# Monetary Policy and the Crosswinds of Change

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Federal Reserve Bank of Atlanta and
Federal Reserve Bank of Dallas Conference
Technology-Enabled Disruption: Implications for Business,
Labor Markets and Monetary Policy
Dallas, TX
May 25, 2018

FEDERAL RESERVE BANK OF CHICAGO

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**Introduction**

Before I begin, let me remind you that my comments here today are my own and do not necessarily reflect the views of the Federal Reserve System or the Federal Open Market Committee (FOMC). This session is about how innovations in technology may potentially influence the macroeconomy and, in response, how central banks should conduct monetary policy. As we've heard at this conference, advances in technologies such as machine learning (ML) and artificial intelligence (AI) are big news, with important implications for almost every sector of the economy. And for economists they provide lots of opportunities and lots of challenges.

First, let's consider the opportunities: Researchers now have access to masses of new data and better computing power. This is really cool for me and my staff as we are data users—after all, most economists are data scientists. These tools are great for basic economic research, especially for the work of microeconomists. But there's lots of scope for macroeconomists as well. Some of these data may help us more precisely identify key policymaking parameters—for example, how consumer spending and business spending respond to tax changes.

These tools may also help improve our ability to forecast short-term movements in the economy. In particular, we could see some exciting new indicators of the business cycle derived from new sources of big data. Here, though, there may be limits to what we can learn from big data, at least for a while. The business cycle is in essence about small data. There just haven't been a lot of business cycles, and each one has idiosyncratic features. And big data weren't available during past business cycles, so cross-cycle comparisons are not possible. We're stuck with this situation.

But this session isn't really about the use of big data. It's about the consequences of large-scale technological innovation. So, now let's discuss the challenges: Such innovation could create challenges for monetary policymakers if it leads to hard-to-identify changes in the structure of macroeconomic relationships that might influence the business cycle. And in the end, that's what we monetary policy folks are concerned about—the business cycle.

The potential structural changes that come with innovation can affect the evolution of inflation and employment. As such, they may have implications for the achievement of our dual mandate objectives of maximum employment and price stability. For instance, these changes could generate headwinds for inflation that mean we might need to provide more accommodation to reach our inflation target than we have in the past. But we don't know that. Perhaps these forces will lead to higher inflationary pressures that policy might have to counteract. There's a lot we don't really understand yet.

**Dealing with an evolving economic structure is an old problem**
Of course, making policy in the presence of a changing economy is nothing new; we have dealt with lots of structural changes before. History offers plenty of examples.

Chairman Greenspan (1998) grappled with this issue almost 20 years ago when he considered the possibility of a "new economy." He said, and I quote:

> There is no question that events are continually altering the shape and nature of our economic processes, especially the extent to which technological breakthroughs have advanced and perhaps, most recently, even accelerated the pace of conceptualization of our gross domestic product. We have dramatically reduced the size of our radios, for example, by substituting transistors for vacuum tubes. Thin fiber-optic cable has replaced huge tonnages of copper wire. New architectural, engineering, and materials technologies have enabled the construction of buildings enclosing the same space but with far less physical material than was required, say, 50 or 100 years ago. Most recently, mobile phones have been markedly downsized as they have been improved. As a consequence, the physical weight of our GDP is growing only very gradually. The exploitation of new concepts accounts for virtually all of the inflation-adjusted growth in output.[1]

Going back even further, more than 50 years ago, a *Time* magazine article on "the automation jobless" reported that "automation may prevent the economy from creating enough new jobs… . In the past, new industries hired far more people than those they put out of business. But this is not true of many of today's new industries."[2] Sounds familiar, doesn't it? And in 1964 these concerns were broad enough to warrant the creation of a presidential commission to study the implications of new technologies.[3]

**Influences on the economy and policymaking**
We don't know how various innovations will ultimately play out and how they will affect the economy. Figuring out the effects of these developments is complicated: The sign, magnitude, and timing of their impact are all uncertain.

Technological advances can lead to conflicting effects. For instance, internet commerce may make markets more competitive. This might lead to lower prices and push inflation lower in the short run. But it may also allow companies to price-discriminate better, making markets less competitive and leading to higher average prices**.**

[1] Greenspan (1998).
[2] Time Inc. (1961).
[3] The National Commission on Technology, Automation, and Economic Progress was established by President Lyndon B. Johnson on August 19, 1964. For further details, see Johnson (1964).

