Monetary Policy and Learning

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It is a great pleasure to attend this conference on monetary policy and learning and enjoy the many excellent papers presented here. I am very grateful for the opportunity to speak to this distinguished audience of researchers and policymakers, and I hope my remarks will stimulate some further discussion. I will talk about three things, namely, (1) good monetary policy and central-bank learning, (2) private-sector learning and central-bank transparency, and (3) modeling good monetary policy.

Good Monetary Policy and Central-Bank Learning

In talking about good monetary policy and central-bank learning, I will start by characterizing good monetary policy. Travestying Tolstoy, one could say: "Every good monetary policy is (approximately) the same, but bad monetary policies are all different." Indeed, I believe there is increasing agreement on a best-international-practice way of conducting monetary policy. Let me try to briefly outline this.

There is a clear objective for monetary policy. This objective can be described as "stabilizing inflation around a low inflation target with some concern for stabilizing output around potential output" or some variant of this. This objective is consistent with what is often called flexible inflation targeting.

To achieve this objective, the central bank relies on its view of the transmission mechanism of monetary policy—the transmission mechanism that, through several channels, links the central bank's instrument (usually a short interest rate, the *instrument rate*) and the target variables (inflation and the output gap in the above formulation of the objective for monetary policy). There is now considerable agreement among central banks on this transmission mechanism. Let me give a very stylized picture of this conventional wisdom about the transmission mechanism.

The central bank controls the instrument rate, a short interest rate. Because inflation and inflation expectations are sticky, the central bank has some control over the short real interest rate. Private-sector expectations of future short real rates affect longer real interest rates as well as other asset prices—for instance, exchange rates. Long real interest rates and various asset prices have an effect on consumption and investment and thereby affect aggregate demand.

Furthermore, private-sector inflation expectations and the output gap—the latter through its impact on production costs—affect firms' price setting and thereby inflation. Thus, central banks have some control over the output gap and inflation. However, this control is very imperfect: varying lags are present in the transmission mechanism, the strength of different channels varies, and intervening shocks occur. The mean control lag may be three to five quarters for the output gap and perhaps five to nine quarters for inflation.

In this transmission mechanism, private-sector expectations are crucial. I think it is fair to say that central banks control the output gap and inflation mostly through the private-sector expectations they give rise to. (For this reason, central bankers' obsession with "credibility" is completely rational.) For instance, the current instrument rate by itself has a minimal effect on longer interest rates and the economy; what really matters is the private-sector expectations of future instrument rates. Furthermore, inflation expectations have a major impact on actual inflation.

Let me also note that, counter to what is the case in the simple Lucas-type Phillips curve, monetary policy does not have real effects because it brings surprises. In this conventional view of the transmission mechanism, because inflation and inflation expectations are sticky, anticipated policy actions have real effects. Indeed, the more correctly anticipated the policy action, the larger the effects may be.

Central banks accumulate experience and learn from successes and mistakes. Having observed this process of learning in several good central banks, I find it a very efficient and rational process and, indeed, a very impressive one.

How does a good central bank conduct good monetary policy? It first constructs conditional forecasts—projections—of the target variables. These projections are conditional on the central bank's view of the transmission mechanism and various models used, available and relevant information about the state of the economy, forecasts of exogenous variables, alternative instrument-rate paths, and, importantly, the central bank's "judgment." All models are simple representations of a complex reality. A good central bank needs to supplement the use of models with its own judgment, which includes extra-model modifications, add factors, and so on.

The central bank's decision problem is to select an instrument-rate path and corresponding inflation and output-gap projections that "look good" and then implement that instrument-rate path. By "looking good," I mean that the inflation and output-gap projections are consistent with the objectives. That is, the inflation projection approaches the inflation target and the output-gap projection approaches zero (the output projection approaches the potential-output projection), both at an appropriate pace. The resulting inflation and output-gap projections can be seen as minimizing an intertemporal loss function over the set of feasible inflation and output-gap projections, conditional on available information.

