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Inflation Modeling: A Policymaker's Perspective

Remarks by

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An occasion like this one is a natural opportunity to reflect on how policymakers' understanding of the inflation process has progressed over time.¹ Clearly we have come a long way since the early 1970s. Most important, we have absorbed the central lesson of Milton Friedman's 1968 address to the American Economic Association--that any tradeoff between inflation and unemployment is only temporary because of the dynamic nature of expectations. We have also taken on board the practical application of this lesson that monetary policy must be vigilant about anchoring inflation expectations. Operationally, maintaining price stability requires abiding by the Taylor principle of raising nominal interest rates more than one for one in response to movements in inflation, especially those movements perceived as persistent. It also requires that policy tighten or ease systematically to bring aggregate demand in line with the economy's productive potential, not only because output stabilization is a policy objective in its own right but also because such actions help to head off undesirable changes in inflation down the road.

These basic precepts, embraced by central bankers everywhere, have almost certainly contributed to the improved performance of inflation over the past decade or two, and this better price performance probably has helped to damp business cycles. Of course, economists and policymakers still have a great deal to learn about the interactions of monetary policy, the real economy, and inflation. But as the conference papers illustrate, we are making progress.

Still, when it comes to inflation modeling and policymaking, as my grade school report cards used to say: There is room for improvement. Specifically, I wonder whether current inflation research adequately addresses the questions that bedevil me as a policymaker. Tonight I cannot resist the opportunity presented by having access to a captive group of researchers to

¹ The views I express here are my own and not necessarily those of other members of the Federal Open Market Committee. Flint Brayton and David Reifschneider, of the Board's staff, contributed to these remarks.

share these concerns with you, with the intention of providing some constructive suggestions for future work.

What properties am I looking for in a model of inflation and the economy overall? First, the model should provide a coherent analytical framework that the policymaker can use to interpret incoming data and to choose a proper policy response. Second, the model should provide an accurate empirical description of the economy as it relates to both forecasting and the influence of policy on the outlook. My experience on the Federal Open Market Committee (FOMC) as a consumer of model-based forecasts and analysis suggests that work remains to be done on both fronts--and, in particular, on meeting both objectives with the same model.

As regards the first property, the conceptual--albeit informal--framework that many policymakers like to use is largely "bottom up" and features costs and expectations. It starts with wages and the prices of other inputs into production, and after taking into account productivity, it sees prices set as a markup over unit costs. Wage determination plays a key role in this framework and is influenced by such factors as inflation expectations, productivity, and labor market slack; the markup, too, is important because it varies over time depending on changes in the competitive environment, expected future costs, and other factors.

At first glance, the empirical structural models currently favored in academic research and discussed at this conference--such as the New Keynesian Phillips curve--appear to conform to the informal policymaker model: Expectations formation is dealt with formally, and price inflation, at least in some empirical representations, is directly tied to measures of unit labor costs. On closer inspection, however, one sees that the specifications of these models typically ignore important factors bearing on the inflation outlook.

One category of neglected factors is price shocks--changes in the levels of key inputs, such as energy or imports. Policymakers spend a great deal of time discussing the circumstances under which such shocks can lead to persistent changes in the rate of inflation. Yet, despite their historical importance for aggregate inflation, energy prices, for example, are controlled for in only one of the structural models discussed at this conference. And this importance is not necessarily a concern of the past: Prices for oil and natural gas have soared since 2003, directly boosting the energy component of the consumer price index as well as raising the production costs, and ultimately to at least some degree the prices, of non-energy goods and services. As a policymaker, I can assure you that any model of inflation that did not take account of these effects, and how they might or might not affect ongoing rates of inflation, would have been of little practical use to the FOMC over the past few years.

