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Understanding the Evolving Inflation Process

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I have to admit that I was apprehensive when Steve and Anil asked me to participate in this Forum and comment on a report on inflation dynamics, especially when I found out that one of the authors was going to be an old friend, Mark Watson. Mark is a pre-eminent time-series econometrician, so my first thought was that I was going to need to brush up on unit-root asymptotics. When the report arrived, however, I was pleasantly surprised to find a wide-ranging and insightful review of the historical behavior of inflation in the G-7 countries along with a thoughtful examination of alternative explanations of those dynamics. I think the Report makes a very useful contribution to applied monetary economics and illuminates well some of the key challenges in monetary policy today. The usual disclaimer applies here, however; the views I express are my own and not necessarily shared by my colleagues in the Federal Reserve System.

A glance at historical plots of G-7 inflation strongly suggests that the dynamics have changed over time in consequential ways. Section 3 of the Report provides a clear and parsimonious way of characterizing changes in the dynamic behavior of inflation. Estimating the standard time-invariant autoregressive process clearly would leave little scope for understanding how inflation dynamics might have evolved over time.

The usual method of stepping away from the standard time-invariant approach is to look for shifts from one fixed regime to another at discrete points in time. The authors set off in a different direction, however, one that allows more range of variation in the underlying dynamics and is more agnostic about the timing of transitions. They decompose inflation into a time-varying trend and a transitory component, where both components are allowed to have time-varying volatilities. The results confirm in a very precise way our general sense of what's happened with inflation over the last 40 years: There was a broad increase in trend inflation and inflation volatility in the 1970s followed by a return to more stable behavior in the decades since. The authors show that the rise and decline was sharp and synchronized across the G-7 countries. Moreover, their technique attributes much of the observed rise in inflation volatility in the 1970s to increased volatility in the inflation trend. Trend inflation, of course, is always and everywhere a monetary phenomenon, so to me these results immediately imply that the conduct of monetary policy has varied substantially over this period.

The author's careful modeling of the time series behavior of inflation is, by itself, of limited use in thinking about how alternative approaches to policy-making might alter inflation behavior. To do this, a structural model is required — that is, a model in which the parameters do not vary when one varies the conduct of monetary policy. The authors trot out a popular workhorse macroeconomic model and use it to draw some lessons from their empirical work. They do not fit the model to the full set of variables, which makes sense because the model has policy following a fixed reaction function, and their empirical analysis indicates that inflation dynamics have undergone significant shifts. Instead, they look for parameter values that allow the model to best replicate the autocorrelation of the change in inflation.

The authors' focus on the autocorrelation properties of inflation is motivated by recent research suggesting that inflation has become less persistent since the early 1980s. Some observers have suggested that the decline in measured persistence implies that inflation will moderate more rapidly in the next year or two than would otherwise be the case. The model calibrations reported here, however, demonstrate the extent to which the autocorrelation properties of inflation depend on how monetary policy is conducted. (See Figure 6.3, for example.) This implies that policymakers should be quite wary of interpreting the fall in persistence since the 1980s as something monetary policy can exploit. If persistence has declined because policy now responds more strongly to inflation, for example, achieving a more rapid moderation in inflation may require tighter policy.

The reported model calibrations strongly suggest that inflation expectations are forward-looking. What does this mean? One of the equations of the workhorse model links current inflation to a measure of real marginal cost (or real activity) and people's expectations of future inflation. This is commonly referred to as a "Phillips Curve" and it was prominently featured last month in a front-page article in the Wall Street Journal. A key question regarding the modern Phillips Curve is how people form expectations regarding future inflation. The conventional approach to this question is to assume that a fraction of prices in the economy are set by forward-looking agents that make their best current estimate of future inflation, while other prices are set based on a backward-looking moving average of recent inflation experience, and then to let the data tell you the appropriate weight to put on backward-looking price-setting. Common estimates are that around 25 percent of agents form expectations in a backward-looking fashion. The authors find that their model fits the data much better if price-setters are nearly entirely forward-looking, in the sense that the fraction of prices set by backward-looking agents must be quite low — close to zero.