I have previously called this procedure of finding the optimal projections *forecast targeting*. It can be seen as an operational way of solving a complex optimal-control problem. However, this problem is not solved by deriving an explicit reaction function for the instrument. Such a function would be an exceedingly complex function of all the inputs in the forecasting process, including the central bank's judgment. Fortunately, there is no need to specify this reaction function; it can remain implicit. Instead, the procedure described above results in an instrument-rate path that can be implemented as is, until the next decision point when the forecast-targeting procedure is repeated.

Suppose that the central bank's view of the transmission mechanism corresponds to linear relations between the different variables, that its objectives can be interpreted as a quadratic loss function, and that all uncertainty enters in an additive way. Then the conditions for certainty equivalence are fulfilled. In that case, only the first moments—the means—matter for the policy, and all projections can be interpreted as mean forecasts. The procedure can then be called *mean* forecast targeting.

Suppose instead that the central bank's view of the transmission mechanism corresponds to nonlinear relations between the different variables, that its objectives are different from a quadratic loss function, or that uncertainty enters in a nonadditive way. Then the conditions for certainty equivalence are not fulfilled. In that case, more than the first moments matter. Indeed, in the general case, the whole probability distribution of future realizations of the target variables matters. Then the decision problem is to find the instrument path for which the probability distributions of the future target variables "look good" and are consistent with the objectives. The Bank of England and Sweden's Riksbank illustrate the probability distribution of forecasts with the help of so-called fan charts. Given a loss function, the intertemporal loss can still be calculated with numerical methods if visual inspection is not considered sufficient. This procedure can be called *distribution* forecast targeting.

I have already emphasized that private-sector expectations are crucial in the transmission mech-

anism for monetary policy. Indeed, good central banks take account of private-sector expectations and treat them very much as independent state variables that they monitor and respond to. Good central banks devote considerable resources to monitoring and extracting private-sector expectations from a number of sources, including extensive surveys, term structure data, options prices, and other asset prices. The extracted or estimated private-sector expectations are then used as one set of inputs in the forecasting process. Using private-sector expectations as inputs in the forecasting process indeed implies that the central bank in the end will respond in the appropriate way to these expectations.

Indeed, the forecast targeting described above ensures the appropriate instrument-rate response to all incoming information. As I have expressed it before, the incoming information is, in effect, "filtered through the forecasts." Only if an incoming piece of information shifts the inflation or output-gap projections will an adjustment of the instrument-rate path be motivated. In practice, most of the incoming information will not have any effect on the projections and will therefore not be responded to. Actually, filtering through the forecasts provides a safeguard against overreacting and responding too much to incoming information.

I believe this monitoring and response to private-sector expectations is an important aspect of forecast targeting and something that the literature on central-bank learning should take into account. At this conference, the Orphanides and Williams (2003) paper stands out in explicitly taking this into account.

The learning inside the central bank takes on a number of different forms: continuous research on the economy and the transmission mechanism and corresponding model development, exchange of research and information with other central banks and academic researchers (for instance, at conferences such as this one), estimation and reestimation of a number of different models, and refinement of techniques and the decision framework. Central banks also accumulate experience and learn from successes and mistakes. Having observed this process of learning in several good central banks, I find it a very efficient and rational process and, indeed, a very impressive one.

Private-Sector Learning and Central-Bank Transparency

Next, let me talk about private-sector learning (including learning by policy authorities other than central banks) and central-bank transparency. Private-sector learning involves learning about the economy and about policy. It involves forming expectations and predicting the economic environment for the purpose of making the most informed decisions. This private-sector learning is the subject of several excellent papers at this conference.

Nevertheless, I believe an important aspect of private-sector learning is missing in the papers presented here—namely, the role of central-bank transparency. I am convinced that central-bank transparency can have an important impact on private-sector learning and, for instance, facilitate private-sector learning and speed up its convergence.

Increased central-bank transparency about the state of the economy, the working of the economy, and monetary policy should provide useful information to the private sector and induce better private-sector decisions and thus improve welfare.

