Discussion of Stock and Watson, “Has Inflation Become Harder to Forecast?”

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Northwestern University and NBER
QEPD Conference, Fed BOG,
Washington, September 30, 2005
A Paper that Tackles Forecasting Opens Up Many New Issues

A Basic Distinction between:
- A macro variable explained *ex post* over some historical interval
- Versus Forecasting, with no advance knowledge of coefficients or values of explanatory variables

Key differences in forecasting
- Must estimate “rolling coefficients”
- Any right-hand variables in the forecast equations must themselves be forecast
We Can Learn from both Ex-post Historical Econometrics and Pure Forecasting

- S-W have done both. What about S-W on history?
  - With Staiger, their 1997 JEP paper used the “triangle model”
- Here, they throw out their own past analysis of history and start from scratch
- An unanswered puzzle in their paper is the “permanent stochastic trend” component of inflation
- The answer was already provided by the triangle model in 1980, and in their own 1997 and 2001 papers, but here they pretend they don’t have a clue
S-W’s Paper is not an Easy Read

- Let’s Count the Acronyms
- Reader already knows: CPI GDP PCE VAR
- Reader is expected to keep track of
  - ADF ADL AO AR AR(AIC) IMA MA MCMC MSE MSFE NAIRU PCED PC PC-Δu QLR RMSFE UC-SV
- “Pseudo” out of sample (what’s “pseudo” about it?)
- Paper has no discussion of real-time data
  - PHL and STL Feds
Plan of This Comment

- What we know from historical analysis that might be useful for forecasting
- Exposition of triangle model
  - Theory, textbooks, econometrics
  - Peel the onion of the SSR as we transition from A-O’s AR model to the full triangle model
  - Interplay of long lags and supply shocks
What We Learn from S-W’s Forecasting Tests

- Econometric AR’s are competitive with the rectangular distribution of the univariate A-O model

- What about multivariate models?
  - The triangle model is not tested
  - What they call testing “multivariate models” is nothing more than seeing if alternative activity variables improve univariate forecasts, and their answer is “no”
  - There is no mention of Supply Shocks
What this Comment will Show

- The Triangle Model Outperforms A-O and S-W’s univariate forecasts
- The Margin of Superiority of the Triangle Model over A-O and S-W increases, the longer ahead is the time horizon
- Using a model with long lags, an unemployment gap, and supply shocks beats univariate forecasts, especially at the 8 quarter horizon
The Triangle Model: Merges the NRH Phillips Curve with Inertia and Supply Shocks

- Theory? Gordon (1975) and Phelps (1978)
  - Relative price increase of an important price-inelastic product requires an increase in expenditure share (i.e., on oil)
  - Key condition: A wedge must open up between nominal GDP growth and nominal wage growth to make room for this increased expenditure share (i.e., on oil)

- One Extreme: Flexible nominal wage decline could eliminate any problem

- Other Extreme: Sticky nominal wage growth requires a decline in real nonoil output to reduce the expenditure share of nonoil sector
  - “Inflation Creates Recession” (NYT 1974)
The Textbooks

- The diagram: inflation on the vertical, output gap on the horizontal
  - Short-run Phillips curve slopes up, and is shifted around by both adaptive expectations and by the oil shock
  - Joined with a negative 45 degree line, the “DG” curve, the demand-growth curve dependent on nominal GDP

- With constant nominal GDP growth, a supply shock slides the economy northwest along the DG curve

- Invented by Rudi Dornbusch in a classroom handout in April, 1975
  - Introduced in two textbooks, Dornbusch-Fischer (1978) and Gordon (1978)
The Econometric Model was put into its current form in 1980

The “triangle model” of inflation dynamics

\[ p_t = a(L)p_{t-1} + b(L)D_t + c(L)z_t + e_t \]

- \( D \) is demand (output or unemployment gap), \( z \) is supply shocks, \( e \) i.i.d error
- Restrict sum of LDV to unity, \( D^N_t \) is natural rate – implies constant inflation
- \( D_t, Z_t \) variables defined relative to zero

Supply shocks in today’s tests are food-energy, imports, Nixon control dummies (“on” and “off”)
Allowing the NAIRU to Vary

- The Kalman smoother:

\[ p_t = a(L)p_{t-1} + b(L)(U_t - U^N_t) + c(L)z_t + e_t \]

\[ U^N_t = U^N_{t-1} + \nu_t, \ E(\nu_t) = 0, \ \text{var}(\nu_t) = \sigma^2 \]

- SSW implemented this in JEP 1997 using the Gordon “triangle model” and Gordon adopted the SSW innovation simultaneously, a true “merger”

- What the TV-NAIRU looks like now compared to 1998
The “Unexplained Permanent Component”
#1 Big Question: Why did the “Permanent Stochastic Trend Component” of Inflation rise 1972-83 and then fall?

