Do we get more out of theory than we put in?

John B. Taylor assesses the impact of theoretical breakthroughs on monetary policymaking, and evaluates the results.

The best measure of the value of a theory – in any endeavour – is how much we get out of it. The Governor of the Bank of England, Mervyn King (2005), has suggested that we could get more out of monetary theory, and I am sure that this is a frequent wish of all central bankers. But wishing aside, how much do we actually get out of monetary theory? And in particular do we get more out of it than we put into it? To address this question – which should be on the minds of all central bankers, their research departments, and monetary scholars everywhere – I first consider the story of the so-called "Great Moderation" and then examine one of its central theoretical subplots: the theory price adjustment with forward-looking expectations.

The "Great Moderation"

Currently there is a heated debate in policy-making and academic circles about the role of monetary policy in bringing about the Great Moderation – the remarkable improvement in both price and output stability observed in the United States and other countries in the decades following the early 1980s. Most notably the frequency and severity of recessions has declined sharply as has the inflation rate.

In my view, monetary policy played a large role in achieving these results (see Taylor, 1998 and Bernanke, 2004). A key piece of evidence supporting this view is that a shift in the responsiveness of monetary policy occurred at the same time as the improvement in macroeconomic stability. In particular, central banks, reflecting a greater focus on inflation, started adjusting their policy interest rates in response to inflation by much larger amounts and more quickly. Their responses to real GDP also rose. Hence a "Great Monetary Policy Shift" accompanied the Great Moderation. This close timing is very strong evidence for a large role for monetary policy.

John B. Taylor is the Mary and Robert Raymond Professor of Economics at Stanford University Bowen H. and a Senior Fellow at the Hoover Institution. This article is based on his speech at the Swiss National Bank on 21 September 2007.

There has been relatively little discussion about the connection between monetary theory and this important shift in monetary policy. If indeed there is such a connection, then there is no doubt that we got a great deal more from theory than we put into it. This argument may be as debatable as the causes of the Great Moderation, but again, the timing suggests the strong possibility of such a role for theory. Some thirty years ago, monetary theorists set out to help improve the conduct of monetary policy with the objective of making the fluctuations in real GDP and inflation smaller. They even wrote down that stability objective mathematically. And using a novel expectations-based theory, they came up with new ideas for monetary policy, stressing the need for greater predictability and credibility, and larger responses of the instruments of policy to inflation and real GDP.

As we look back over the years, the shifts in the procedures for setting interest rates have been very close to what theory recommended, mainly in the prompt and aggressive reactions of interest rates to changes in inflation and real GDP. In parallel with those two changes, as I already mentioned, the economy changed too: The fluctuations in inflation and real GDP came down as was the objective of the theoretical research. This interaction between monetary theory, policy, and results is one of the most fascinating stories in economics. The connection, let alone the causal direction, between theory, policy and results can never be proven beyond a shadow of doubt, but the timing is remarkably close.

The engine of monetary theory

The main engine of monetary theory during this period is well known to researchers in central banks. It has three interlocking parts. One part is a model of inflation which describes how firms and workers set prices and wages and how these aggregate into the price level and the inflation rate. The second part describes how the real economy is affected by the policy interest rate of the central bank. The third part focuses on how the policy rate of the central bank is set, usually through a policy rule.

To better understand the role of monetary theory it is insightful to "look under the hood" and examine the first and crucial part of this engine – the price adjustment or inflation model. To do so, I will examine the origins of this model and how it developed over time.

The starting place for discussing this modern, price adjustment model is the so-called expectations-augmented Phillips curve, which Milton Friedman and Edmund Phelps first suggested in the late 1960s. The expectations-augmented Phillips curve told us that if inflation rises above what people had expected, then output and employment will rise above normal levels, and *vice versa*. It also told us that if inflation is to be reduced below the level currently expected, then real output and employment have to fall below normal levels for a while. As long as expectations were assumed to be adaptive – to change slowly – this expectations-augmented Phillips curve gave a reasonably accurate description of the time series pattern of inflation and real GDP.

Enter rational expectations

But with the advent of rational expectations, all this changed. If you assumed that expectations were rational, then monetary policy – as long as it was anticipated or followed a known rule – could not create a difference between actual and expected inflation rate: there was no way

for monetary policy to affect the real GDP. The central bank could achieve any inflation rate it wanted with any degree of accuracy without any adverse impact on the real economy.

Though this striking result attracted a lot of attention at the time, it was not a very accurate theory and was not useful for finding how monetary policy could reduce fluctuations in inflation and output. So a new theory was developed: one that endeavoured to incorporate some real world features of price and wage adjustment along with rational expectations. The basic idea of the new theory is that firms would not change their prices instantaneously.[1] Instead, there would be a period of time during which the firm's price would be fixed, and the pricing decisions of different firms would not all be made at the same time – price adjustments would be staggered and unsynchronised.