Transparency about the objectives of monetary policy is an important part of central-bank transparency. It involves announcing the inflation target applied and indicating the relative weight on other objectives, for instance, output-gap stabilization. Indeed, in Svensson (2003a), I have argued that the time has come for central banks to announce also the relative weight on output gap stabilization and suggested procedures for how monetary policy committees can decide on this weight. Without these announcements, the private sector has to spend time and resources on learning the objectives of monetary policy. Indeed, another paper by Orphanides and Williams (forthcoming) demonstrates that private-sector learning about the inflation process is more effective if the private sector knows the inflation target. The paper provides a precise example of how an explicit inflation target can provide a better anchor for inflation expectations. As a consequence, the trade-off between inflation and output-gap stability becomes more favorable. Faust and Svensson (2001) show that increased transparency allows the private sector to better discover any central-bank deviation from announced goals. This greater likelihood of discovery increases the cost for the central bank of any deviations and thereby induces the bank to stick to its announced objectives; transparency then works as a commitment mechanism.

Transparency in the form of publication of inflation projections, the output gap, and interest rates, including assumptions and analysis, is likely to have a direct impact on inflation expectations. This impact makes the implementation of monetary policy more effective. Indeed, I emphasized earlier that the expectations of the future instrument rate is more important than the current instrument rate. What better way of affecting the term structure of interest rates than publishing a well-motivated instrument-rate path?

Transparency about the central bank's view of the economy and the transmission mechanism can also speed up private-sector learning. Good central banks actually educate the general public about the economy and how monetary policy works. As an example, I can mention that the Riksbank has had some success in teaching powerful Swedish trade unions that the long-term Phillips curve is vertical.

There is often a conspicuous asymmetry in many papers in that central-bank behavior is still often modeled in a mechanical way, as following an ad hoc instrument rule, such as a Taylor rule.

More generally, increased central-bank transparency about the state of the economy, the working of the economy, and monetary policy should provide lots of useful information to the private sector and induce better private-sector decisions and thus improve welfare. Indeed, there are hundreds of Federal Reserve economists who thoroughly monitor and analyze the U.S. economy. Why should their information be kept secret from the general public?

On a more technical note, in situations with multiple equilibria, Svensson and Woodford (forthcoming) argue that published central-bank forecasts can potentially provide a focal point for private-sector expectations and this way ensure a unique and desirable equilibrium.

Modeling Monetary Policy

Finally, let me get to the issue of how to model monetary policy. Many papers, including several at this conference, model monetary policy in a mechanical and ad hoc way as a given reaction function—an *instrument rule*, for instance, a Taylor rule or a given money-supply process. In particular, that instrument rule is treated as a structural relation. As I have argued in several papers, most recently in Svensson (2003b), this practice is very problematic, and there are better ways of modeling good monetary policy.

Let me remind you of the state of macroeconomics before the mid-1970s. Then, private-sector behavior was often modeled in a rather mechanical way, with ad hoc consumption functions for households and investment functions for firms. The Lucas critique emphasized that such behavioral functions were reduced forms and endogenous rather than structural and that they would not be invariant to changes in the economic environment, for instance, the policy regime.

These days, it is standard instead to model households and firms with microfoundations in the form of optimizing behavior. Households' and firms' intertemporal optimization results in first-order conditions (Euler conditions) for consumption and investment, which form the basis for a structural aggregate-demand relation between aggregate demand and the real interest rate. Firms' optimal price-setting causes a first-order condition that results in a structural aggregate-supply relation between inflation, inflation expectations, and the output gap—a Phillips curve.

However, there is often a conspicuous asymmetry in many papers in that central-bank behavior is still often modeled in a mechanical way, as following an ad hoc instrument rule, such as a Taylor rule. This instrument rule is implicitly treated as structural. But the good monetary policy described above does not result in a Taylor rule. Instead, it implies a more complex reduced-form reaction function in which the instrument rate is a function of all the inputs in the forecasting process. Furthermore, no central bank (that I am aware of) uses a Taylor rule as the main guide to its instrument-rate setting or has committed itself to a similar instrument rule. (Then the central bank staff could be reduced to a clerk armed with a formula and a hand-calculator, as McCallum has expressed it.)

