

Federal Reserve Bank of Richmond

Inflation: Perspectives and Outlook

Richmond, Virginia • November 30, 2018



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Inflation: Perspectives and Outlook

Federal Reserve Bank of Richmond

November 30, 2018

- 9:00 AM** **Welcome and Introduction**
Kartik Athreya, Executive Vice President and Director of Research,
Federal Reserve Bank of Richmond
- 9:15 AM** **Slack and Cyclically Sensitive Inflation**
Mark Watson, Princeton University
- 10:00 AM** **Empirical Properties of Inflation Expectations and the Zero Lower Bound**
Mirko Wiederholt, Sciences Po Paris
- 10:45 AM** **Break**
- 11:15 AM** **Trade Exposure and the Evolution of Inflation Dynamics**
Simon Gilchrist, New York University
- 12:00 PM** **Lunch Speaker**
Tom Barkin, President, Federal Reserve Bank of Richmond
- 2:00 PM** **The Neo-Fisher Effect:
Econometric Evidence from Empirical and Optimizing Models**
Martín Uribe, Columbia University
- 2:45 PM** **Flex-Price Monetary Policy**
Narayana Kocherlakota, University of Rochester
- 3:30 PM** **Break**
- 4:00 PM** **Structural Models of Price Dynamics: Retrospect and Prospect**
Robert King, Boston University
- 4:45 PM** **Closing Remarks**

Conference Summary

Why hold an international research conference on inflation at a time when inflation has been low and stable for years? The reason the Richmond Fed did so, according to Thomas Lubik, a senior advisor in the Bank's Research Department, was to "form an impression of how the profession sees the low-inflation outcomes in the U.S. and in many other advanced economies."

Lubik added, "This has been a major economic puzzle: Over the last ten years, why has inflation behaved the way it has? Despite all the monetary and fiscal stimulus, inflation has consistently refused to rear its ugly head. The idea behind this conference was to put together a cross-section of thinking in the profession about the sources and behavior of inflation and to inform our internal discussions."

Researchers gathered to discuss these questions at the Richmond Fed on November 30, 2018. Presenters included Mark Watson of Princeton University, Mirko Wiederholt of Sciences Po Paris, Simon Gilchrist of New York University, Martín Uribe of Columbia University, Narayana Kocherlakota of the University of Rochester, and Robert King of Boston University.

Watson presented "Slack and Cyclically Sensitive Inflation," coauthored with James Stock of Harvard University. Their paper considered the diminishing relationship between the unemployment rate and inflation, an association commonly known as the Phillips curve. In both the United States and Europe, they noted, inflation has tended to remain low even



during times of high economic activity, especially over the past several years.

Watson and Stock first looked at around a dozen measures of economic activity in addition to unemployment to see whether the Phillips curve might be "resuscitated," as Watson put it, with some other measure. They found that the relationship had diminished with those alternative measures, also. They then put forward a hypothesis that inflation actually has been increasing but only in sectors that are highly sensitive to the business cycle and where prices are not set in international markets. Such sectors would presumably be the ones most responsive to the country's domestic business cycle. They constructed an inflation index, the Cyclically Sensitive Inflation (CSI) index, in which sectors with a large cyclical component have greater weight. They found that inflation, as measured by the CSI index compared to the Personal Consumption Expenditures index, has indeed been higher over the period from 2014 to the first quarter of 2018 but only modestly so (2.1 percent vs. 2.6 percent). In the euro area, the CSI index essentially tracked core inflation. The receding of the Phillips curve relationship thus largely stands even with the new inflation measure.

The consequences of the public's beliefs about future inflation were the subject of Wiederholt's "Empirical Properties of Inflation Expectations and the Zero Lower Bound." Wiederholt noted that in New Keynesian models of the economy with a binding zero lower bound — that is, monetary policymakers cannot set nominal policy rates below zero — inflation expectations of households are important in determining how inflationary shocks



are propagated in the economy and in determining the effectiveness of monetary policy. He suggested that it is therefore important to model inflation expectations in a way that is consistent with real-world data.

New Keynesian models commonly assume that households and firms have uniform inflation expectations and perfect information about shocks affecting future inflation. Empirically, however, households and firms have varied inflation expectations and information, and their expectations, on average, respond slowly to such shocks. Wiederholt's research assessed the implications of this discrepancy between theory and empirics. He found that with slowly and heterogeneously adjusting inflation expectations, forward guidance by monetary policymakers is less effective and, in some circumstances, can be counterproductive. In addition, the fiscal multiplier is smaller; that is, consumption becomes less responsive to public spending.

The third presentation of the day looked at the changing nature of international trade and how it has affected price-setting. In "Trade Exposure and the Evolution of Inflation Dynamics," presented by Gilchrist and coauthored by Egon Zakrajšek of the Federal Reserve Board, the researchers investigated whether the weakening of the relationship between inflation and economic activity in the United States — resulting in lower-than-expected inflation — might have arisen partly from the growing reach of trade in the U.S. economy. Gilchrist explained that they approached this question on an industry level by using import and export data to measure



industries' trade exposures. They then compared the relationship of inflation and economic activity within high-trade-intensity industries to that within low-trade-intensity industries.

Gilchrist and Zakrajšek found that producer price inflation in low-trade-intensity industries was significantly more responsive to both financial shocks (a proxy for demand shocks) and commodity price shocks (a proxy for supply shocks). Overall, they estimated, producer price inflation was three times more responsive to changes in output in low-trade-intensity industries than in high-trade-intensity ones. They concluded that rising globalization does appear to have contributed substantially to the flattening of the Phillips curve.