By itself, this evidence might not convince a skeptic. I say that because the stylized fact they seek to match — the autocorrelation of changes in inflation, not the autocorrelation in inflation — does not strike me as a sharply-drawn fact. It's just one correlation among many in the time series, and one could expect more robust results by fitting the model to more dimensions of the

data. Fortunately, there is a burgeoning literature that does just that. A series of recent papers estimate full structural models of the type from which the reduced-form workhorse model is derived, and they consistently point to less backward-looking behavior than is found in single-equation estimates of the Phillips Curve. (Lubik and Schorfheide 2004, Rabanal and Rubio-Ramirez 2005)

While it may be too soon to declare this research issue entirely settled, my sense is that the preponderance of empirical evidence suggests that price setting is predominantly forward-looking. Why does this matter? Common implementations of models with forward-looking price setting endow people in addition with a great deal of information about prospective policy setting. The typical assumption is that people see the central bank as following a policy algorithm in which trend inflation is a fixed, time-invariant parameter. A "Taylor Rule" is a popular example in which inflation is always expected to return to a target that is widely known and constant. In contrast, I am persuaded that at times there are aspects of policy-making, including trend inflation, about which the public is uncertain. This is consistent with the main assumption underlying the authors' decomposition of inflation into trend and transitory components; namely that the conduct of monetary policy evolves over time, and that the future evolution of that conduct is, at times, subject to significant uncertainty.

The notion of uncertainty about the future conduct of monetary policy might seem strange in an era in which inflation expectations are often characterized as "anchored." But there is uncertainty and then there is uncertainty. I am fairly confident that the public places an extremely low probability on the Federal Reserve allowing inflation to average 10 percent over the next decade. (Presumably one could document this using financial market data, though I have not done so.) On the other hand, I suspect that market participants place some probability on inflation remaining at around where it is now — a 2 ¼ percent core PCE price index, for example — rather than moderating to 1 ½ percent. In that sense, one might question whether inflation expectations are anchored close enough to the price stability shore. Three-quarters of a percent might seem like a relatively small difference in inflation rates, but sustained over a decade or two, it would amount to a material difference in purchasing power.

Actual measures of inflation expectations can provide some evidence on this question. The Report examines survey and other measures of inflation expectations and shows that they do a poor job at predicting inflation trends in the period after the Inflation Moderation of the mid-1980s. Unfortunately, the market for inflation-indexed U.S. Treasury securities is not old enough to allow fruitful empirical tests using measures of the inflation compensation implied by nominal Treasury yields. Casual inspection of fluctuations in implied inflation compensation, however, suggests larger and more frequent movements in inflation expectations than displayed by survey-based measures. Moreover, the observed volatility in implied inflation compensation many years ahead seems inconsistent with a world in which the central bank's inflation objective is a fixed, time-invariant parameter.

The inability to forecast trend inflation using available measures of inflation expectations leads the authors to caution policymakers against relying too heavily on them. The Report does not say that inflation expectations are unimportant to the determination of inflation — their calibration exercise argues exactly the opposite, in fact — only that our available measures provide imperfect indicators. The stability of expectations measures, the authors argue, might mask potential instability in actual inflation expectations. With this I wholeheartedly agree; as I noted a moment ago, one can see measures of inflation expectations as in some sense "anchored" without being either satisfied with where they are anchored or sanguine about their stability.

The broader lesson to take away from this Report is that inflation dynamics have evolved significantly over the last 50 years, and inflation expectations appear to be forward-looking. To again paraphrase the late Milton Friedman, inflation is always and everywhere an expectational phenomenon. The intuition should be clear: the current value of money depends on value people expect it to have in the near future, and thus the current inflation rate depends critically on what people expect inflation to be in the near future. To put it another way, inflation expectations are an outcome of monetary policy, not an autonomous help or hindrance. Central banks are as responsible for the behavior of inflation expectations as they are for the behavior of inflation.

The relevance of these lessons is well illustrated, I believe, by recent experience. On several occasions in the last few years, market participants have shown some uncertainty about how the Fed would respond to sharply higher energy prices. For example, following the heavy hurricane season of 2005, energy prices surged, policy expectations initially softened and measures of inflation expectations rose. Shortly thereafter core inflation also increased. Expectations were subsequently realigned after a number speeches and statements by FOMC members, but similar sequences occurred in early 2004 and the spring of 2006. Now there is no intrinsic reason why energy price increases need to cause core prices to accelerate. Relative prices change all the time in a healthy dynamic economy, and price stability means that the average price level is not materially affected.

These recent examples of core inflation following movements in energy prices seem to reflect fluctuations in the public's beliefs about the current and future conduct of monetary policy, and thus about trend inflation. In a world where expectations are in play, the cost of bringing inflation down depends on one's ability to move expectations, and thus it matters a great deal whether inflation expectations are viewed as a policy outcome or an independent process. If expectations are backward-looking, policymakers naturally will be less forceful about returning inflation to a desired rate. If expectations are forward-looking, a central bank has the opportunity to move expectations in the right direction through clear communication reinforced by appropriate actions, and a more rapid return to price stability would be warranted. In my view, this Report, along with abundant other recent research in monetary economics, clearly points in the direction of forward-looking price setting. We should not, therefore, underestimate our capacity to influence the public's understanding of the conduct of policy.