Discussion of "Trend Inflation in Advanced Economies"

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1. Introduction

Garnier, Mertens, and Nelson (this issue, GMN hereafter) conduct model-based trend/cycle decomposition of inflation for fourteen advanced economies since 1960. To do so, they develop a multivariate unobserved components (UC) model of inflation that assumes a common stochastic trend for three different measures of inflation based on headline CPI, core CPI, and the GDP deflator. As in many previous studies, the model also allows for stochastic volatility in the underlying shocks driving inflation. Estimation using Bayesian methods is conducted on a country-by-country basis, with certain historical shifts in each country's price level that are due to non-market factors (e.g., price controls and large changes in indirect taxes) taken into account.

GMN find that the estimates of trend inflation for their multivariate UC model are smoother and more robust to controlling for price shifts than estimates based on a univariate UC model along the lines of what has been previously applied to inflation for G7 countries by Cecchetti et al. (2007). However, despite the relative smoothness of the multivariate estimates, trend inflation is clearly still the primary driving force behind the behavior of inflation over the past fifty years. In particular, mirroring the pattern for measured inflation in all fourteen advanced economies, trend inflation was high and volatile in the 1970s and lower and more stable in recent years.

Reflecting the importance of trend inflation, GMN find that quasi-real-time estimates of trend based on their model provide reasonably good out-of-sample point forecasts of headline CPI inflation, regardless of forecast horizon. Notably, these forecasts are generally more accurate than random-walk benchmarks or forecasts based on the univariate UC model, although not always significantly so

according to Diebold-Mariano (1995) tests. Density forecasts are also generally more accurate for the multivariate UC model than for the univariate UC model and often significantly so.

GMN consider the role of formal inflation targets in anchoring trend inflation by also estimating a modified version of their multivariate UC model that sets trend inflation to an explicit objective when one is available (e.g., the midpoint of an official target range for CPI inflation). In several instances—especially for Australia, Canada, Germany, New Zealand, and Sweden—the point and density forecasts are significantly improved by setting the trend in this way.

The main contribution of GMN is to develop a very flexible time-series model of inflation that, based on the forecast evaluation, appears to provide more accurate estimates of trend inflation than other approaches. Notably, the multivariate UC model's flexibility makes it readily applicable to inflation data for many different economies, including in terms of being able to handle missing observations and, as mentioned above, in producing more robust estimates in the presence of discrete price shifts.

The remainder of my discussion focuses on how, in addition to providing more accurate estimates of trend inflation for advanced economies, GMN also shed partial light on two challenging and potentially related questions that are of utmost importance to macroeconomists: Why has trend inflation changed? Why has inflation become less persistent? However, I conclude that these questions remain largely unresolved and suggest possible modifications to GMN's approach that might help address these questions in future research.

2. Why Has Trend Inflation Changed?

Estimates for GMN's main model are consistent with the idea that changes in monetary policy practices are responsible for the big swings in the level and volatility of trend inflation over the past fifty years. However, this is just an ex post interpretation of the results based on the broad timing of the estimates, including a general rise in the level and volatility of trend inflation around the collapse of the Bretton Woods system in the early 1970s and a general fall and stabilization of trend inflation during Paul Volcker's chairmanship of

the Federal Reserve in the early 1980s and continuing with the adoption of formal inflation targeting in several countries from the early 1990s and on. As far as the model is concerned, though, the trend is assumed to be exogenous, meaning that the model itself provides no direct insights into the sources of changes in trend inflation.

The modified version of GMN's model that sets trend inflation to an explicit objective when one is available goes some way towards addressing this exogeneity issue, and the strong performance of this modified model in the forecast evaluation provides reasonably compelling support, beyond just a broad sense of timing, for the idea that monetary policy practices have helped determine trend inflation. However, there remains a question, unanswered by the model at least, of what exactly led to the increase in trend inflation in the 1970s. Also, what was it about the specific conduct of monetary policy under inflation targeting that appears to have stabilized trend inflation?

As a robustness check, GMN follow Kang, Kim, and Morley (2009) and allow for correlation between the inflation gap (i.e., the deviation of measured inflation from trend inflation) and changes in trend inflation in another modified version of their model. This alternative specification nests the accelerationist view that shocks to the inflation gap (e.g., aggregate demand and cost-push shocks) can also impact the level of trend inflation—i.e., trend inflation is endogenous with respect to these shocks. However, GMN find that, for most countries at least, estimates of trend inflation are very similar to what they were for their main model, presumably reflecting relatively little correlation between the inflation gap and changes in trend (although these estimates are not reported). Thus, there appears to be empirical support for the assumption in the main model that trend inflation is exogenous with respect to the shocks driving the inflation gap.