Uribe addressed another possible influence on inflation dynamics, namely, nominal interest rates. In "The Neo-Fisher Effect: Econometric Evidence from Empirical and Optimizing Models," he distinguished transitory monetary shocks (that is, those perceived



as short-term), such as transitory changes in policy rates, from permanent monetary shocks. Monetary economics has been concerned primarily with the former, with a consensus view that a transitory increase in nominal interest rates will lead to a short-run decrease in inflation but will have no effect on inflation in the long term. An interest rate increase or other monetary shock perceived as permanent, however, may bring a “Neo-Fisher” effect, in which the policy change increases inflation in both the short run and the long run.

Uribe found empirically that Neo-Fisher effects have played an important role in determining U.S. inflation. He argued further that a gradual and permanent increase in nominal rates, perhaps accompanied by a credible announcement that the change is indeed long-term, may be a desirable policy option in a setting where inflation is persistently below target. He held that such a policy move would raise both inflation and output while reducing real interest rates.

Kocherlakota, in “Flex-Price Monetary Policy,” highlighted the need for monetary policy models to incorporate bounds on firms’ pricing — meaning that price changes are constrained somewhat by the current price — and to assume that central banks can commit themselves to an interest rate rule for no more than a year or two. Without pricing bounds, he said, standard models cannot generate predictions for numerous relevant monetary policy choices.

Models with bounded pricing, or flex-price models, do allow for predictions about any central bank policy choice. Flex-price models, like standard models, predict that overly tight monetary policy can lead to both unduly low demand and unduly low inflation.

The final session of the conference, King’s “Structural Models of Price Dynamics: Retrospect and Prospect,” considered the recent history of the profession’s thinking about inflation and possible future directions of analysis. In the mid-to-late 1990s, he reflected, macroeconomists seemed to have a full understanding of inflation dynamics; moreover, their general equilibrium macro models were reliable. This consensus was challenged in the early 2000s by researchers using micro data from government surveys, which underscored the heterogeneity among economic sectors, though it was unclear whether that heterogeneity mattered substantially to macroeconomic analysis. Another challenge came from research that showed the standard New Keynesian models could not account for the falling labor share of national income. Elements of future analysis of inflation and of price-setting in general are likely to include models incorporating the behavior of multiproduct firms and attention to industry-level cost data. ■

For more information on the research discussed at the conference, please see the interviews that follow. Interviews have been edited for length and clarity.



Slack and Cyclically Sensitive Inflation

by James Stock and Mark Watson



Monetary policymakers in the United States face what James Stock of Harvard University and Mark Watson of Princeton University call “the low-inflation puzzle.” Over the past decade, the unemployment rate has declined dramatically.

It hit a peak of 10 percent in October 2009, shortly after the Great Recession, and remained very close to that figure for another six months; from there, it has fallen to lows not seen for almost a half century. Yet inflation has remained low and stable contrary to predictions of macroeconomic theory. Stock and Watson’s paper looks at various possible explanations for this pattern. Watson discussed their paper at the conference.

What are you trying to understand with this research?

Watson: The Phillips curve is a standard name for the relationship between economic activity, often measured by the unemployment rate, and inflation. I’m going to call it the “Phillips correlation” because we’re interested in just the correlation between these two things. I don’t necessarily want to think about causation, at least at this point. If one looks at this Phillips correlation, in the 1960s and 1970s it was reasonably strong. But as you get into the 1980s, into the 1990s, to the current period, this correlation has fallen a lot. And by some measures, it has disappeared in the last ten years or so. So we were interested in doing some detective work and asking why this is.

One approach is to dissect the measures of real activity to ask whether the correlation becomes

stronger if one chooses real activity in a different way or if you look at inflation or the components of inflation in a different way. That’s what we were up to in this paper.

Does the correlation become stronger when you look at a different measure of economic activity?

Watson: The answer seems to be no. What we do in the paper is look at several different measures of slack. A standard measure is, as I said, the unemployment rate. We looked at around a dozen other measures — capacity utilization and growth of real output, among others — and one still sees a deterioration in this correlation over time with all of them. One measure of unemployment for which it doesn’t fall quite as much is the short-term unemployment rate; it has fallen by a factor of two instead of falling by a factor of five, but it has still fallen significantly.

The prices of certain goods and services move up and down with economic activity, that is, with the business cycle. In what sorts of sectors do you find that that’s the case, and why do you think that’s true?

Watson: Let’s think about sectors that might not move very much with domestic slack in the U.S. Think about a tradable commodity like oil or gasoline. The price is determined on the international market. Of course, the United States is a big part of the international market, but it’s not the whole market. So tradable goods in general, where inputs come from abroad, is an area where one might not expect to see the slack measure be important.

Another kind of sector where you might not think that slack is very important for the measured inflation rate is one in which the inflation rate is measured poorly. The most obvious would be ones

with the new goods problem, which shows up in clothing, the IT sector, our cell phones, and places like that. In these markets, new products or new styles are coming out every year.

How far back in terms of inputs do you have to look to investigate what's driving some of these changes?

Watson: These are prices of final goods and services, and those are built up from lots of things. Input prices are relevant. If one thinks about restaurant prices, there's the food input, there's the rent on the land, there's the labor input and so on. Some of the food prices may be determined in international markets, but the local labor market is determining wages and local markets are determining rents. So slack or lack of slack in local labor markets is going to push up labor costs for restaurants, and strong demand is going to push up rents.

How helpful do you think the use of micro data has been in traditional macro questions like this, and is the profession doing better at using micro data?

Watson: Ultimately, macro things are an aggregation of a bunch of micro things, right? An old sense has been that if one looks at the micro data, they're very noisy because lots of idiosyncratic things are affecting variability in micro units. There's a sense that once you aggregate, much of that idiosyncratic variability gets averaged out. So looking at the micro data per se can sometimes confuse you because you can be led astray by all of the noise going on with individual people and individual firms. Once you aggregate them to get to things that we as macroeconomists care about, you can see the sort of systematic patterns in the macroeconomy.

