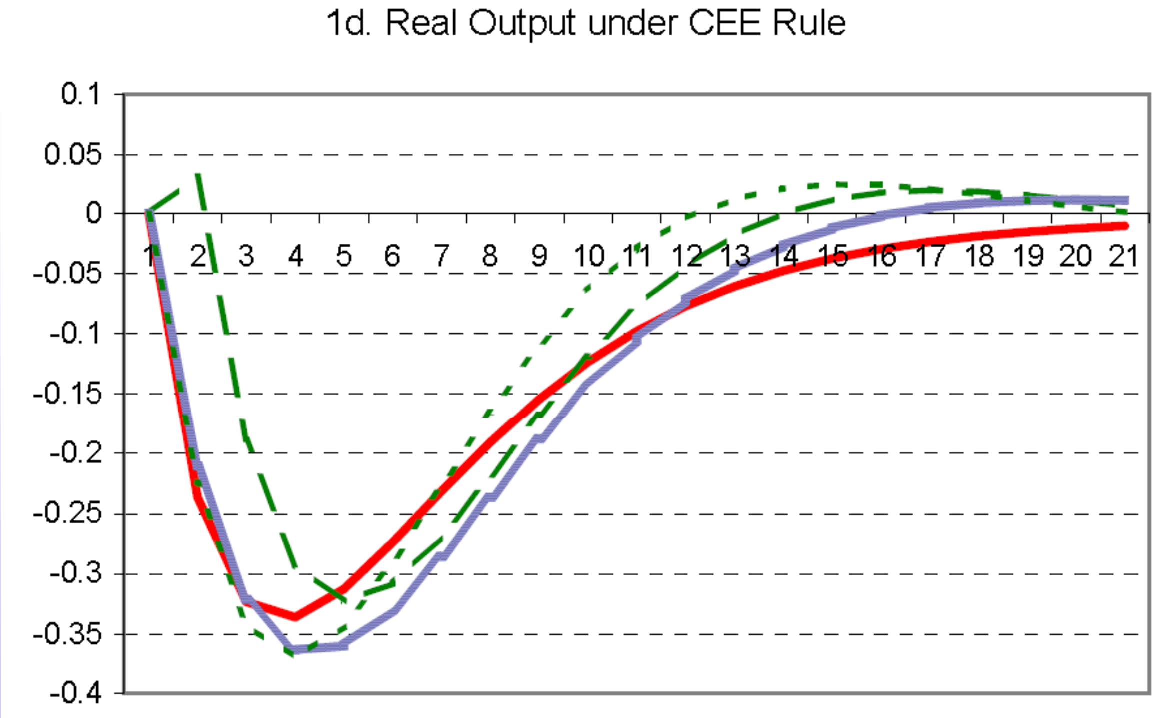
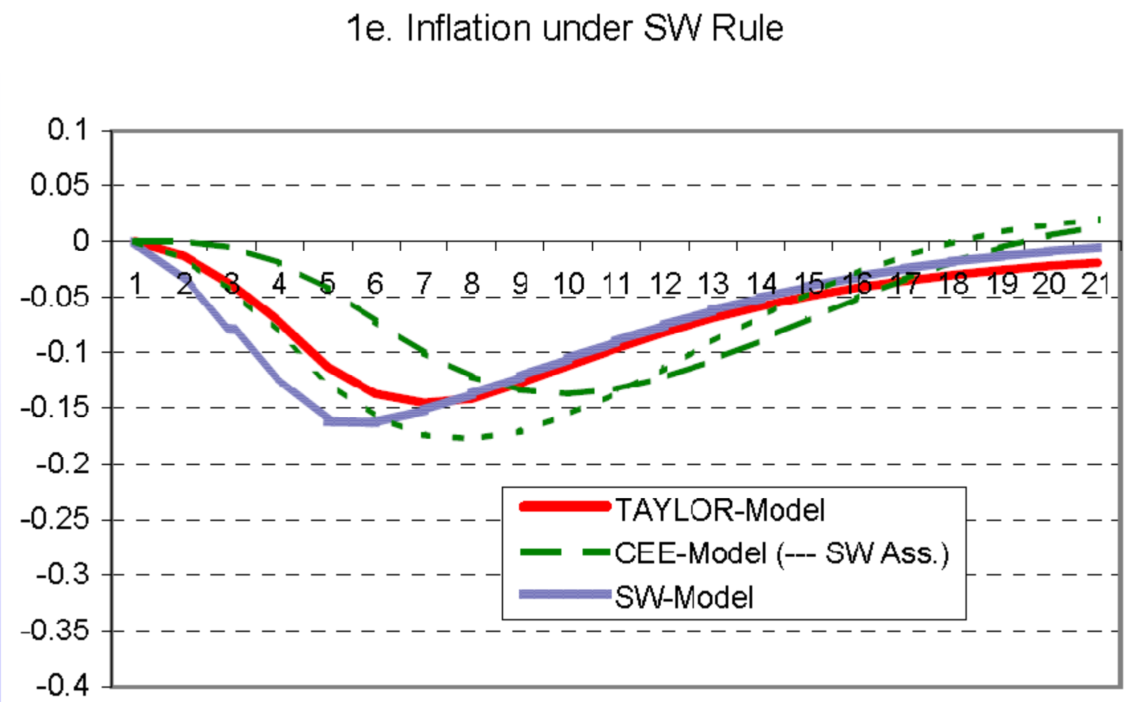
Effect of Policy Shock on U.S. Real GDP