I believe that it is better to model monetary policy as optimizing in the same way we model the private sector. Such modeling specifies the objectives and constraints of monetary policy, derives first-order conditions (Euler conditions), and models monetary policy with the help of those first-order conditions, what I have called optimal targeting rules. This approach restores the symmetry in the modeling of private-sector and central-bank behavior. Indeed, I believe good central banks are at least as goal-directed, rational, and optimiz-

ing as the average household or firm. (For one thing, good central banks employ far more sharp Ph.D.s to assist them in their policymaking.) Recently, several papers—for instance, Svensson and Woodford (forthcoming) and a series of papers by Giannoni and Woodford, including (forthcoming)—have taken this approach to modeling monetary policy.

Regarding the learning literature, Orphanides and Williams (2003) and Sargent and Williams (2003) at this conference examine learning under the assumption of optimizing behavior. In other papers than those presented in this conference, Evans and Honkapohja (2003) and Preston (2002) have recently examined learning under the same assumption of optimizing behavior.

This criticism of modeling monetary policy with ad hoc reaction functions should in no way be understood as an attempt to reduce the importance of Taylor's (1993) classic paper. Indeed, we can compare it with another classic paper, Friedman's 1967 presidential address (1968). This is indeed a classic paper in the field of monetary policy, with deep insights, warning about the danger of an overambitious monetary policy with insufficient knowledge about the transmission mechanism of monetary policy and suggesting money growth targeting, $k\%$, as a safer way of conducting good monetary policy rather than directly targeting inflation or the price level (even if the latter, everything else being equal, would be more desirable). This paper, a great contribution at the time, is one that we can still admire. But few sensible people would advocate or model monetary policy as $k\%$ today. The reason is that central banks can do better, and are doing better, than $k\%$ today. The understanding of the transmission mechanism is better today, and during the last decade a number of central banks have demonstrated that they can successfully target inflation directly, counter to what Friedman thought possible at the time of his presidential address. Instead, I believe we should think of $k\%$ as something we could fall back on in case of an emergency, when the transmission mechanism drastically changes or some unanticipated event reduces the power to target inflation directly.

Similarly, Taylor's (1993) classic paper is also full of important insights. The Taylor rule is a very interesting and very simple benchmark for monetary policy. The Taylor principle—that inflation-stabilizing monetary policy should imply a larger than one-to-one interest rate response to a persistent increase in inflation—is an important insight. Taylor's contribution was a great advance at the time, and we should still admire his paper. But this admiration does not mean that we should advocate the Taylor rule as good monetary policy now or model good monetary policy as following a Taylor rule. Indeed, central banks can do, and are doing, better than the Taylor rule today. Good central banks use and implicitly respond to much more information than the Taylor rule, as does optimal policy. As explained above, all information that affects the inflation and output-gap projections is implicitly responded to. Again, as for $k\%$, we should think of the Taylor rule as something that we could fall back on in emergencies. (And if that wouldn't work and stabilize the economy, we could fall back further to $k\%$.) But normally, good central banks can do better than the Taylor rule, and we should model good monetary policy accordingly.

Good monetary policy should not be modeled with ad hoc reaction functions that are not structural but instead as optimizing policy, with the help of optimal targeting rules.

Conclusion

So let me finish here. I have talked about three things. First, I talked about good monetary policy and central-bank learning, emphasizing the role of private-sector expectations as independent variables to be monitored, used as inputs in forecasts, and (implicitly) responded to. Second, I talked about private-sector learning and central-bank transparency, emphasizing that central-bank transparency can improve private-sector learning (and have many other good consequences, too) and should be taken into account in the work on learning. Finally, I talked about modeling good monetary policy and emphasized that good monetary policy should not be modeled with ad hoc reaction functions that are not structural but instead as optimizing policy, with the help of optimal targeting rules.

Again, let me thank the organizers very much for the opportunity to speak here.

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