But I think we're learning now, though, that going all the way from micro data to averaging it and looking at aggregates is probably a bad idea; you may be missing lots of interesting things, such as understanding how different sectors in the economy interact with one another. We are starting to understand how to do that, and in part that's

because our data availability has increased. That seems to be an area where we're making a lot of progress.

You constructed a cyclically sensitive inflation, or CSI, index. How does the CSI index work?

Watson: We looked at seventeen sectors that go into the PCE, the personal consumer expenditure measure of consumer goods in the United States. As we've talked about, we don't expect inflation in some of these sectors, like oil, to be particularly highly correlated with output. In others, like clothing, inflation isn't measured very well, so it probably is not going to be highly correlated with output for that reason.

What we do is look at the data, find the sectors that are highly correlated with output, and form an index of them where the sectors that are more highly correlated get a bigger weight. So you can ask, in what way can we aggregate these sectors to make the correlation as high as possible? That turns out to put a lot of weight on housing and housing services, a lot of weight on food and restaurants, and some weight on food and beverages and on recreational services such as movies. Other services gets a little bit of the weight, but then there are many that receive a weight of zero.

What do you think is the primary utility of the index?

Watson: Let's start with what it isn't. It isn't a measure of the cost of living because it only has certain goods in it. More than half the weight is on housing. There's no weight on transportation services, there is no weight on health care — things that are very important if we are trying to measure the cost of living.

So what purpose does it serve? I think it serves two related purposes. One is inferring the level of slack in those sectors. We measure prices pretty well in these sectors; we measure slack maybe less well. So taking this problem and standing it on its head, you might say that if you see the CSI increase, why did it

increase? Well, because it's correlated with output, slack must have gone down and output must have gone up. So you can use it as an indirect measure of what's going on in the real economy.

The other thing you might use CSI for is that when you see it tick up, it may help forecast inflation. Now, we haven't investigated yet whether these components are actually useful for predicting future inflation, but that's a potential use.

Are there other potential policy applications of this work?

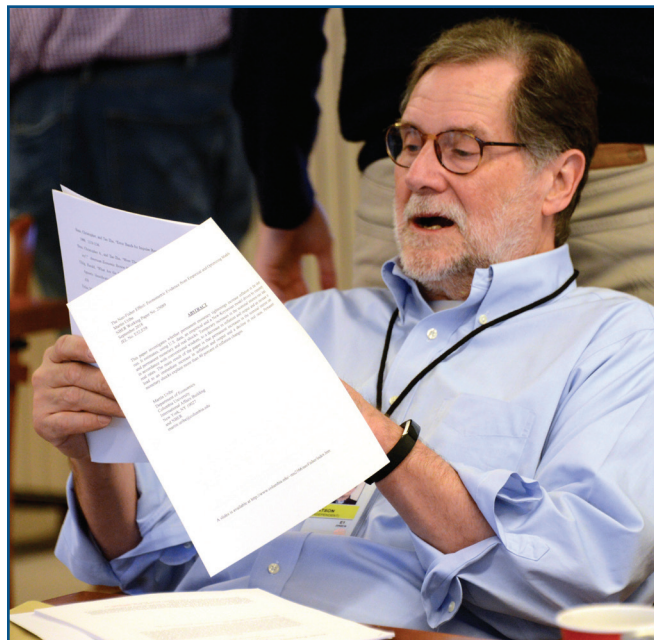
Watson: If I were working at the Fed and I knew that these sectors were highly correlated with output, I might look for movements there in the PCE releases. I would expect to see inflation first in housing, restaurant prices, and the other sectors that are heavily weighted in the CSI. As a signal of inflation coming from tightening slack, this is where I might look.

We have seen a number of explanations for the flattening of the Phillips curve — one story about the success of anchoring inflation expectations, another having to do with offshoring and the greater use of technology as a substitute for labor. Where do you think those fit in?

Watson: I think the international aspect of this is very important; technology is potentially very important.

Regarding the anchoring of expectations, the theory behind that makes some sense. Price setters are forward-looking and, because there is some cost to changing prices, you need to look at the future, including what your competitors are going to be doing and how they're going to think you're going to act. This is all dynamic, so expectations of future inflation seem to matter a lot in theory.

But empirically, if you look at expectations of inflation, they track actual inflation. There doesn't seem to be a lot of independent variation in expectations of future inflation, so is it really anchoring that's keeping inflation low, or is low inflation the reason why expectations are low? There's a chicken and egg



problem there. The data really can't help me think about that.

What do you think comes next in this work?

Watson: We think we're going to extend this by looking not at a single measure of slack — the unemployment rate, the short-term unemployment rate, capacity utilization, what have you — but at an index of four or five of these to try to average out idiosyncratic things that might be going on in any particular measure.

Another area where we want to spend more time is looking at its utility in forecasting inflation. Jim and I have some older work, two years older, in which we look at these same sectors and ask, if I want to forecast inflation, how should I weight these? Which sectors are important for prediction of future inflation? And we have a trend inflation index that comes out of that work. We really haven't reconciled that work with this work. ■

Empirical Properties of Inflation Expectations and the Zero Lower Bound

by Mirko Wiederholt



The predominant family of macroeconomic models employed by economic researchers, known as New Keynesian models, typically treat households and firms as if they have complete information about the shocks that drive

inflation. Mirko Wiederholt of Sciences Po Paris has analyzed the extent to which these assumptions correspond to reality — and what the answer means for researchers and policymakers.

Modern macroeconomic models tend to assume that people know a lot about shocks related to inflation and that they all have the same expectations about inflation. Are these assumptions well-founded?