I would also note that a decent-size literature has emerged on the rise of industry concentration in general, not just in internet retailing. This is an issue economists are thinking about a good deal, but there is as yet no consensus.[4]

These new technologies can affect the natural rate of unemployment too. The natural rate of unemployment is the unemployment rate that would prevail in an economy making full use of its productive resources. We sometimes refer to this natural rate as *u**. Online job boards and other technology may be improving matching efficiency. If so, *u** would be lower. But these new technologies can also cause *u** to rise. This would happen, for example, if people become more specialized and labor markets become less fluid as a result.

We've struggled to understand the effects of changing *u** before. In the 1990s, there were indications that the rise of labor market intermediaries such as temporary help firms was lowering the natural rate. And in 2010, an increase in vacancy measures without a drop in unemployment led some to conclude the natural rate had risen.

Dynamic issues related to innovation may also cause difficulties for policymakers because some effects might be different in the short run than in the long run. For instance, firms might be charging low prices today to acquire a first-mover advantage in certain markets. They might for a time operate at a loss. But if successful in establishing a foothold, they hope to charge higher prices and be more profitable in the future.

Technological change also poses important challenges for the standard statistical measures of prices. Here too the effects can go both ways.[5] On one side, standard measures might not be factoring in correctly the time cost borne by the user. For instance, when booking your travel tickets online, you cut out the intermediary, and that is probably efficient as a whole; but you also have to do more work for yourself than you used to. The same is true for pumping your own gas or using the self-checkout line. If not accounted for, this would understate inflation. But we might also be overstating inflation by not incorporating quality improvements, increased varieties of products, the value of free content, and the like. Of course, in either direction, such inflation mismeasurement has consequences for output mismeasurement as well.

Monetary policy relies on the economic relationships between the tools we control—for instance, the short-term interest rate—and our policy objectives. Technological innovation may be changing these relationships. For example, it must be much easier for firms to change online prices than it is for them to change prices in a physical store. That might make prices in the overall economy less sticky, which would change the parameters of the Phillips curve relationship that is important to much of monetary policy analysis.[6] But this is pure conjecture at this stage.

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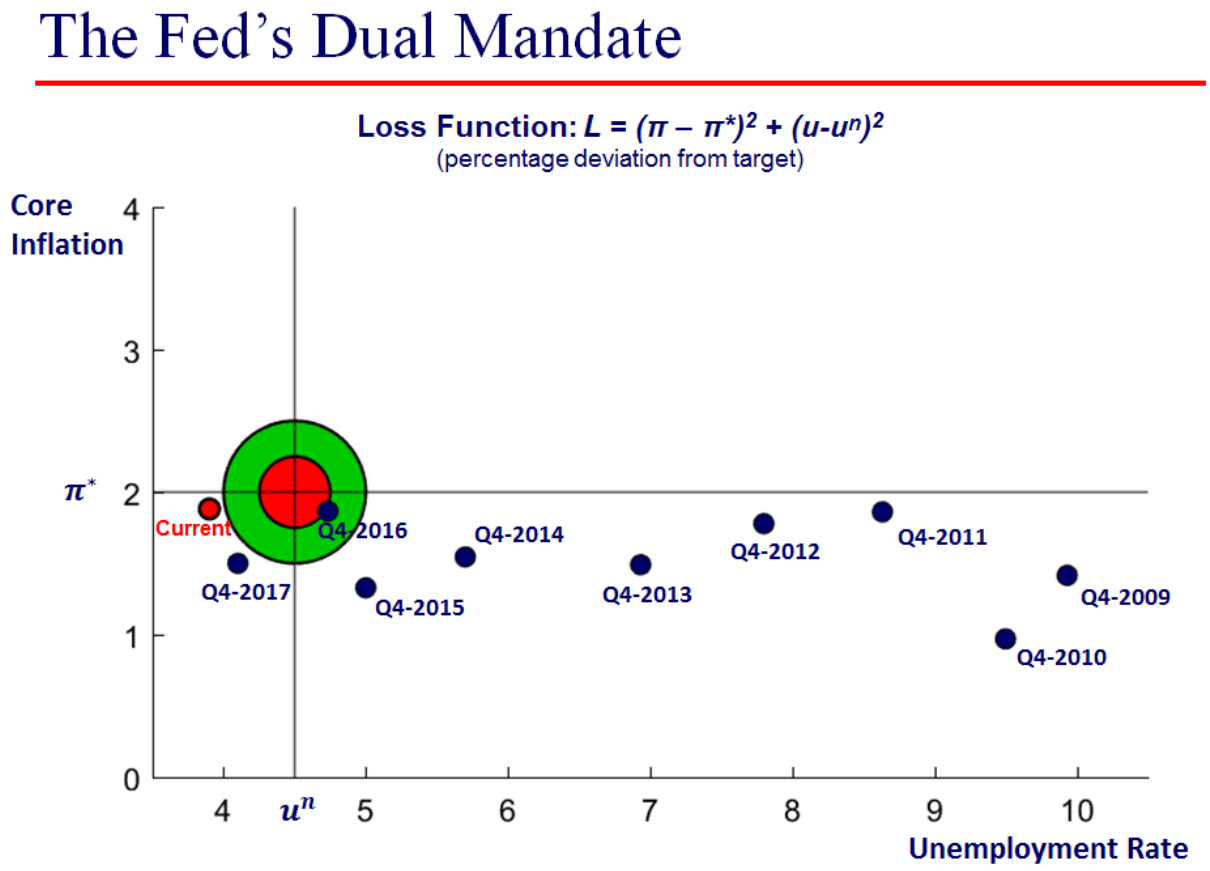
[4] See, for example, De Loecker and Eeckhout (2017) and Karabarbounis and Neiman (2018).
[5] For a discussion, see Brynjolfsson, Rock, and Syverson (2017).
[6] The Phillips curve is a statistical relationship that describes a negative correlation between inflation and unemployment—that is, lower unemployment is associated with higher price and wage inflation. It is often drawn as a negatively sloped curve that has a measure of labor market tightness, such as the

