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Recent Research on Sticky Prices

This Economic Letter *summarizes the papers presented at the conference "Nominal Rigidities" held in San Francisco on June 16 under the joint sponsorship of the Federal Reserve Bank of San Francisco, the National Bureau of Economic Research, and the Federal Reserve Bank of Cleveland.*

Broadly speaking, the papers at the conference were concerned with modeling the effects of policy in an economy with nominal rigidities—that is, with prices and wages that are relatively inflexible, or "sticky." One set of papers focused on determining the characteristics that a model economy would require to plausibly reproduce the observed behavior of key macroeconomic variables such as output and inflation, especially in response to a monetary policy shock. Christiano, Eichenbaum, and Evans find that wage rigidity (along with some other requirements) is a must, while McGrattan finds that price rigidity is not particularly useful. Mankiw and Reiss argue that it is more useful to think of the rigidities as arising from the costs of acquiring and processing information, rather than the costs of changing wages or prices. The paper by Barro and Tenreyro has a different focus: it assumes sticky prices in only part of the economy and looks at the role played by sticky-ness in propagating business cycles. Their model implies that the more concentrated the industry, the more countercyclical its prices, an implication for which they find some support in the data. The final two papers in the conference, authored by Schmitt-Grohé and Uribe and by Correia, Nicolini, and Teles, discuss how the prescriptions for optimal fiscal and monetary policy that are derived in models with flexible prices get modified when prices are assumed to be sticky. The key finding here is that it may be advisable to pay greater attention to stabilizing prices in an environment with sticky prices than one would in an environment with flexible prices.

What kind of "sticky-ness" is best?

In recent years, economists have been working with models in which the decision-making problems of firms and households are explicitly specified, as are the environments in which they operate. More recently, within this tradition, some economists have begun to explore the role played by "sticky" wages and prices, that is, by prices and wages that are not free to adjust quickly in response to changes in the environment. A key objective of this research program has been the construction of models that produce plausible descriptions of how a change in monetary policy affects the economy. The first set of papers is part of this program; their analysis can be viewed as trying to determine the best place (in the model) to locate this sticky-ness or nominal rigidity.

Christiano, Eichenbaum, and Evans' (CEE) ask what sort of restrictions must be imposed on a model of the economy with optimizing agents and a richly specified environment in order to obtain the same response to a monetary policy shock as observed in a simple description of the actual data. In their model, both prices and wages adjust sluggishly. They find that they can mimic the responses in the data most closely when they allow wage contracts to have an average duration of roughly 2 quarters while prices are allowed to be reset every 3 quarters. Wage rigidity turns out to be the more crucial requirement of the two. Assuming that prices are fully flexible in a world with sticky wages does not lead to results that are very different from the case where both prices and wages are assumed to be sticky; by contrast, assuming that prices are sticky while wages are flexible leads to a marked deterioration in the model's performance.

McGrattan's goal is similar to CEE. She sets up a model with optimizing households and firms as well; her focus, however, is on the role played by sticky prices. In her model monetary policy is conducted using the well-known Taylor rule, according to which the monetary authority sets interest rates in response to changes in inflation and departures of output from an estimate of its long-run trend.

McGrattan's model yields some counterfactual implications. For example, she finds that interest rates are negatively serially correlated, in contrast to the positive correlation observed in the data. She also finds that in her model the response of output to a monetary shock is not as persistent as observed in the data. Allowing for nonmonetary shocks does lead to more persistent changes in output; however, the attempt to make output more persistent makes the amplitude of the business cycles generated by

the model too small. Overall, McGrattan concludes that introducing sticky prices into fully articulated models of the economy does not allow these models to replicate the behavior of key economic data and does not help us understand how monetary policy affects the economy.

Mankiw and Reis (MR) focus on a model where price sticky-ness is associated with the costs of acquiring and processing the information necessary to set prices. In their model, prices are easy to change, but because information is assumed to diffuse only gradually through the economy, these changes end up being based upon old estimates of the state of the economy.

MR show how their model responds to a variety of monetary policy shocks and compare its predictions to those from two versions of the sticky price model which differ in their assumption about how expectations are formed. Consider, for example, what happens when the monetary authority announces that it will engineer a decrease in the growth rate of aggregate demand in the near future. In the (sticky price) model with forward-looking households and firms, the result is an increase in output, because prices start falling when the announcement is made; with the money supply growth rate unchanged, output goes up. By contrast, this announcement has no effect in the (sticky price) model with backward-looking firms and households. However, both prices and output begin to fall sharply after the monetary authority tightens, just as they would if the authority had made no such announcement.

MR argue that, while the predictions of both versions are hard to reconcile with empirical observation, this is not the case for the sticky information model. Although the timing of the responses in the sticky information model is the same as in the backward-looking model, the magnitudes are much smaller and, therefore, closer to what is observed in practice. In particular, because some of the firms have been able to incorporate the relevant information into their plans before the policy change takes effect, output falls less than and inflation falls more quickly than it does in the backward-looking model (once the monetary authority tightens). Thus, a pre-announced reduction in demand leads to a contraction in output that is smaller than it would be if the reduction were a surprise. Note also that this contrasts sharply with the forward-looking model's questionable prediction that output should boom after the announcement.