This new pricing assumption required a fundamental rethinking of the theory of markets. The typical textbook diagram of a demand curve, a supply curve, and an equilibrium price would not work. When you think about how a market might work in these circumstances, you realise a number of important things are not included in the classic supply and demand framework. First, you realise that some firms' prices will be outstanding when another firm is deciding on a price to set. So firms need to look back at the price decisions of others. Second, you realise that the firm's price will be around for a while, so it will have to think ahead and forecast the price decisions of other firms.

Seven key results...

One way to get your hands around how such a market might work is to make a simplifying assumption that the price is set at a fixed level for a fixed period of time. In any case, this is what I assumed when in my original work on this problem in the 1970s.[2] Despite the simplicity of the assumption the theory yields some fascinating results – I will briefly outline seven of these.

First, the theory generates a simple equation that can be used and tested. I list this as one of the seven key findings for the simple reason that had the theory not yielded an equation, none of the progress reported below would have been achieved. The equation describes the decision of firms setting prices today. A key variable in this equation is the prevailing price set by other firms, which is an average of prices set in the past and prices to be set in the future. There is a nice symmetry: the coefficients on past and the future are equal.

The **second** key result is that expectations of future inflation matter for pricing decisions today. With the current price decision expected to last into the future, some prices set in the future will be relevant for today's decision. This is a very important result: for the first time, expectations of inflation come into play in the theory of inflation. It gives a rationale for central bank credibility and inflation targeting.

Third, there is inertia in the inflation process; and therefore past prices matter because they are relevant for present price decisions. The coefficients on past prices can be calculated from the theory.

Fourth, the inertia is longer than the length of the period during which prices are fixed. Price shocks take a long time to run through the market because last period's price decisions depend on price decisions in the period before that and so on into the distant past. This phenomenon is the "contract multiplier" analogous to the Keynesian multiplier.

Fifth, the degree of inertia or persistence depends on monetary policy. The more aggressively the central bank responds to inflation, the less persistent inflation shocks are. This prediction was later shown to be true through practical experience and empirical analysis. Over time, inflation persistence has come down as the monetary responses have gone up.

Sixth, the theory implies a trade-off curve between price stability and output stability. Inefficient monetary policies would be off the curve. Performance could be improved by moving on the curve. The current Chairman of the Federal Reserve, Ben Bernanke (2004), used this curve to explain the role of monetary policy during the Great Moderation.

Seventh, the costs of disinflation are less than in the expectations-augmented Phillips curve. This prediction also proved accurate when people later examined the cost of disinflation of the early 1980s.

... and more

Of course, as one would expect, there have been modifications and extensions to this theory.[3] Fortunately, the seven results remained robust to these changes. Later on, there were more improvements. The price adjustment equations were shown to be optimal if firms had some market power (see for example Yun, 1996 and Chari, Kehoe and McGrattan, 2000). Though the functional form of the optimisation-based price-setting equation is the same as in the original model, we got more out of this theory – an **eighth** result. More aggressive monetary policy responses imply a smaller pass-through of price shocks (commodities or exchange rates) to core inflation. Such a reduced pass-through has now been documented in many countries. Although the theory continues to be sharpened,[4] it appears that the key policy results highlighted above will continue to hold and more results will be discovered.

Has it all been worth while?

I have argued that improved monetary policy has played a large role in achieving the dramatic and remarkable improvement in both price and output stability observed in the United States and other countries in the decades following the early 1980s. In addition, I have reviewed the role of monetary theory underlying the monetary policies that led to the Great Moderation. Central bankers will undoubtedly face new practical problems in the future. Monetary research at central banks and elsewhere will need to focus on these practical problems if it is to continue to deliver. But what this review makes clear is that we have indeed got more out of monetary theory than we put into it in recent years.

Notes

1. The same idea applied to wages, but I will focus on prices here.
2. This simplifying assumption is akin to that of Paul Samuelson's original overlapping generation model that all people live for exactly two periods. See Taylor (1980).
3. Taylor (1979) allowed for a greater variety of time intervals during which prices are fixed, while Calvo (1982) introduced a geometric distribution. A modification by Fuhrer and Moore (1995) generated additional inflation inertia which was needed empirically.
4. Important recent developments are the addition of more flexibility in the timing of firms' price decisions (Dotsey, King, and Wolman, 1999, Gertler and Leahy, 2006, Golosov and Lucas, 2006) and sharper microeconomic tests of the theory: (see Klenow and Kryvtsov, 2007)

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