Wiederholt: If you look at survey data on expectations, you find that people have heterogeneous expectations about inflation, and you also find that the average inflation expectation responds sluggishly to shocks to inflation.

In contrast, theoretical models commonly assume complete information, which means people know all the shocks that have hit the economy, and rational expectations, which means people know the law of motion of the economy. The combination of these two assumptions implies that all agents have the same expectation of aggregate inflation and that expectations respond quickly to shocks.

So given the survey data, the combination of the assumption of complete information and rational expectations is not at all well-founded.

What do you think is the reason for this gap between the assumptions of theory and what the evidence is telling us?

Wiederholt: If you want to match the data, you have to deviate either from the assumption of complete information — that people know the shocks — or from the assumption of rational expectations — that people know the law of motion of the economy.

There's one feature of the data that points toward deviating from complete information. If you think about the gap between inflation and inflation expectations that opens up after a shock, that gap tends to close relatively quickly, say after a couple of years. That points in the direction that there is initially incomplete information about the shock but then people are learning. If deviations from rational expectations were more important, you would not expect this gap to close very quickly because it would take people a long time to learn that the law of motion for the economy they have in mind is the incorrect one.

Why do you think this pair of assumptions is embedded in so many macro models when there seems to be good reason to think that they don't hold up?

Wiederholt: John Muth, who invented rational expectations in a 1961 article, pointed out in that very article that if you look at survey data on expectations, you find heterogeneity and you also find these slow adjustments. It was only with that caveat that then he moved on to present a model that has incomplete information and rational expectations.

And then over time, the caveat fell away. People moved from incomplete information and rational expectations, which you also have in the famous Lucas 1972 paper, to complete information and rational expectations — probably just because it was easier to work with these kinds of models. I think it was probably for tractability or convenience that people moved to the combination of these two assumptions.

In your research, you looked at the effects of diverse inflation expectations among households and slow adjustments of inflation expectations. Did you find that these conditions make a difference to the effectiveness of monetary policy tools?

Wiederholt: Definitely. Think about forward guidance. Forward guidance is supposed to affect the economy by changing people's expectations. But if households adjust their expectations slowly, the power of forward guidance is greatly reduced.

And then on top of that, if expectations adjust slowly, you might be in a situation where, for example, inflation expectations are still too high or the perceived persistence of a shock is still too low. Now the central bank comes in and communicates that you're in a very different state of the world, a bad state of the world with large deflationary risk or a very persistent shock. That might actually be detrimental to the economy because you are moving people's inflation expectations down. So it's not only that the power of forward guidance was reduced, it might actually end up worsening the outcome.

Is there a trade-off, then, between the central bank telling the public what it thinks about inflation risk, even when it might be detrimental or even destabilizing, on the one hand or withholding that information on the other?

Wiederholt: Yes, there is definitely a trade-off, because once interest rates are at the effective lower bound, reductions in inflation expectations are clearly destabilizing. So if the central bank, by

emphasizing deflationary risks, moves inflation expectations downward, that is destabilizing.

At the same time, the central bank, of course, wants to communicate that it's doing some desirable policy, and this policy may in fact be desirable, but it's justifying it by saying we're in a bad state of the world where a large shock and a very persistent shock has hit.

So you have a trade-off between the positive direct effect of the policy — for example, telling people we will keep interest rates at zero for longer — and the negative indirect effect of the policy by destabilizing inflation expectations.

I guess one could design communication in such a way as to benefit more from the direct effect by emphasizing the policy more and have less of the indirect effect by deemphasizing deflationary risks.

What about the effectiveness of attempting to stimulate the economy through fiscal policy under these conditions? Does your research imply anything about that?

Wiederholt: Yes, also, when it comes to fiscal policy, inflation expectations are very important. And it's well-known that according to many models, fiscal policy is more effective when interest rates are at the effective lower bound than when they're above the lower bound.

The intuition is that when government spending goes up, that is inflationary, and the central bank is not increasing the nominal interest rate in response to that — and thereby not crowding out consumption.

But to have a large fiscal multiplier, what you typically need is for consumption to increase. That's where fiscal multipliers greater than one are coming from. And in the model, this is coming from upward movements in inflation expectations in response to the fiscal policy.

But if inflation expectations adjust sluggishly, then this upward movement in inflation expectations occurs less. And hence you have a smaller upward effect on consumption and hence a smaller multiplier.

So to summarize that: in standard models, fiscal policy acts through changing inflation expectations and thereby changing consumption. If inflation expectations don't respond, consumption does not respond.

Looking at monetary policy and fiscal policy under the conditions of heterogeneous and slowly adjusting expectations, where do firms fit into this picture?

Wiederholt: Just like households, firms also have heterogeneous and slowly adjusting inflation expectations. This matters for inflation dynamics. Think about the standard model of inflation, which is the New Keynesian Phillips curve. On the right-hand side, you have two variables, the output gap and inflation expectations. So inflation expectations, according to the New Keynesian Phillips curve, affect inflation. That means that if inflation expectations in the Great Recession didn't fall as much, then that's a potential explanation why inflation itself didn't fall as much during the Great Recession.

And then the same arguments as before apply to downward movements in inflation expectations being destabilizing, so if the central bank now through communication speeds up downward movements of inflation expectations, then that speeds up downward movements in inflation.

Do you think that the beliefs of households about inflation have become less dispersed over time or more so?

Wiederholt: There are certainly fluctuations in the dispersion of inflation expectations over time. In fact a student of mine has looked at time variation and dispersion, and she finds that monetary policy is less effective at times when inflation expectations are more dispersed.

But it's not that there is a systematic trend in the dispersion of inflation expectations. The dispersion tends to go up and down all the time.

For the public at large, one might think that inflation has been a less salient issue during the past couple of decades, let's say, because we've had consistently low inflation. Do you think that could be a factor in all of this, or do you think that that's not particularly relevant?