#2 Big Question: Why is their version of the TV-NAIRU so low in the 1960s and so high in 1978-83?

Triangle Model Answers both Questions
Post-Sample Dynamic Simulations
(this is Figure 6 in BPEA paper)
## Historical Analysis, SSRs and U Coefficients, 1962:Q1 to 2004:Q4

<table>
<thead>
<tr>
<th>Model</th>
<th>SSR</th>
<th>U Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-O</td>
<td>237.2</td>
<td>-0.53</td>
</tr>
<tr>
<td>AR(4)</td>
<td>235.4</td>
<td>-0.89</td>
</tr>
<tr>
<td>16 lags</td>
<td>257.0</td>
<td>-0.91</td>
</tr>
<tr>
<td>Add U</td>
<td>204.1</td>
<td>-0.53</td>
</tr>
<tr>
<td>Add TVN</td>
<td>166.3</td>
<td>-0.89</td>
</tr>
<tr>
<td>Nixon/off</td>
<td>158.6</td>
<td>-0.91</td>
</tr>
<tr>
<td>Food-energy</td>
<td>74.7</td>
<td>-0.59</td>
</tr>
<tr>
<td>Imports</td>
<td>70.1</td>
<td>-0.63</td>
</tr>
</tbody>
</table>
Interplay Between Supply Shocks and Long Lags on LDV

- U4 no SS LDV 1-4  233.9  -0.23
- U4 no SS LDV 1-16  222.5  -0.52
- U4 with SS LDV 1-4  81.4  -0.32
- U4 with SS LDV 1-16  70.1  -0.63

- Substitute S-W current treatment of TV-N
- U4 with SS LDV 1-16  87.4  -0.65
That’s Enough about History, Now It’s Time for a Forecasting Contest

- Aim is to compare A-O, SW AR(8), and the Triangle Model

- Method for Triangle Model
  - Instead of eliminating zero-lag variables from triangle model, each RHS variable is forecast using a AR(8) rolling forecast
  - Rolling coefficients. Consider a 4q forecast for 1990:Q4
    - Coeffs in triangle equation estimated thru 1989:Q4
    - TV-NAIRU estimated thru 1989:Q4
    - Coeffs in AR(8) for RHS variables also thru 89:Q4
    - Values of RHS variables use these 89:Q4 coefficients iteratively to forecast 90:Q4 values

- 4Q Forecasts start in 1977:Q1 (My 1977 BPEA Paper), 8Q Forecasts start in 1978:Q1
Contest for the 4-quarter-ahead Forecasts (Cumulative Sq Errors)
Contest for the 8-quarter-ahead forecasts
Summary Statistics of the Contest between AO, AR(8), and Triangle

- **Four-quarter-ahead RMSE**
  - 1977-2004: AO 1.54, AR(8) 1.45, TR 1.27
  - 1977-1989: AO 2.05, AR(8) 1.77, TR 1.47
  - 1990-2004: AO 1.08, AR(8) 1.18, TR 1.11

- **Eight-quarter-ahead RMSE**
  - 1977-2004: AR(8) 2.17, TR 1.32
  - 1977-1989: AR(8) 3.03, TR 1.58
  - 1990-2004: AR(8) 1.30, TR 1.11
Conclusions, #1

- In historical mode, the “triangle model” invented in 1980 is strongly supported in many dimensions
  - Survives sample split (1962-83 vs. 1984-2005)
  - No variable has a significant shift pre-post 1984 except for FAE. The slope of the PC is stable
Conclusions, #2

- Can we learn from historical econometric equations as we attempt to forecast?
  - S-W emphatically say "no"! We must reject all knowledge gained from three decades of research on inflation dynamics.

- But the triangle model can be used for forecasting
  - Forecast the RHS variables by AR(8)
  - Triangle model has RMSE's in rolling forecasts 1977-2004 that are 12% lower for q4 forecasts but 40 percent lower for q8 forecasts (48% lower for 1977-89)

- Concluding suggestion: Future papers both on forecasting and on counterfactual history should start from the triangle model as a baseline, not from univariate autoregressions that leave most of the interesting questions unanswered.