CEE/CGG Rule



Inflation (SW Rule)



Surprising Finding 1

- The three models agree on the effect of a federal funds rate innovation on US real GDP in spite of differences in structure, estimation method and period.
- This is even more surprising in light of the findings of Levin, Wieland and Willams (1999, 2003) who showed that models built after Taylor (1993a) at the Fed tended to imply longer-lasting and later peaking effects of policy shocks.

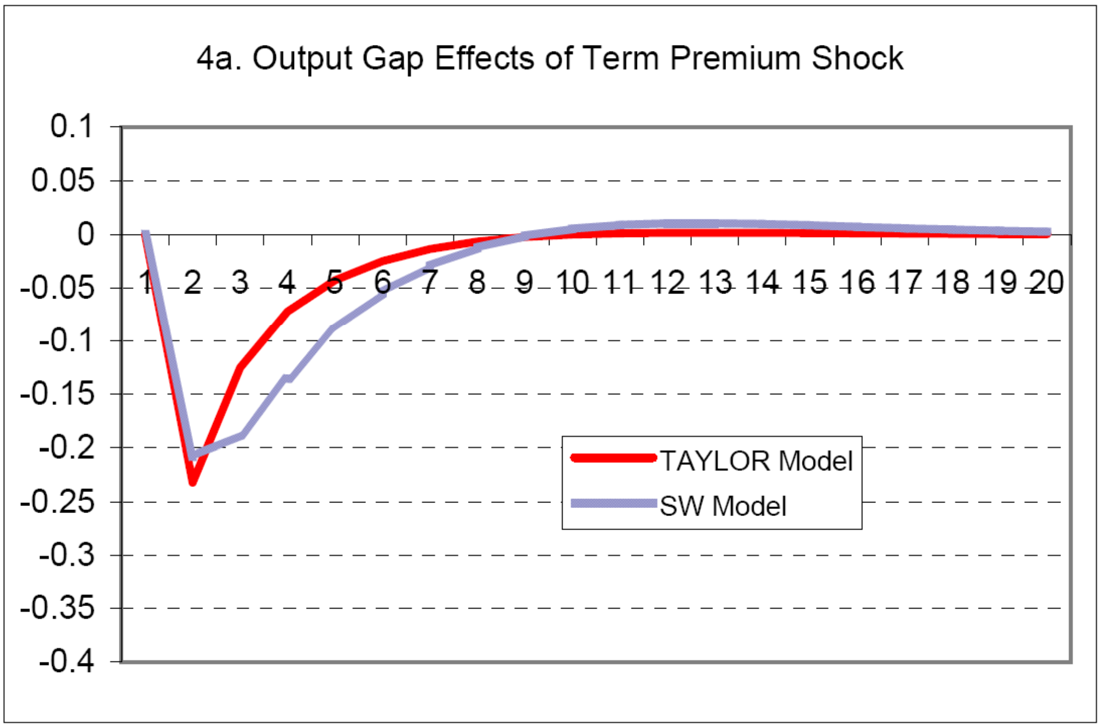
Other Shocks

- Demand shocks (Taylor: many, SW government spending, investment-specific technology shock, (also in ACEL0 05)
- Financial shocks (Taylor: term premium shock, SW risk premium shock)
- Short-run and long-run supply shocks: (Taylor only short run markup shocks, SW short-run markup shocks, long-run technology shock (also in ACEL05)