But ruling out certain shocks, while better than nothing, does little to answer what other factors might be important in driving trend inflation. One interesting possibility would be to explicitly consider whether changes in the systematic behavior of monetary policy in terms of setting a policy interest rate (e.g., the intercept in a Taylor-rule characterization of policy) can be related to changes in trend inflation. Or, assuming that adjusting money growth is really the only way monetary policy can determine trend inflation when a

Fisher relationship holds for interest rates in the long run (see Nelson 2008 on this point), it would be useful to check whether changes in money growth (somehow correctly measured) can be related to changes in trend inflation.

3. Why Has Inflation Become Less Persistent?

The changes in the relative variances of the underlying shocks driving inflation can explain why inflation in advanced economies appears to be less persistent in recent years (see Cecchetti et al. 2007, and Stock and Watson 2007). In particular, a decrease in the signal-to-noise ratio for inflation (i.e., when trend variability falls by more than inflation-gap variability) implies less visible persistence in inflation or, more formally, less persistence as measured by impulse response functions for forecast errors, as in Kang, Kim, and Morley (2009).

However, because GMN's main model assumes time-invariant VAR dynamics for deviations from trend over the whole sample period, it effectively only allows for this "changing signal-to-noise ratio" explanation for the change in inflation persistence. Fortunately, GMN also consider the robustness of their results using another modified version of their model that allows for time variation in the VAR dynamics. Although they find some changes in the persistence of the deviations from trend, as measured by the largest eigenvalue for the companion matrix of the VAR process, there is little impact on the estimates of trend inflation. Thus, the "changing signal-to-noise ratio" explanation for changing persistence appears to be empirically relevant, rather than just being assumed.

At the same time, according to the estimates for the modified version of the model with time variation in the VAR dynamics, the persistence of the deviations from trend has changed over time, begging the question of why. In Morley, Piger, and Rasche (2015), we consider this question when applying a bivariate UC model of inflation and the unemployment rate to data for G7 countries on a country-by-country basis. We find that the impact of the unemployment gap on the inflation gap has been relatively stable for most of the G7 countries over time, but the variance of the residual component of the inflation gap, which turns out to be highly correlated with the food and energy component of headline CPI inflation, has

changed substantially. Because the unemployment gap is more persistent than the residual component, the overall persistence of the inflation gap has correspondingly changed over time. It would be useful to have a version of GMN's model that separated the inflation gap into different components, as in Morley, Piger, and Rasche (2015), in order to get a better sense of why the persistence of the inflation gap and, therefore, inflation itself has changed.

4. Conclusion

Monetary policy appears to have played a role in stabilizing trend inflation in advanced economies over the past fifty years, with the superior forecasting performance of a model that takes formal inflation targets into account providing particularly strong empirical support for this idea. The stabilization of trend inflation also appears to have helped explain changes in the persistence of inflation over time. However, changes in the persistence of the inflation gap may be important too.

When analyzing the role of monetary policy in driving trend inflation, it would be useful to consider a model that allows for multiple discrete regime changes at unknown points of time, including allowing the variance of the change in trend inflation to sometimes be zero in the case of fully anchored expectations, rather than just assuming the only discrete change of this sort was with the formal introduction of inflation targeting. In Kang, Kim, and Morley (2009), we considered a univariate model of U.S. inflation that allowed for discrete regime changes and found that estimates for the timing of changes in trend volatility did, indeed, match with major changes in the practice of U.S. monetary policy. This result provides even more compelling support for the idea that monetary policy drives trend inflation than a result based on imposing a regime change corresponding to a known monetary event like the introduction of an inflation target. Meanwhile, as discussed above, it would also be useful to check whether changes in the level of trend inflation correspond to changes in monetary practices as captured by changes in the parameters of a Taylor rule or in the long-run growth rate of money.

In terms of understanding changes in inflation persistence, it would be useful to consider further multivariate analysis (beyond

multiple measures of inflation) that allows for a changing composition of shocks driving the inflation gap, as well as allowing for changes in the dynamic effects of these shocks. GMN argue against the necessity of such multivariate analysis on the basis that Stock and Watson (2009) and others have shown it is difficult to improve inflation forecasts with other information beyond inflation, including from an assumed Phillips-curve relationship. However, Stock and Watson (2010) find that an "unemployment recession gap" (which looks like a mirror image of the highly asymmetric output gap estimated in Morley and Piger 2012) helps generate at least episodic forecasting improvements over univariate forecasts of inflation. Thus, any further multivariate analysis should take non-standard measures of economic slack and/or possibly non-linear specifications for the Phillips curve into account in order to generate an improved forecasting performance.

Because trend inflation is not directly observed, finding a better measure for it is a crucial first step in understanding its role in the overall behavior of inflation. GMN make an important contribution to this effort by developing a flexible model that appears to provide accurate estimates of trend inflation in the sense that they forecast future inflation relatively well. However, more work needs to be done in future research in order to nail down the empirical sources of changes in trend inflation and inflation persistence.

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