Barro and Tenreyro (BT) show how the existence of sticky prices in part of the economy can play a role in the propagation of business cycles. Their model contains two sectors: final and intermediate goods. Final goods are assumed to be produced in a competitive environment, while the intermediate goods sector is imperfectly competitive and produces goods that are differentiated from each other. Assume now that there is an increase in the degree of competition in the intermediate goods sector. This leads to a decrease in the price of intermediate goods relative to final goods, causing final goods firms to increase the use of intermediate goods and thereby increase output. Labor productivity goes up, as do wages. BT show that the same effect can be achieved through monetary policy if intermediate goods prices are assumed to be sticky. An unexpected monetary expansion leads to an increase in the price of final goods and temporarily reduces the relative price of intermediate goods, causing final goods producers to increase output.

BT neither estimate nor test this model directly, but they do test one of its implications, namely, that the relative price of goods produced by less competitive sectors is countercyclical; that is to say, it falls during booms and rises during recessions. Using the growth rate of real output as an indicator of the cycle and price data for the manufacturing sector over the 1958-1997 period, BT find evidence suggesting that the more concentrated the sector, the more countercyclical its relative price.

Sticky-ness and optimal policy

The final two papers address how optimal policies should be set in a sticky price environment. These papers are part of a research program that asks how the government (including the central bank) can finance a given stream of expenditures while minimizing the distortions that any method of raising revenues is likely to impose upon the economy. Using models with flexible prices, some researchers have shown that monetary policy should be conducted according to the Friedman rule, which calls for a zero nominal interest rate, that is, it calls for deflation at a rate equal to the real rate of interest. As Nobel prize winning economist Milton Friedman originally pointed out, since money is costless to produce, it is optimal to set the cost of holding it (which is the forgone interest) at zero as well. Furthermore, it has been shown that if prices are flexible and the government cannot issue debt whose value varies with the state of the economy, the optimal inflation rate is highly volatile but uncorrelated over time. In this setting, the government uses inflation as a non-distorting tax on financial wealth in order to offset unanticipated changes in the deficit. By contrast, the income tax rate remains relatively stable.

Other researchers have shown how the existence of sticky wages and prices leads to the government's facing a tradeoff in choosing the optimal inflation rate. The benefits of using inflation as a non-distort-

ing tax on financial wealth must now be balanced against the costs that inflation imposes on firms and households who are unable to adjust prices quickly enough. As Schmitt-Grohé and Uribe (S-GU) point out, these researchers have assumed that the government can freely deploy some rather unusual tools, including production or employment subsidies as well as lump sum taxes. (Since lump sum taxes are, by definition, independent of economic activity, they do not distort the incentives to undertake such activity.) Given these tools, the government is able to keep the inflation rate close to zero, so it can avoid the distortions imposed by nominal rigidities.

S-GU assume that the government does not have access to either lump sum taxes or production subsidies. Even so, they find that optimal policy calls for low inflation volatility. Specifically, in a model in which firms are assumed to adjust prices roughly once every nine months, the volatility (here defined as the standard deviation) of inflation under sticky prices is one-fortieth of what it is under flexible prices. And even if the parameter that governs price sticky-ness is assumed to be ten times smaller, the volatility of inflation is still a thirteenth of what it is under flexible prices.

Correia, Nicolini, and Teles (CTN) take up the issue of optimal fiscal and monetary policies as well. Their key finding is that, even if prices are sticky, a benevolent government can steer the economy to the same equilibrium as it would if prices were flexible. In a sense, then, the way in which prices are set becomes irrelevant to the final outcome. At first glance, this result seems to contradict the results of the previous authors. It turns out, however, that CTN assume that the government has access to state-contingent debt, that is, it can vary the value of its outstanding obligations depending upon the state of the economy. For instance, in the case of an expensive war, the government could default on some of its debt. It is this extra "instrument" that gives the government the ability to attain the same equilibrium in an economy with sticky prices that it would under flexible prices.

Bharat Trehan
Research Advisor

Conference Papers

Barro, R. J., and S. Tenreyro. 2001. "Closed and Open Economy Models of Business Cycles with Marked Up and Sticky Prices."

Christiano, L. J., M. Eichenbaum, and C. Evans. 2001. "Nominal Rigidities and the Dynamic Effects of a Shock to Monetary Policy."

Correia, I., J. P. Nicolini, and P. Teles. 2001. "Optimal Fiscal and Monetary Policy: Equivalence Results."

Mankiw, N. G., and R. Reis. 2001. "Sticky Information Versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve."

McGrattan, E. R. 1999. "Predicting the Effects of Federal Reserve Policy in a Sticky Price Model: An Analytical Approach."

Schmitt-Grohé, S., and M. Uribe. 2001. "Optimal Fiscal and Monetary Policy under Sticky Prices."

All papers are available at http://www.frbsf.org/economics/conferences/0106/index.html

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