Wiederholt: From a theory point of view, if you look at rational expectations and attention theory, that suggests that when inflation is becoming less volatile, it's less important for people to track inflation, which is something that you do see in the survey data — the response of inflation expectations to shocks has become even slower since 1985, that is, since the beginning of the Great Moderation.

So that's very consistent with the idea that since inflation volatility has fallen, inflation has become less important, people pay less attention to it, they respond even slower with their inflation expectations to shocks.

Finally, as you know, DSGE models are models of the macroeconomy that are widely used in academia and increasingly looked at within central banks. DSGE models assume that people have a lot of information about what's going to happen in the future, about what the risks are to the economy. Do you think the data on the actual heterogeneity of expectations have any implications for DSGE models?

Wiederholt: I think it's definitely important to include a modeling of inflation expectations, and expectations in general, in these DSGE models that is consistent with survey data. That means deviating from the combination of complete information and rational expectations in these DSGE models. It's particularly important for the policy implications of these models, as we discussed before.

So I think an important avenue for future research is to more consistently include deviations from complete information and rational expectations in these DSGE models and discipline them by survey data. ■

Trade Exposure and the Evolution of Inflation Dynamics

by Simon Gilchrist and Egon Zakrajšek



The relationship between changes in economic activity and changes in the price level seems to have diminished in the United States since the early 1990s. As generations of macroeconomics students have learned,

this relationship, which is one version of the Phillips curve, has historically implied that an increase in economic activity would drive up inflation, all other things equal, while a recession would lead to lower inflation or deflation. While these effects still exist, they have become more subdued. One possible explanation is the rise in globalization during the past several decades. Simon Gilchrist of New York University and Egon Zakrajšek of the Federal Reserve Board are studying the extent to which this explanation is supported by industry-level data. Gilchrist presented their paper at the conference.

In your research, you looked at the post-1990 flattening of the Phillips curve and whether it has been related to globalization. To begin with, why is the flattening of the Phillips curve important?

Gilchrist: A flattened Phillips curve is showing that inflation will be less responsive to economic slack. That could help us understand recent environments where we have seen significant declines in the unemployment rate but very little inflationary pressure. And relatedly, during the Great Recession period, we saw a substantial increase in economic slack and an increase in the unemployment rate and, again, very little price response.

So we're trying to understand the extent to which inflation has become decoupled from economic

activity in that sense. That has policy implications regarding the extent to which monetary policy will be effective in keeping inflation under control.

You looked at the effect of globalization on the Phillips curve relationship at the industry level. How did you measure that?

Gilchrist: To start with, we had very detailed industry categories, six-digit NAICS industry categories, and at that level of detail, we also had measures of the trade exposure of that industry. The trade exposure is measured by the ratio of the sum of imports plus exports divided by shipments. With that trade exposure measure in hand, we examined the response of inflation to industry-level output and whether or not that differed depending on whether the industries were high trade-exposure or low trade-exposure industries. We defined the industry trade exposure cutoff for the two categories so that 50 percent of employment fell in each category.

Then we did two things in our empirical analysis. First of all, we estimated fairly standard-looking Phillips curve relationships, regressing inflation at the one-quarter to four-quarter horizon on measures of industry slack. We found that, indeed, industries that have low trade exposure were roughly three times more responsive to industry slack measures in terms of their price response than the industries with high trade exposure.

The second thing we did was ask whether or not we saw the same pattern in response to changes in aggregate economic conditions. So rather than focusing on the industry variation, we said, well, let's look at something that causes a contraction in aggregate economic activity.

We then traced out the effect on the industry activity for each industry and on the response of industry inflation as well. And again, we found the

same thing, which is that the industries that were classified as having low trade exposure had a price response three times larger than the industries classified as high trade exposure. We also found that the output of these industries responded by roughly the same amount.

Does it seem to make a difference whether the shocks to output are financial shocks or nonfinancial ones?

Gilchrist: Well, we focused primarily on the financial shocks, and we interpreted the financial shocks as a shock that causes an overall contraction in economic activity and looks a lot like what one would traditionally call a demand shock, an aggregate demand shock.

We also looked at shocks to conditions in the commodity markets as a way of looking at responses to supply shocks. We found a fairly similar pattern there.

What do you think is the mechanism that makes inflation in these highly trade-intensive or trade-exposed industries so much less responsive to changes in economic activity?

Gilchrist: I think there are two broad hypotheses to think about. The first one has to do with marginal costs. Traditionally, we think that prices should respond to marginal costs. It might be that because these industries are trade-intensive, their marginal costs might not vary so strongly with the output movements that you see.

In that situation, a relatively large fluctuation in output wouldn't necessarily lead to a large fluctuation in marginal cost. Given that there's not a big movement in marginal cost, there aren't necessarily large movements in prices. So that's a first mechanism — basically to say that globalization attenuates the response of marginal cost to local economic conditions precisely because companies are importing a significant fraction of their inputs from abroad.

The second mechanism is related to the pricing behavior of the firms. To the extent that they set their prices with reference to global markets as

well as local markets, then in response to changes in local economic activity, they might still want to keep their overall prices stable for the global market. In that case, they would then be less responsive in terms of how their price changes in response to local demand conditions.

Are you able to say which of those dominates, if either of them does?

Gilchrist: It will require further research. This was very much a preliminary look at the data, and the pattern seemed fairly strong. I think now the next step is to try and decompose these two mechanisms. Examining import intensity versus export intensity, for example, would be one way to do that. And perhaps some other considerations as well.

On a global level, would you expect to see similar results to the ones you found in the United States?