Reduced-form regressions suggest that the response of core inflation to energy prices has diminished over the past twenty years. Does this smaller response reflect a change in the expectations formation process that has come about because the public perceives that inflation will remain low, perhaps because the monetary authority is now seen to be more vigilant in reacting to price pressures? Or does it reflect a reduction, from the late 1970s until a couple of years ago, in the persistence of energy price movements that has prompted firms to be less worried about passing temporary cost increases onto customers? Determining which of these explanations is most important is a critical issue for monetary policy right now, when futures markets indicate that people expect the current elevated price of energy to persist.

But economists are not well positioned to provide much evidence on this issue, given the relative paucity of empirical work on expectations formation. Certainly the standard approach used to estimate structural models is not that helpful because it simply assumes an answer--

rational expectations, typically accompanied by full central bank credibility. But how well does this assumption match reality? True, financial market participants do seem to respond to incoming economic data in a generally forward-looking and logical manner, but we also observe asset price levels, volatility, and implied risk premiums that are sometimes difficult to understand. And I doubt that any central bank has achieved perfect credibility in the markets. Moreover, it is not obvious that investors' expectations always line up with those of households and firms, the ones that should matter for wage and price setting. We really know very little about the precise manner in which these agents form their beliefs about the future, in part because of a lack of comprehensive data on expectations. Nonetheless, economists are certainly grappling with this issue, as evidenced by the growing interest of late in models that incorporate rational inattention, sticky information, learning, and imperfect credibility. Behavioral economics, with its focus on how people perceive and act on information in making decisions, may also provide some insights into the modeling of expectations.

If plausible departures from rational expectations and full credibility are empirically verified, then our structural models need to take that into account. A new set of questions would then be on the table in policy analysis. Among other questions that could be addressed would be how policy actions (as opposed to inflation outcomes) influence expectations and how sensitive Federal Reserve credibility is to short-run departures from low inflation. Such knowledge would be extremely useful in current circumstances in gauging the scope for monetary policy to offset the short-run output effects of higher energy prices without triggering adverse longer-run inflation consequences.

Another area needing further attention is wage setting. My impression, reinforced by the papers at this conference, is that many of the newer empirical structural models of price inflation

posit a central role for real marginal cost but seem to have little to say about its determination or that of its main component, labor compensation. This neglect may reflect the difficulty of specifying the aggregate dynamics of an atomistic labor market characterized by pronounced heterogeneity, significant informational imperfections, and important adjustment costs. By comparison, these complications seem less severe in product markets, which for the most part are more transparent and easier to analyze. Moreover, as I will discuss in a minute, empirical work on wage determination may be especially hindered by issues of data quality.

Let me give an example of why I think it is important to have a firm grasp of how wages are set. Many economists, both inside and outside the Federal Reserve, think that the acceleration in labor productivity in the mid-1990s subsequently helped to restrain the rate of price inflation. This conclusion requires that the adjustment of nominal wages to the higher trend in productivity was slow, an outcome that put downward pressure on unit labor costs and, hence, on prices. Its consistency with the data notwithstanding, I would be more comfortable with this hypothesis if it were supported by a structural model of wage determination that was firmly grounded in theory and microevidence.

As noted earlier, the design of sound structural models is only a start. As a policymaker, I need those models to provide accurate forecasts and empirically well-grounded policy analysis. The analysis contained in the papers by Rudd and Whelen, Kiley, and Laforge are valuable first steps in comparing the empirical properties of alternative structural and reduced-form models.

Nonstructural specifications, despite their shortcomings with regard to the desirable model properties I noted earlier, do have an important role to play in policymaking--in particular, forecasting. Structural models do not as yet fully encompass the information used by reduced-form specifications, and the historical relationships summarized in these latter models have often

proven to be more useful guides to future inflation developments. Such models often include energy- and import-price terms along with measures of slack and expectations. They inform the staff's judgmental inflation forecast as well as my own thinking about the outlook.

