Comments on James Morley's paper

Jun Il Kim[1]

Measuring or estimating economic slack has long been a challenge to central bank research and policymaking, particularly after a major economic event such as a financial crisis that might also affect the trend at which the economy normally expands. While it is still debatable which measure would best capture economic slack in conceptual terms, the output gap has been widely used by many. In this light, the paper by Prof. Morley is a good contribution not only to the current literature on the business cycle and monetary policy but also to practical policymaking in central banks. I believe it offers particularly useful information to some Asian central banks which, for various reasons, including data collection problems, can afford only a limited array of reliable cyclical indicators for their conduct of monetary policy.

Summary of the paper

The paper by Prof. Morley argues for a forecast-based model-averaged output gap (MAOG) as a better measure of output gap than others that can be obtained from a class of univariate models – both linear and nonlinear models. Moreover, in contrast to the Phillips curve-based framework for forecasting inflation (Liu and Rudebusch 2010, Stock and Watson 2009), the MAOG is estimated without imposing a Phillips curve (PC) relationship *a priori* so that it avoids the distortion that can arise from "assuming the answer". For the US data, the MAOG appears to perform better than other estimates of output gap from univariate models in the sense that it is more consistent with the (possibly convex) Phillips curve relationship, produces higher correlations of the expected sign with other key cyclical indicators (eg unemployment rate, capacity utilisation rate), and also theoretically correct correlations with future growth. When applied to the sample of 12 economies in Asia and the Pacific, the MAOG continues to show broadly desirable features as a measure of economic slack, although the results are not as strong as in the case of the US.

General comments

First, it is less obvious what criteria can or should be used to evaluate the relative performance of the MAOG over other estimates of the output gap given that the output gap is simply unobservable. A more stable PC relationship or higher correlations with observable business cycle indicators would in and of itself be a desirable feature from the macroeconomic point of view, but may fall short of being a useful criterion to evaluate the statistical performance or policy relevance of the

[1] Deputy Governor, Bank of Korea.

estimated output gap. If the PC relationship changes over time as noted in the paper, a stable and positive output gap-inflation relationship would not necessarily render support for the MAOG. What if an estimate of the output gap is almost perfectly correlated with the unemployment rate? Many central banks would not sweat to estimate the output gap but instead look at the unemployment rate since the cost of ignoring the output gap would be small. Moreover, in many emerging economies in Asia and the Pacific (and also in other regions), there is no guarantee that the unemployment rate or the capacity utilisation rate is a more reliable business cycle indicator than real GDP. For these reasons, additional criteria are to be used. For example, one may examine how troughs and peaks of the MAOG and other estimates are related to specific economic events or episodes of monetary and/or fiscal policy changes, financial crisis, external shocks such as oil shocks, and so on. Such efforts would also help central banks to seek economic identification of the impact of macroeconomic policies on the business cycle.

Second, the paper would benefit if it further elaborated on the apparent asymmetry in MAOGs – particularly the seemingly negative sample mean of the MAOGs – which makes their economic interpretation somewhat difficult. If the output gap is a deviation from a trend, it should naturally have zero mean so that real GDP is as close to its trend as possible in the long run. If the output gap is negative on average (which seems to be the case for many economies in the sample, as shown in Figures 7 and 8 in the paper), then the trend around which the output gap fluctuates would no longer be considered a good representation of real GDP in the long run. On the technical level, the source of asymmetry in the MAOG is obviously nonlinear models – particularly those with bounce-back (BB) specifications – that are used in model averaging (note that the model averaging used equal weight between linear and nonlinear models). I wonder if such asymmetry with negative mean implies that higher-than-average growth over the expansion phase is largely driven by innovations in the trend. I also wonder if it would be possible to model the business cycle component as an asymmetric but mean-zero stochastic process.

Third (and related to the second), the MAOG estimates presented in the paper suggest that business cycles should have far greater welfare implications than one may think. A sharp fall in output for one or two years (as large as a 3 percent fall) during recessions with limited upside potential during normal or expansion periods would reduce welfare by a significant amount and may call for substantial precautionary saving by households.

Fourth, the estimated MAOG for the US which allows the structural break in the estimation (as shown in Figure 7) indicates that the depth of the Great Recession that followed the collapse of Lehman Brothers is less severe than previous recessions in the mid-1970s and the early 1980s, which is somewhat counterintuitive. By contrast, the MAOG with no structural breaks allowed suggests that the Great Recession is the most severe one in the post-war period. For Korea, the MAOG suggests that the 1980 recession was the most severe one and also significantly more severe than the 1998 recession that followed the financial crisis.