**Outcome-based policy is a robust response**
Technological advances create a difficult picture to read and present a challenge for policymakers.




*Natural rate of unemployment taken from the median of the long-run Projections in the FOMC Summary of Economic Projections, currently equal to 4.5%. Inflation target of 2% was first announced in January 2012.*
*Source: Federal Open Market Committee, Bureau of Economic Analysis and Bureau of Labor Statistics from Haver Analytics*

The FOMC's goal is to reach the center of the bull's-eye where the economy is at its natural rate of unemployment and inflation is 2 percent. The inflation target is the choice of the central bank. As I've just discussed, technological change could have some effect on the natural rate of unemployment. It could also influence how the economy responds to monetary policy adjustments—and thus the speed at which we are able to obtain our policy objectives. However, the magnitudes and even the signs of these effects are highly uncertain.

One message is that following a fixed rule to determine the setting of our instruments may not be the best strategy to follow in a changing environment. In general, such changes can reduce the effectiveness of a strict instrument-setting rule or, at times,

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unemployment rate, on the horizontal axis and a measure of wage or price inflation on the vertical axis. See Phillips (1958).

even make it counterproductive. For instance, it would be a mistake to set policy according to a Taylor rule with a 2 percent intercept if we think the equilibrium funds rate is different from 2 percent—perhaps, for example, because of the influences of technological change and its diffusion on the economy.[7]

And, while machine learning and artificial intelligence might become helpful in identifying emerging trends, I don't see them coming up with a better rule that will replace us central bankers any time soon! We economists have a lot of experience data mining—and we know the pitfalls of taking it out of sample in a changing environment.

Fundamentally, what's important is the Fed's ability to deliver on our mandated policy goals of full employment and price stability. A policy focused on hitting mandated outcomes and managing risks against adverse scenarios—something I often refer to as outcome-based policy—can avoid missteps that might come from strict adherence to a fixed policy rule. Execution of outcome-based policy often requires using informed discretion in instrument setting. And by doing so, a central bank can do a better job in delivering on its ultimate employment and inflation targets.

Indeed, we may never be able to come up with good estimates of how the various crosscurrents associated with AI and ML are affecting the aggregate economy. But we will be able to observe whether our current policy coincides with restrictive, disinflationary financial conditions or with undesired inflationary pressures. We can then adjust the setting of policy accordingly.

So, while structural change may make our task more challenging, it's something we have been dealing with for a long time. And hopefully, we can continue to navigate our way through it by keeping a close eye on our policy objectives.

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[7] The equilibrium federal funds rate is the funds rate associated with a neutral monetary policy (policy that is neither expansionary nor contractionary).

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