Financial Shock

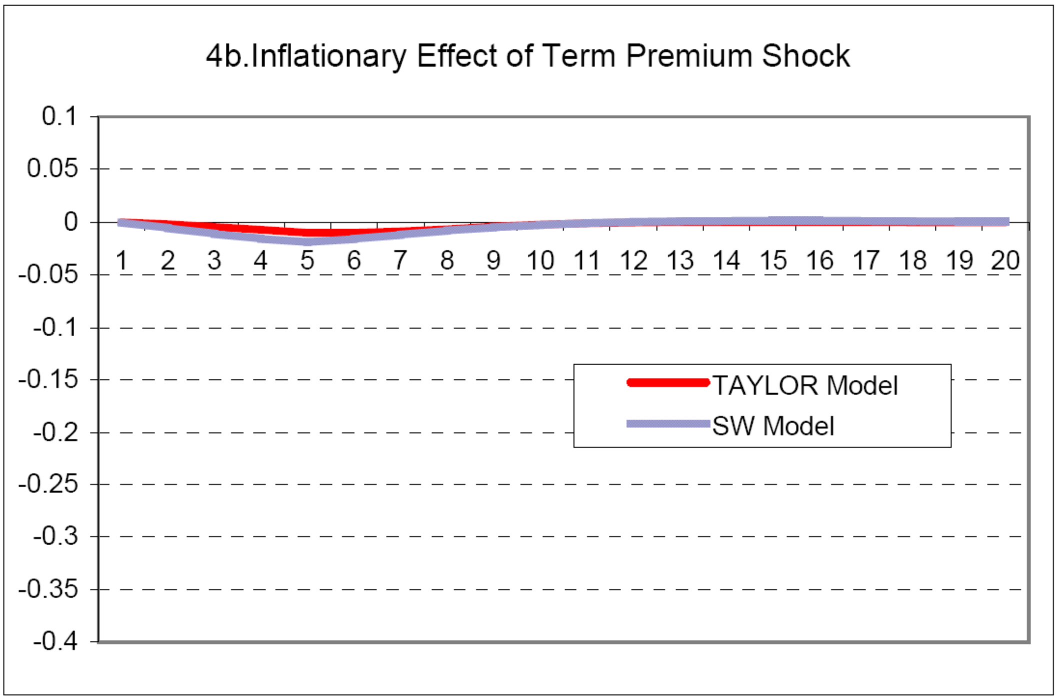
- In light of the dramatic increases in risk spreads during the recent financial crisis it is of interest what these models have to say on their impact, if anything.
- Neither SW07 nor TAY03 model spreads endogenously, but they contain serially correlated risk premium shocks.
- SW emphasize that the premium introduces a wedge between the interest rate controlled by the central bank and the return on assets held by households and has similar effects as a net-worth shock in a model with a financial sector as Bernanke, Gertler, Gilchrist.

Effect of Financial Shock (Risk Premium)



Increase in risk premium by 1 percentage point.

Effect of Financial Shock (Risk Premium)



Increase in risk premium by 1 percentage point.

Surprising Finding # 2

- Financial risk premium shock has almost identical effect on U.S. real GDP in Taylor (1993) and Smets and Wouters (2007).
- Note, most other shocks have quite different, quantitative effects on output (although often similar qualitative properties)

What is an effective and robust and simple monetary policy rule?

- Taylor-style rules with interest rate smoothing and lagged output gap:

$$i_t = \rho i_{t-1} + \alpha \pi_t + \beta_0 y_t + \beta_1 y_{t-1}$$

- Loss function (or model-based utility):

$$L = Var(\pi) + \lambda_y Var(y) + \lambda_{\Delta i} Var(\Delta i)$$

➔Choose rule parameters to minimize losses in one model and compare outcomes if another models constitutes a more appropriate representation of the U.S. economy.