Finally, the results of the pairwise Granger-causality test for Asia and the Pacific seem counterintuitive in many cases. For instance, the output gaps of Indonesia, India and, to a lesser degree, Singapore turn out to Granger-cause Korea's output gap. This may well be explained by the fact that one-quarter of Korea's exports goes to the ASEAN market. But it is hard to explain that the output gaps of China, the US, and Japan do not cause Korea's despite high trade and financial linkages among the

four countries. To be sure, China accounts for one-quarter of Korea's exports and the US and Japan together account for about 20 percent.

Minor and technical comments

- *Sensitivity to structural breaks*: MAOGs for the US appear sensitive to whether structural breaks are allowed in the estimation or not, as shown in Figure 5 (perhaps both MAOGs in Figure 5 are sensitive to the end-point problem). Estimated structural breaks shown in Table 1 seem to be too few for the Asian economies that have not only registered high growth for decades but also undergone rapid transformation of the economic structure. For instance, Table 1 shows only one structural break for Korea at 1997Q2, which is near the Asian crisis. It is odd that no structural break was found for Thailand and the Philippines in 1997. Several event studies suggest more structural breaks for Korea, including 1980 and 1989. In light of the sensitivity observed for the US data, including more structural breaks may change the shape of MAOGs for the Asian economies.
- *Equal weighting versus Bayesian averaging*: The paper used equal weighting in model averaging for good reasons (Timmermann 2006). For a robustness check, it might nevertheless be useful to try alternative and equally simple weighting schemes. The computational cost would be quite high for full Bayesian averaging when applied to a large number of countries. As a low-cost alternative, for instance, one might attempt to use a simpler form of Bayesian averaging whereby the (inverse of) RMSEs of underlying univariate models are used as a weight in model averaging.
- *Granger-causality test versus factor analysis*: Trade and financial integration over the past several decades has increased interconnectedness among economies in Asia and the Pacific and also between major and emerging economies in the region. Against this backdrop, the results of the pairwise Granger-causality test could be usefully complemented by a principle component analysis or more generally a factor analysis. The share of the first principle component or a common factor in the total variation of MAOGs of the sample economies would convey useful information on the degree of interconnectedness or co-movement in Asia and the Pacific. One might also compare the common factor with the MAOG of the US to check any spillovers from the US to the region.
- *Convex Phillips curves*: The paper presents evidence of a convex PC relationship for the US and a few countries in Asia and the Pacific, including Korea (Figures 5 and 6). Such evidence, albeit limited to a small number of economies in the sample, is broadly in line with the findings of Barnes and Olivei (2003) and Peach et al. (2011), among others. But it could possibly be an artifact, for two reasons. First, the scatterplots span the long period of time (four decades or longer) during which the PC relationship could have changed significantly. The apparent convexity (and even lack of it in many other economies in the sample) may in fact be an illusion arising from multiple linear PCs of different slope plotted on the same space. As a check, PCs might be plotted for selected subsample periods. Second, asymmetric MAOGs with negative mean may create or accentuate convexity. Note that convexity derives mostly from the steep (almost vertical) portion of the PCs associated with small positive MAOGs.

As such, even moderate increases in inflation, if plotted against small positive output gaps, are likely to produce convexity.

Concluding remarks

The paper by Prof. Morley offers a very useful empirical technique to estimate the output gap with improved statistical and economic properties. The technique could be particularly useful to emerging market central banks that can afford only a limited array of business cycle indicators in their conduct of monetary policy. As always and for practical purposes, however, central banks may complement the suggested MAOGs with other available (and more conventional) estimates of the output gap.

References

Barnes, M. and G. Olivei, 2003. "Inside and Outside Bounds: Threshold Estimates of the Phillips Curve." Federal Reserve Bank of Boston, *New England Economic Review*, 3–18.

Liu, Z. and G. Rudebusch, 2010. "Inflation: Mind the Gap." Federal Reserve Bank of San Francisco, *Economic Letter*, No. 2010–02.

Peach, R., R. Rich and A. Cororaton, 2011. "How does slack influence inflation?" Federal Reserve Bank of New York, *Current Issues in Economics and Finance*, 17(3).

Stock, J. and M. Watson, 2009. "Phillips Curve Inflation Forecasts." in *Understanding Inflation and the Implications for Monetary Policy: A Phillips Curve Retrospective*, Proceedings of the Federal Reserve Bank of Boston's 2008 economic conference.

Timmermann, A., 2006. "Forecast Combinations." *Handbook of Economic Forecasting*, G. Elliott, C. Granger and A. Timmermann eds., Elsevier.