Gilchrist: I think the question is whether or not these trade-intensive industries are more responsive to global factors than the less trade-intensive industries. That's something that has been explored by other researchers but not, I think, with the level



of detail that we have in this dataset. So asking the extent to which trade exposure changes your response to global factors is also of great interest, I think.

Is there anything that can be said about whether this phenomenon, the differences in industry-level responsiveness, would be found in a developing economy?

Gilchrist: I think the basic reasoning should apply to both developed and developing economies: industries that rely more on local inputs are going to be more sensitive to local demand conditions, and industries that rely more on global markets for customers are also likely to be less sensitive to local economic conditions. So I don't see any strong reason why this wouldn't apply to developed economies as well as developing economies. It might be that for other reasons, developing economies are more sensitive to certain local factors such as, say, credit conditions. Typically, we think access to credit is more of an impediment in developing economies than in developed economies. But broadly speaking, I think this is a phenomenon that would translate across a variety of economic settings.

You mentioned earlier that there are policy implications to these findings in terms of the effectiveness of monetary policy. Could you elaborate on that?

Gilchrist: I think one clear example would be the extent to which policy is coordinated across countries. Monetary policy conducted in isolation is going to have less of an effect on trade-intensive industries than a monetary policy that's more global in nature. So I think that's one important consideration to think about.

And then I think probably the other important consideration is that monetary policy conducted by the Fed may have stronger effects in certain markets than in other markets on account of their trade exposures. That's another consideration to think about. ■



The Neo-Fisher Effect: Econometric Evidence from Empirical and Optimizing Models

by Martín Uribe



Martín Uribe of Columbia University looked at the effects of permanent and temporary changes in the nominal interest rate — that is, changes that were perceived to be permanent or temporary. Analyzing postwar data, he considered whether

the permanent or temporary nature of the changes affected inflation, output, and the real interest rate. He found that the results are consistent with the idea that a credible announcement by the central bank of a gradual return of nominal interest rates to “normal” levels on a long-term basis can both increase below-target inflation to its desired level and support a mild expansion of the economy.

What led you to pursue this research?

Uribe: The paper is motivated by two empirical observations. One is that many countries and regions of the world are experiencing low, and in many cases negative, rates of inflation, significantly below their intended targets. The second empirical observation is that these countries have very low, and in many cases effectively zero, nominal interest rates. So an important question for central bankers in these countries and regions of the world is how to bring inflation rates up to their targets. Countries that are in this predicament include Japan, Korea, the eurozone, and, until recently, the United States itself.

In the title of the paper, you refer to the “Neo-Fisher effect.” What do you mean by that?

Uribe: To define what I mean by the Neo-Fisher effect, I have to explain what is meant by the Fisher effect without the “neo.”

The Fisher effect precedes the Neo-Fisher effect. It says that there is a positive relationship between the rate of inflation and the nominal interest rate in the long run. For example, if you take data for a long period of time, say thirty years, on inflation and the nominal interest rate, you will see that, on average, countries that have experienced high levels of inflation have also had high nominal interest rates and countries that have experienced low levels of inflation also have low nominal interest rates. That’s the Fisher effect.

The Neo-Fisher effect says that if the central bank announces an increase in the nominal interest rate that is expected to be permanent, the inflation rate increases not only in the long run, but also even in the short run. That short-run increase in the inflation rate in response to an increase in the nominal interest rate that is expected to be permanent is what I mean in my work by the Neo-Fisher effect.

This concept is sometimes thought to be counter-intuitive. I think the reason is that economists and central banks alike are used to thinking about changes in policy rates in terms of the effects that transitory changes in interest rates produce on inflation.

For instance, say the central bank has an interest rate of 4 percent and increases it to 5.5 percent, and that increase of 1.5 percentage points is expected to slowly disappear and go back to 4 percent in around two years. That kind of increase in the nominal interest rate does have the conventional effect. That is to say, the central bank increases the nominal interest rate and inflation goes down.

Now suppose the central bank is instead making a change to the nominal rate that is expect to be of a

more permanent nature. It could be that the central bank engages, for instance, in a process of normalization of rates where the nominal interest goes from a very low level of near zero to a historically more normal level of, say, 4 percent. That type of change in policy rate is what the Neo-Fisher effect is about.

The normalization we're seeing in the United States, where the Fed has gradually increased its nominal interest rate target, does not seem to be transitory. Do you see any evidence that the policy is being driven by Neo-Fisherian ideas?

Uribe: What I do see is that when the Fed started to normalize rates in late 2015, the rate of inflation at the time was 1 percentage point below target. It was around 1 percent with a target of 2 percent. Since the process of normalization, what we have seen has been a gradual increase in nominal interest rates together with a gradual increase in the rate of inflation and a strengthening of the level of economic activity. That is not proof that the nominal interest rate and the level of aggregate activity are driven by a Neo-Fisher effect, but it's certainly consistent with the concept of the Neo-Fisher effect.

What were the results of your research?

Uribe: The main result of the paper is to show econometric evidence that the Neo-Fisher effect is present in postwar U.S. data. That is to say, in the United States, increases in the nominal interest rate that were of a permanent nature have been associated with increases in the rate of inflation in the short run and without loss of aggregate activity.

For the public to know that an increase is going to be permanent and therefore increase inflation in the short run, there has to be some sort of credible signal given to the public saying this is not a transitory increase. How do you tease that out?

Uribe: Well, from an econometric point of view, what I do is to focus on the components of the interest rates that are cointegrated with the components of

inflation and see how changes in those components are associated with changes in the policy rate and changes in inflation.

The model is based on the assumption that the monetary authority is credible. In terms of actual Fed policy, it is reasonable to believe, especially since the Volcker era, that the monetary authority is quite credible, especially in the U.S. For instance, few people, if anyone, doubted that when the Fed announced a normalization of rates in late 2015 that the announcement of those progressive increases in rates would take place. That was less true before the Volcker era; there was a process of acquisition of credibility starting in the late 1970s.