Optimized Response Coefficients

Model	$\lambda_y = 0$			
	ρ	α	β_0	β_1
	2 Parameters			
TAYLOR		2.54	0.19	
SW		2.33	-0.10	
CEE/ACEL		4.45	0.28	
	3 Parameters			
TAYLOR	0.98	0.37	0.09	
SW	1.06	0.49	0.01	
CEE/ACEL	0.97	0.99	0.02	
	4 Parameters			
TAYLOR	0.98	0.37	0.07	0.02
SW	1.06	0.46	-0.03	0.03
CEE/ACEL	1.01	1.11	0.18	-0.18

Optimized Response Coefficients

Model	$\lambda_y = 1$			
	ρ	α	β_0	β_1
TAYLOR		3.00	0.52	
SW		2.04	0.26	
CEE/ACEL		2.57	0.45	
TAYLOR	0.98	0.21	0.53	
SW	1.13	0.012	0.015	
CEE/ACEL	2.84	7.85	-2.12	
	(0.14)*	(2.44)*	(0.42)*	
TAYLOR	0.96	0.18	0.41	0.19
SW	1.07	0.16	1.63	-1.62
CEE/ACEL	1.04	0.51	2.24	-2.30

Improvements from Interest Rate Smoothing and Lagged Output Gap

	$\lambda_y = 0$	
Model	4 versus 3 Parameters	3 versus 2 Parameters
TAYLOR	0.12% (0.001)	278% (1.38)
SW	0.22% (0.001)	316% (0.78)
CEE/ACEL	5.10% (0.001)	229% (0.04)

- Percentage vs absolute losses. Absolute losses in terms of implied inflation variability premium (implied increase in standard deviation of inflation relative to best rule of the same type if model is known) (as in Kuester and Wieland (2009 forth. JEEA)

Improvements from Interest Rate Smoothing and Lagged Output Gap

Model	$\lambda_y = 1$ 4 versus 3 Parameters	$\lambda_y = 1$ 3 versus 2 Parameters
TAYLOR	1.81% (0.07)	98.8% (2.14)
SW	10.6% (0.47)	25.6% (1.17)
CEE/ACEL	14.4% (0.11)	9.67% (0.11)

Finding # 3

- Confirm Levin, Wieland, Williams (NBER volume 1999, AER 2003) regarding benefits of interest rate smoothing in new models.
- New models prefer output growth to output gap, but performance improvement is negligible.

Robustness

Rule	TAYLOR-2-Par. Rule		TAYLOR-3-Par. Rule		TAYLOR-4-Par. Rule	
Model	SW	ACEL	SW	ACEL	SW	ACEL
IIP (λ_y=0)	0.37	0.03	0.83	0.12	0.90	0.14
IIP (λ_y=1)	0.17	0.001	5.41	M.E.	7.18	M.E.
Rule	SW-2-Par. Rule		SW-3-Par. Rule		SW-4-Par. Rule	
Model	TAYLOR	ACEL	TAYLOR	ACEL	TAYLOR	ACEL
IIP (λ_y=0)	0.27	0.15	0.13	0.02	0.15	0.02
IIP (λ_y=1)	0.86	0.03	3.20	0.21	2.71	0.13
Rule	ACEL-2-Par. Rule		ACEL-3-Par. Rule		ACEL-4-Par. Rule	
Model	SW	TAYLOR	SW	TAYLOR	SW	TAYLOR
IIP (λ_y=0)	0.54	0.76	0.11	0.27	0.09	0.34
IIP (λ_y=1)	0.07	0.12	108	24.9	0.53	3.85

Finding # 4

- Rules are robust if central bank cares exclusively about inflation stabilization.
- 3- and 4-parameter rules are not robust if central bank cares also about output stabilization.

Robustness of 2-Parameter Rules

Rule	TAYLOR-2-Par. Rule	TAYLOR-3-Par. Rule	TAYLOR-4-Par. Rule
in Model	SW	SW	in SW
IIP (λ_y=0)	0.37 (1.08)*	0.83	0.90
IIP (λ_y=1)	0.17 (1.53)*	5.41	7.18
Rule	SW-2-Par. Rule	SW-3-Par. Rule	SW-4-Par. Rule
in Model	TAYLOR	TAYLOR	TAYLOR
IIP (λ_y=0)	0.27 (1.58)*	0.13	0.15
IIP (λ_y=1)	0.86 (2.64)*	3.20	2.71

* Comparison to best 4-parameter rule in that model.

Plan

- Publish modelbase along with paper and applications,
- Make platform widely available via website for download.
- Create self-sustaining protocol for inclusion of new models by model authors.
- *Advertisement: American Recovery and Re-Investment Act Evaluation,* Cogan, Cwik, Taylor, Wieland (2009), Old Keynesian versus New Keynesian Government Spending Multipliers.