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Discussion

Discussion of In-Koo Cho and Kenneth Kasa, "Learning and Model Validation"

James Bullard

Federal Reserve Bank of St. Louis

7 November 2006

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Discussion

Parameters versus models

Connections to secape dynamics Model validation Specification testing Assignment of the PLM Nature of the validation dynamics Instability generated by rival models Artificial intelligence Comparison with artificial intelligence Statistical versus economic selection Hypothesis

- Restricted perceptions
- Conquest
- example
- Conclusions

Parameters versus models

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• Main idea: Allow agents to select forecasting models in addition to recursive learning.

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example

• Main idea: Allow agents to select forecasting models in addition to recursive learning.

• Most of the action in actual economies?

Parameters versus models

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Conclusions

- Main idea: Allow agents to select forecasting models in addition to recursive learning.
- Most of the action in actual economies?
- Appeal: Forecasters can "express doubt" about their models, switch models.

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Restricted perceptions example Conquest example • Main idea: Allow agents to select forecasting models in addition to recursive learning.

• Most of the action in actual economies?

- Appeal: Forecasters can "express doubt" about their models, switch models.
- Mostly thinking in terms of non-nested models.

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Conclusions

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• Model validation would alter learning dynamics even in economies where REE is unique and expectationally stable.

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- Model validation would alter learning dynamics even in economies where REE is unique and expectationally stable.
- The authors are interested in whether policymaker model switching might *induce* escape dynamics ...

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- The authors are interested in whether policymaker model switching might *induce* escape dynamics ...
- ... and hence the regime switching we see in many macroeconomic variables.

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- Model validation would alter learning dynamics even in economies where REE is unique and expectationally stable.
- The authors are interested in whether policymaker model switching might *induce* escape dynamics ...
- ... and hence the regime switching we see in many macroeconomic variables.
- Some examples maintain the possibility of escape, others do not.

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• A forecasting community entertains a menu of forecasting models.

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- A forecasting community entertains a menu of forecasting models.
- Parameters are recursively updated ...

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- A forecasting community entertains a menu of forecasting models.
- Parameters are recursively updated ...
- ... and misspecification tests based on the Kullback-Leibler Information Criterion (KLIC) are carried out.

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- A forecasting community entertains a menu of forecasting models.
- Parameters are recursively updated ...
- ... and misspecification tests based on the Kullback-Leibler Information Criterion (KLIC) are carried out.
- Models can be discarded, replaced with alternatives, and possibly reincarnated.
- Knowledge of the true data generating process is not required. Multiple, misspecified models can be compared.

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• The econometric specification testing literature is large.

Specification testing

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Specification testing

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- The econometric specification testing literature is large.
- But "endogenous data" generated from beliefs-outcomes feedback makes application of statistical theory problematic.

Specification testing

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- The econometric specification testing literature is large.
- But "endogenous data" generated from beliefs-outcomes feedback makes application of statistical theory problematic.
- Dominant recursive learning model has smallest asymptotic rejection probability.

Specification testing

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- The econometric specification testing literature is large.
- But "endogenous data" generated from beliefs-outcomes feedback makes application of statistical theory problematic.
- *Dominant recursive learning model* has smallest asymptotic rejection probability.
- Main result: The authors provide conditions under which validation dynamics converge to the dominant recursive learning model, which the agent then uses almost always.

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• Any assignment of the perceived law of motion (PLM) will affect system dynamics.

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- Tradition: endow agents with a (locally) correctly specified, linear representation of the REE. It may not be unique.

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- Each model may induce a self-confirming equilibrium.

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Nature of the validation dynamics

• An agent retains the current model unless it is rejected by an appropriate test.



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- An agent retains the current model unless it is rejected by an appropriate test.
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- There is no 'averaging' across models weighted by measures of fit—instead there is classical rejection and adherence to a new model.

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 - Facilitates regime-switching type outcomes?

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 - Facilitates regime-switching type outcomes?
 - Maybe not: new model may not be very different from old model.
- Asynchronous updating (p. 12). Agent may be unaware that an alternative model is better until rejection of current model occurs.

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• Expectational stability may fail to hold for some misspecified PLMs.

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- Expectational stability may fail to hold for some misspecified PLMs.
- The best fit model at *t* may be one which, if employed, generates expectational instability. This model would presumably eventually be rejected under the conditions of the theorem.