Data measurement issues add to the challenge of developing better empirical models for policy work. One important example concerns hourly labor compensation. The measure reported in the national accounts is often revised significantly, displays substantial volatility from quarter to quarter, and has components that may not coincide with the labor costs relevant to business pricing decisions. These deficiencies, among others, also affect published estimates of labor's share in the nonfarm business sector--the usual measure of real marginal cost used in empirical work. Other measures of labor compensation, such as the employment cost index, have their own particular deficiencies and can yield conflicting signals of trends in labor costs. An unpleasant implication of these various data problems is that they may make difficult the development of structural models incorporating wage behavior that are reliable enough for policy analysis, despite their attractiveness to policymakers like me.

Of course, measurement issues do not afflict only models that exploit data on labor compensation. Many inflation models in use, both structural and reduced-form, include some measure of resource utilization as a determinant of price inflation, such as the gap between the unemployment rate and the non-accelerating inflation rate of unemployment (NAIRU). And as we know, the latter cannot be directly observed. Although economists have made some progress in estimating potential output, policymakers should be cautious about responding aggressively to estimated movements in economic slack.

Paradoxically, the ability to confirm our estimates of output relative to potential in a timely way may have been diminished by the success of the Federal Reserve and other central

banks in achieving low and stable inflation. Although controversial, some evidence from reduced-form price equations suggests that inflation has become less sensitive to economic slack in recent years, possibly as a consequence of more firmly anchored inflation expectations. Consistent with this evidence, the Board staff's rule-of-thumb estimate of the sacrifice ratio rose from around 2 or 3 in the mid-1980s to around 4 currently.² Imbalances between demand and potential supply would thus now be slow to show through convincingly to inflation, but when they do, they may be costly to correct.

The various specification and empirical issues that I have raised tonight are major challenges, and based on our experience using the FRB/US model here at the Board, they may prove quite difficult to overcome. FRB/US has many of the desirable attributes mentioned earlier. In particular, its wage and price equations are variants of the New Keynesian Phillips curve, with core specifications that are derived from cost minimization and equations that are estimated assuming rational expectations. However, in incorporating the effects of such factors as energy costs, import prices, and productivity into the model's wage-price block, the staff found it necessary to sacrifice some theoretical niceties in order to get close to the predictive accuracy provided by reduced-form models. Perhaps future researchers will be able to resolve this tension in some clever way, but some tradeoff between purity of design and forecasting accuracy probably will always be unavoidable. In addition, the staff's experience with FRB/US illustrates some of the problems inherent in using real-time wage data. Although the policy analyses generated using the model have been quite useful from my perspective, and the model has compiled a reasonable forecasting record overall, the accuracy of its price inflation forecasts has suffered from their sensitivity to current readings on labor's share.

² The sacrifice ratio is defined as the cumulative amount of unemployment greater than the NAIRU (in percentage points) required to reduce the inflation rate by 1 percentage point, all else being equal.

These remarks have presented a long list of “helpful” suggestions for future research.

You might ask: Does successful monetary policymaking really require all this additional knowledge? Do not central banks already have what they need to do a good job? If policymakers continue to recognize the critical role of long-term price stability, keep a close eye on inflation expectations, and adhere to the Taylor principle, would not things be OK, as they have been for much of the past twenty years?

This view strikes me as too complacent. Even if it is true that things tend to turn out OK on average under the present state of knowledge, macroeconomic performance could be better yet if policymakers were able to take advantage of a fuller understanding of the dynamics of the economy. And we would do well to be cautious about attributing the good macroeconomic performance entirely to good monetary policy. Decomposing the sources of the Great Moderation is a difficult business, and a number of researchers interpret the evidence as suggesting that monetary policy was *not* the most important factor. Luck as well as structural changes in the economy may have had a lot to do with the current low level and apparent stability of U.S. inflation. If so, and if our luck turns and we experience a series of adverse shocks, our ability to formulate policies that deliver sound performance may depend upon a much better understanding of the inflation process and of expectations formation.