What share of postwar U.S. inflation can be explained by permanent monetary policy shocks?

Uribe: The econometric evidence in my paper shows that permanent monetary shocks are quite significant and explain on average around 40 percent of the variance of changes in the rate of inflation. So they have a very significant role. Transitory shocks explain a much smaller share of inflation.



What are the implications of your paper?

Uribe: I think there are implications along three different dimensions: policy implications, theoretical implications, and econometric implications.

Regarding policy implications, I think the most relevant is that if a central bank is dealing with inflation that is significantly below target, has nominal interest rates close to zero, and announces a gradual and a credible normalization of rates, the most likely scenario is that the inflation rate is going to start to move up toward hitting the inflation target in the short run. That process of normalization of both the nominal rate and the inflation rate itself will take place in the context of a mild expansion. That is to say, the process of normalization of rates will not be associated with a contraction.

The main theoretical implication of my work, I believe, is to call attention to the need for permanent monetary shocks to become a regular feature of monetary macro models — both those belonging to the family of empirical models and those belonging to the family of optimizing dynamic stochastic general equilibrium, or DSGE, models. Transitory monetary shocks are a regular feature of such models but much less often do we see permanent monetary shocks appearing in them.

The econometric implication is more or less of a more technical nature. What the paper brings to the table there is an econometric technique that allows for the estimation of structural vector autoregression models, or SVARs, with more identified shocks than time series. This is an estimation study that borrows from the techniques we use to estimate DSGE models.

That kind of exercise was not possible in the context of SVAR models. For instance, if the SVAR is about monetary policy, it limits itself to identifying one shock, which is the monetary shock. If the SVAR is about fiscal policy, it identifies one shock, mainly the lower expenditure shock, or two shocks, the tax shock and the government expenditure shock and so on. What the technique that I employ in this paper allows is to estimate or identify in the context of the SVAR more shocks than time series. For instance, in the exercise that I perform in the paper, I have three

time series and I estimate four shocks plus three measurement shocks.

Do you have any reason to believe that if you were to look at postwar data from countries other than the United States or if you were to look at, say, a panel of countries, that the results would have been any different?

Uribe: In the paper, as a robustness check, I estimate the model using Japanese data over the postwar period, mid-1950s until now, and I find that the results I obtained in the U.S. are robust to use in Japanese data. So the Neo-Fisher effect appears to be a feature also of the Japanese data.

I cannot generalize that to other countries, but based on that evidence on two important big developed countries, I could conjecture that it would be likely to find similar results for other developed countries. I'm working with a colleague of mine here at Columbia, Stephanie Schmitt-Grohé, on an extension of this paper to a multicountry setting.

Is there anything you can tell us about the results at this point?

Uribe: I can advance to you one result that we find, and that is that the well-known effect on overshooting and on deviations from uncovered interest rate parity are completely reversed when one thinks about temporary versus permanent changes in the nominal interest rate. ■

Flex-Price Monetary Policy

by Narayana Kocherlakota



Most central banks aren't committed to a fixed interest rate rule, yet their choices do exhibit significant persistence. This might suggest, argues Narayana Kocherlakota of the University of Rochester and the former president

of the Minneapolis Fed, that they can be seen as being committed to a rule for roughly a year or two. But are central banks employing the most useful frameworks for determining policy over such periods? He argues, among other things, that central banks must employ models that incorporate bounds on firm pricing, otherwise those models will be unable to yield predictions about the outcomes of many relevant policy choices.

How does this paper relate to existing models of monetary policy?

Kocherlakota: In the academic context, the prevailing idea is that any change you see in output in the long run has to be coming from the supply side, the real side of the economy. You look at how long output has been low in Japan relative to expectations, or in Greece, and the immediate thinking in academia is that it can't be driven by monetary policy. It can't be the nominal side that's driving it; it has to be the real side. The point of this paper is that even after prices have had a chance to adjust, this model will tell you that you could still have demand-determined output.

The fact of the matter is that those countries that have monetary policy challenges also have

other challenges. So there's a temptation in the case of Japan to say, look, there are a bunch of other issues that are going on in terms of the way their labor markets are organized, in the way their firms compete, and that's what's dragging output downward. The same thing holds with Greece. There are absolutely things you can point to with Greece at a high level that seem like problems on the real side as well as on the nominal side. We have all been taught these frameworks, and the organizational models we have in our heads all say that in the long run it has to come from the real side. To move away from that is a very big change in thinking.

To be clear, I'm a pro-model person. I'm a theorist. But on the other hand, when you see the data from Japan and the data from Greece, I think you have to be willing to say that maybe there's something missing from the way we have been viewing the world.

When did you start thinking about this line of research?

Kocherlakota: It seemed like the effects of the interaction between monetary policy and the real side of the economy just persisted, in the United States and then in Europe and in Japan, much longer than could be accounted for through things like the frequency of price changes. So we had a lot of great work done on the micro side to say, look, prices change actually very often. And even wages, which change less frequently, change fairly often.

It's hard to talk about that if your models, your vision of the world, did not seem to be capturing the persistence of the effects of monetary policy on the economy that I was seeing in my previous job. So I was thinking about how we can make a change.

Why is a model without pricing bounds an ineffective tool for central banks? And given that, why have such models become common — maybe less so among central banks, but within the profession?

Kocherlakota: Without pricing bounds, the model is a much less effective tool because if demand is too low relative to supply, the model without pricing bounds tells you simply that the firms want to engage in a price war. That seems natural enough: demand is low, and they're going to compete with each other by pricing. And without a bound, the model says, "I don't understand what a price war is." It's like one of these old sci-fi TV shows where you ask a computer a question and the computer says, "That doesn't compute."