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- The best fit model at t may be one which, if employed, generates expectational instability. This model would presumably eventually be rejected under the conditions of the theorem.
- Subsequent attempts to fit the resulting data with other models would be problematic.
- A general difficulty for validation dynamics is that models are being fit to data generated by other models. A policymaker that is learning would know this.

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• The ambitious goals reminiscent of economic applications of classifier systems and genetic algorithm learning from the artificial intelligence literature:

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 - Many possible models in play.

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- The ambitious goals reminiscent of economic applications of classifier systems and genetic algorithm learning from the artificial intelligence literature:
 - Many possible models in play.
 - Agents make decisions based on their currently favored model

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- The ambitious goals reminiscent of economic applications of classifier systems and genetic algorithm learning from the artificial intelligence literature:
 - Many possible models in play.
 - Agents make decisions based on their currently favored model
 - Heterogeneity among models in use.

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 - New models can be created via genetic operators.

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 - Evolutionary selection pressure keeps better models in population.
 - Population of models can eventually become homogeneous and consistent with an SCE.
- Literature is simulation-based.

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• Fitness criterion in AI approach plays role of KLIC. AIC has interesting feature, fit versus parsimony.

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• parsimony mitigates overfit

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- Initial set of models important.

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 - Al approach conceives of evolving sets of models.

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 - Validation approach requires good models to be in the initial set.

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- Initial set of models important.
 - Al approach conceives of evolving sets of models.
 - Validation approach requires good models to be in the initial set.
- Evolutionary dynamic not part of the story here.

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- Cogley-Sargent (2004) story about Samuelson-Solow vs. Lucas-Sargent. The decision-maker downweights the evidence because of the economic consequences of choosing the wrong model.

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Statistical versus economic selection

- Authors use a statistically-based concept for model selection.
- Natural part of the attempt to get econometricians into the model.
- Utility-based criteria? Good fit may not imply good decision-making.
- Cogley-Sargent (2004) story about Samuelson-Solow vs. Lucas-Sargent. The decision-maker downweights the evidence because of the economic consequences of choosing the wrong model.
- Kocherlakota (2006): better fit not the same as better model.

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• Model k remains the model of choice for an extended period.

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- Model k remains the model of choice for an extended period.
- What economic advantage does the agent gain from resistence to switching models?

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- Model k remains the model of choice for an extended period.
- What economic advantage does the agent gain from resistence to switching models?
- Why not simply adopt today's best model?

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$$H_{1}(\beta_{1}) = \left(\frac{2(1-\alpha)}{\eta\Sigma_{1}(\bar{\beta}_{1})}\right) \left(\beta_{1}-\bar{\beta}_{1}\right)^{2}$$
(1)
$$H_{2}(\beta_{2}) = \left(\frac{2(1-\alpha)}{\eta\Sigma_{2}(\bar{\beta}_{2})}\right) \left(\beta_{2}-\bar{\beta}_{2}\right)^{2}$$
(2)

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 Dominant recursive learning model is the alternative with smaller Σ_i. It fits better.

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- Dominant recursive learning model is the alternative with smaller Σ_i. It fits better.
- But this may not be the better restricted perceptions equilibrium for household allocations.

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- Dominant recursive learning model is the alternative with smaller Σ_i. It fits better.
- But this may not be the better restricted perceptions equilibrium for household allocations.
- The agent may prefer to use an alternative model, experience the RPE associated with that model, and adopt that.

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• Parsimony favors the static reference model. Switch to it near the SCE.

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- Parsimony favors the static reference model. Switch to it near the SCE.
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- Parsimony favors the static reference model. Switch to it near the SCE.
- Dynamic model superior outside the SCE, which is most of the time.
- The switch to the static model is reminiscent of Brock and Hommes (1997).
- Parsimony a key ingredient in this story. Something to hang our hats on?



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• A fascinating paper.

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- A fascinating paper.
- Authors make some progress on the analytics of validation dynamics.



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Conclusions

- A fascinating paper.
- Authors make some progress on the analytics of validation dynamics.
- Realism is compelling, but raises lots of questions.
- 'Minimal deviation from rational expectations' has been a valuable feature of the recursive learning literature.

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Conclusions

- A fascinating paper.
- Authors make some progress on the analytics of validation dynamics.
- Realism is compelling, but raises lots of questions.
- 'Minimal deviation from rational expectations' has been a valuable feature of the recursive learning literature.
- Doing more than a 'minimal deviation from rational expectations'?