“From Many Series, One Cycle: Improved Estimates of the Business Cycle from a Multivariate Unobserved Components Model”
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Summary

- Carefully specified state-space model of the joint dynamics of a few output and labor-market series, and an inflation measure

- A few “cointegrating relationships”, coupled with a “common-cycle restriction”

- Incorporation of knowledge about methodology for data construction

- Estimate of the “common cycle” component, and of policy-relevant trends
A little detail

- \( X_{it} = \lambda_i(L)\text{cyc}_t + X_{it}^* + (B_i Z_t + A_i(L) X_{it-1}) + u_{it} \)

- \( \text{cyc}_t = \rho_1 \text{cyc}_{t-1} + \rho_2 \text{cyc}_{t-2} + \eta_t \): common cycle

- \( X_{it}^* \): stochastic trends (some of them common to pairs of series)

- \( u_{it} \): idiosyncratic residuals; some cross-correlation, but \( u_{it} \perp \eta_t \)

- \( Z_t \): regressors
A little more detail

- $X_{it}$:
  - GDP, GDI (per capita)
  - NFBP, NFBI (per capita)
  - NFB sector employment (per capita)
  - NFB sector workweek; labor-force participation rate; employment rate
  - Core CPI inflation

- Sample: 1963:Q2 to 2011:Q1

- Maximum likelihood estimation
Account for influence of federal and state emergency and extended benefits (EEB) programs on the unemployment rate and labor force participation. Hypothesize that EEB programs may have a first-order effect on the latter, but not on employment (EEB programs typically are available only during periods of unusual weakness in labor demand). Impose the restriction that EEB programs enter $ER$ and $LP$ equations with coefficients that are equal but of opposite sign.
Data knowledge, ...

- Data knowledge

\[ u_{1t} = \sigma u_{3t} + \xi_{1t} \]
\[ u_{2t} = \sigma u_{4t} + \xi_{1t} \]

Only one idiosyncratic error for both GDP and GDI ($\xi_1$) because in the national accounts data, the discrepancy between nonfarm business output and overall output is measured only on the income side.
And "tricks"

- “Tricks”

\[
DCPIX_t = A(L)DCPIX_{t-1} + \beta_{11}(L)drpe_{t-1} \\
+ \beta_{12}(L) * d85_t * drpe_{t-1} + \beta_2(L)drpi_t + ...
\]

Ten lags of core inflation

\[ A(1) = 1 \text{ (first coefficient freely estimated; remaining coefficients constrained to be the same)} \]

Relative price of energy enters with a six-quarter moving average

Handle changing effects of energy and import prices by weighting them by their nominal expenditure shares
2. How do the labor market and inflation respond to the cycle in the model?

3. What are the model’s estimates of output measurement error and how do they affect our assessment the cycle in the recent period?

4. What are the model’s implications for movements in trends?

2.1—Model estimate of the cycle

Figure 1 presents the (two-sided) estimate of the cycle along with a 90 percent confidence interval and recession shading. As we discussed above, we have normalized the model so that the cycle variable has the same interpretation as a conventional output gap. Our estimate of the output gap typically falls sharply during NBER-dated recessions, after topping out within a couple of quarters of the NBER-dated peak. Consistent with the conventional view, the recessions of the mid-1970s and early 1980s were particularly deep, while the 1990-91 and 2001 recessions were relatively shallow, with the cyclical component dropping by only a few percent below its long-run value of zero. In the recent crisis, this gap estimate moved down sharply from 1 percent at the NBER peak in 2007:Q4 to -7 percent in 2009:Q3. The degree of slack at the trough was somewhat less.
Results

- Focus on Phillips curve

- Challenge: given “PC” view of inflation dynamics, reconcile estimates of very negative output gaps with the fact that inflation hasn’t fallen by much

- Backward-looking Phillips curve
The results of the Section 3 suggest that the Phillips curve makes a substantial contribution to the estimation of the cycle. Nonetheless, the well-known instabilities associated with the Phillips curve may raise concerns that including it may lead to misleading signals and biased results. We therefore consider results from a model that does not include a Phillips curve.

The parameter point estimates from the no-Phillips-curve (NPC) model are very similar to those for the baseline model and therefore not shown. This model does, however, have different implications for the estimates of the latent variables. Figure 7 presents the estimate of the cycle from the no-Phillips-curve (NPC) model along with a 90 percent confidence interval and the baseline-model estimate. The confidence interval around the NPC estimate is 87 percent wider than that around the baseline model, consistent with the earlier finding that the Phillips curve is quite helpful in identifying the cycle. The NPC cycle is broadly similar to the baseline estimate. There are, nonetheless, some notable differences, especially in the latter part of the sample. In particular, since the mid-1990s, the average level of the cycle has been notably higher in the model without the Phillips curve.
Alternative PC

- Estimate of the output gap based on PC model in which long-term expectations matter (Carvalho, Eusepi, Moench 2011, wip)

- “NKPC” with arbitrary expectations, as in Preston (2005):

\[
\pi_t = \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha \beta)^{T-t} \left[ \kappa (y_T - y^n_T) + \beta (1 - \alpha) \pi_{T+1} \right],
\]

rewrite as

\[
\pi_t = \kappa \frac{1}{1 - \alpha \beta} (y_t - y^n_t) + \frac{\alpha \beta}{1 - \alpha \beta} \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha \beta)^{T-t} \left( \Delta y_{T+1} - \Delta y^n_{T+1} \right) + \\
\mathbb{E}_t \sum_{T=t}^{\infty} (\alpha \beta)^{T-t} \beta (1 - \alpha) \pi_{T+1},
\]
Alternate PC - 2

- Specify empirical (shifting endpoints) model for expectation formation, as in Kozicki and Tinsley (2006)

- Estimate with term structure of survey forecasts of inflation and output growth

- Use it to construct measures of

\[ \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha \beta)^{T-t} \Delta y_{T+1} \text{ and } \mathbb{E}_t \sum_{T=t}^{\infty} (\alpha \beta)^{T-t} \beta (1 - \alpha) \pi_{T+1} \]

- Assume univariate process for \( y_n^t \)

- Backout estimate of \( y_t - y_n^t \)
Figure 1: Model Estimate of Cycle

Shading indicates NBER recessions.
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