That's what happens. The model says, "I don't know what to make of a price war." If you add a bound, now the model says, "Okay, now I know what a price war is; they're all going to go to the bound." That's basically a way to make sense of the fact that low demand leads to price wars among firms.

As for the second part of your question, why models without pricing bounds have become standard, let me talk about the central bank front first and then circle back to the academic front. What happens in my model is that you have a flat portion of the Phillips curve and a vertical portion of the Phillips curve. When the economy is demand-constrained, you're basically in the flat portion of the Phillips curve, and when the economy is supply-constrained, you're in the vertical portion of the Phillips curve. This, I think, is not that different from the way central bankers think about the macroeconomy. It has gotten flatter than maybe they would have thought possible, but the idea is that right now we are on a flat portion and that represents demand constraints. At some point, the central bank would stimulate the economy so that actually output wouldn't be responsive but inflation would be responsive. That is a very powerful organizational device for how central bankers think about the world.

They don't think about pricing bounds. You don't need to know every last detail of the microfoundation

of the macroeconomy to be an effective central banker. And you don't worry about that when you're in that job. But you have to know something about how the Phillips curve works, so that if you stimulate demand, you know how that is going to show up in prices versus output. That's what you really need to know. My model is largely congruent with that.

Now we circle back to the academic front. When you go back to the 1970s, it seemed pretty clear by the end of the decade that we were on a pretty steep portion of the Phillips curve — meaning that stimulus was showing up mainly in prices and much less in output. That led to the real business cycle (RBC) revolution. Well ironically, or maybe there's a deeper reason that I don't know, almost immediately after that revolution took place, the Phillips curve became extremely flat. But the problem is we started with the RBC model where the Phillips curve is vertical and haven't really moved away from that.

So we get these short-run deviations from verticality but not over the long run. It's a matter of timing. The RBC revolution started in a world where the Phillips curve was vertical, and if you wanted to understand output, you wanted to understand the supply side and that's it.

And then, we've had the New Keynesian addendum to the RBC world. And that allows for some short- to medium-term deviations from verticality in the Phillips curve but not very much. Many of those models would predict completely vertical Phillips curves even if you are looking at quarterly data. It's just been hard to get people to move away from anything more than slight deviations of the real business cycle modeling of the 1980s.

Do you believe monetary policy has been too tight?

Kocherlakota: In the beginning of 2012, I was arguing that policy had been too tight. My only regret is that the policies I was arguing for, which were viewed as ridiculously dovish, were actually still too tight.

I think you see the outcomes in growth and inflation. I think it's very clear — to me, at least —

that policy has not been as easy as we want it to be, but I think my model gives you maybe a different way to formulate this, which is really all about the slope of the Phillips curve. As long as we agree that the slope of the Phillips curve is as flat as it seems to be in the data, so that we can stimulate output without much impact on inflation at all, I think we all have to say that policy has been too tight.

You assume in your paper that central banks are unable to commit themselves to a monetary policy rule for more than a year or two. Do you think that is actually the case, or is it just a feature of the model?

Kocherlakota: I think in practice central banks can't commit themselves to a rule for more than a year or two. In fact, I actually think the controversy in terms of the assumption I made in the model is whether they can really commit themselves for that long. If you have an institution that comes together eight times a year, they will want to do things. So I do think that in the last fifteen years, the Fed, excepting emergencies, has attempted to commit itself while allowing escape clauses. That's about the best you can hope for. I don't really believe that the central bank can commit itself to a rule for more than a year

or two; there's just too much change of personnel, too much change in what we know in the economy.

The profession is going more in the direction of using microdata for work in macro. Has that been a useful development?

Kocherlakota: I have a paper I've written that's called "Practical Policy Evaluation," which argues against the microfoundation approach.

I think there are two kinds of policy questions that come up in the world, and one is about regimes: for instance, should the United States have a 2 percent inflation target for the rest of all time or a 4 percent inflation target? That's a regime question. You might want to know a bunch of things about changing the regime in that way, such as whether the rich are going to benefit more than the poor. And then you might want to know a lot of details about how people would respond. There, I think the microfoundation and the microdata approach has been a good thing for us.

Now, there are a bunch of other questions we get asked all the time. For instance, suppose we have a new 2 percent inflation target — how much should we be raising rates, if at all, at this stage? With those





kinds of questions, I'm much less convinced the microfoundation approach really matters because you have two goals, unemployment and inflation, and it's really about how interest rates influence them. As long as that connection between your tool and your objectives is one that you understand reasonably well, then there's no reason to have a deeper microfoundation. I don't need to know how aspirin works to know that it's a good thing to take when I have a headache.

You might want somebody working on whether aspirin works or not. But my problem with it is I feel we may be overtilted toward a more basic science approach. We don't have as much work taking place on what I would call the more practical, more everyday kinds of policy questions.

What extensions do you plan to add to this work?

Kocherlakota: I definitely want to add investment. I think the challenge is that we don't really understand the drivers of investment very well. And a model of this kind is going to really stress real interest rates as being the key driver for investment. And that does not seem to be true in the data. I do want to add investment and I want to be able to think about it, but I think it's going to be a very steep climb.

The only thing I would emphasize again is that I worry that we have compartmentalized macro too much. There has been a lot of work trying to understand asset prices. A lot of that has been largely unsuccessful; it's been very difficult to model. And the reaction in macroeconomics has been, "Well, let's just ignore asset prices, then." But the failure to model asset pricing correctly is probably a clue about other failings in our models as well.

And the same is true of inflation. I think the struggle we are having in understanding inflation dynamics is a clue about something very fundamental in the macroeconomy and in terms of what policy should be doing on an ongoing basis in terms of real outcomes. And that's a lesson I worry is not being taken on board. ■



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