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***“Estimating Key Economic Variables:
The Policy Implications”***

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President & Chief Executive Officer
Federal Reserve Bank of Boston

*84th International Atlantic Economic Conference
International Atlantic Economic Society*

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Good morning. It is a pleasure to be with you in Montreal. I’d like to thank the International Atlantic Economic Society for inviting me to share my views on the economy today. At the outset, let me note as I always do that the views I express are my own, not necessarily those of my colleagues on the Federal Reserve Board or the Federal Open Market Committee (FOMC).

Every economic recovery has its own unique puzzles. Certainly, one puzzle in the most recent recovery is why it has been so difficult for central banks in many developed economies to achieve their inflation objectives, even as employment has rebounded. Both Japan and the

United States are at or beyond many estimates of full employment, and the Euro Area has made significant progress toward full employment – and yet, inflation in all three areas remains below targets set by their respective central banks. One would expect robust employment conditions to nudge up wages and in turn prices, leading the inflation rate towards its target.

One possible explanation for this puzzle could be that what economists call the “natural rate” of unemployment – the unemployment rate that is consistent with an inflation rate at its target value – may have fallen. A lower *natural* rate of unemployment in the economy might explain why lower *actual* levels of unemployment are not driving up wages and prices as quickly as some have expected. In fact, Federal Reserve policymakers – the participants in the FOMC – have lowered their estimates of the unemployment rate that they expect in the long run.

While it is certainly possible that the natural rate of unemployment for the U.S. economy is now lower, I believe some caution is in order in making this assessment. Short-run estimates of the natural rate have tended to follow the actual unemployment rate fairly closely; hence, policymakers’ estimates of full employment¹ tend to be lower when the economy is doing well and higher when the economy is doing less well. But with the benefit of hindsight, estimates of the natural rate are less variable than initially thought, tracking actual unemployment less closely.²

Modest and gradual movements in the natural rate are consistent with the sense that long-term economic trends, such as improvement in human capital and demographic changes, are the main source of variation in the natural rate. Such changes are unlikely to occur quickly or in unexpected ways over relatively short time periods, such as over a business cycle.

So, since I do not believe a significant decline in the natural rate of unemployment explains the subdued-inflation puzzle, it remains just that – a puzzle.

A second surprise in this recovery has been the relatively slow rate of economic growth we have experienced in the U.S., despite unusually low interest rates. While short-term *real* interest rates have actually been negative throughout the recovery – clearly, very accommodative monetary conditions – the economy has still grown at a rather tepid rate of about 2 percent. A common explanation for this dynamic has been that the equilibrium interest rate – the interest rate that in the long run is consistent with stable inflation and full employment – has fallen.

In this case, the movement does seem more understandable. What policymakers call “potential GDP growth” has declined. Indeed, FOMC participants are surveyed on their views of what the long-run sustainable interest rate, and GDP growth rate, will be in the longer term – and both estimates have fallen quite substantially.

However, like the natural rate of unemployment, the equilibrium interest rate can only be inferred, rather than known. The rapid decline in estimates of the equilibrium interest rate should also be viewed cautiously, given the imprecision in estimation – and given how much estimates have varied over a relatively short time period.

The relatively rapid changes in these estimates of variables like the natural rate of unemployment and the equilibrium interest rate may of course reflect actual changes in economic relationships. However, they also may attempt to explain developments in “high frequency” information with changes in relatively “low frequency concepts,” and stretch too far in attempting to explain developments in economic measures. While attempting to infer possible long-run changes or implications from recent high frequency data may be reasonable, history

shows that policymakers tend to place too much weight on short-term fluctuations in their real-time estimates of long-run concepts.

This tendency is of more than academic interest. One can make significant policy mistakes if one assumes incorrectly that significant changes in long-run variables have occurred, when in fact no change has occurred.³ Central bankers should hesitate to change their policy stance based on estimated changes in long-run variables that in statistical terms are not large, relative to the standard errors with which these quantities are estimated.

In my own view, maintaining negative real short-term rates once we have achieved full employment risks the potential of an eventual overheating of the economy, which could be reflected in higher wages and prices, or higher asset prices. Already-tight labor markets are likely to tighten further as the economy continues to grow faster than its potential. In these circumstances, prudent risk management would argue for the continued gradual removal of monetary policy accommodation in order to minimize the risk of outcomes that might prematurely shorten the current economic recovery.

Recovery Puzzles

It is not particularly surprising that the economic recovery, in the wake of a financial crisis, has been quite slow. Studies of earlier episodes find that recoveries following financial crises are usually slow – as firms and households are understandably more risk averse, and the collateral values that are essential for obtaining financing are slow to rebound. However, what has been more surprising is how slowly wages and prices are growing a decade after the onset of the Great Recession.⁴

Figure 1 shows the unemployment rate in the United States, the Euro Area, and Japan. By this measure, there has been significant improvement in all three economies. In both the U.S. and Japan, unemployment rates are now below levels reported immediately prior to the Great Recession. In the case of the Euro Area, the unemployment rate is still elevated, but is on a path reflecting relatively consistent improvement.

In contrast, **Figure 2** shows that the progress on achieving stated inflation targets has been somewhat disappointing. In all three regions, inflation rates are currently below their 2 percent targets. While there have been periods during the recovery when measures of total inflation have temporarily exceeded 2 percent, the inflation rate has remained below target for much of the recovery. For example, the total PCE inflation rate in the U.S. over the last year has most recently averaged only 1.4 percent. In Japan, the inflation rate has been particularly low, possibly reflecting a fall in the expected inflation rate due to the very long period when actual inflation has been below the 2 percent target.

One Puzzle: Implications of Low Inflation

During periods of substantial slack in the economy, it is not surprising that wage and price inflation are modest. However, as we reach or exceed many economists' estimates of full employment, one might expect that wage and price pressures would gradually increase. One way that economists try to capture this relationship is through the Phillips Curve, which describes inflation as being generated by expectations of future inflation and the amount of labor-market slack in the economy. One challenge of this simple formulation involves how best

to capture the amount of slack in the economy. The measurement of slack depends on obtaining an estimate of the natural rate of unemployment.⁵

Figure 3 provides estimates of the natural rate of unemployment and forecasts of the unemployment rate in the longer run. The dark blue line is the median of FOMC policymaker estimates of the unemployment rate in the longer run, from the Federal Reserve’s Summary of Economic Projections (SEP). Since this is a survey, the estimates reflect what participants knew as of the time of the survey. Participants are asked the unemployment rate they expect in the longer run, assuming an absence of shocks and assuming appropriate monetary policy. A second measure – the green line – is the current Congressional Budget Office (CBO) estimate of the natural rate over the same time period. Since the financial crisis, the median estimate of FOMC participants has moved from a high of 5.45 percent, to the current low of 4.6 percent. The shaded region provides the SEP “central tendency,” the range of estimates provided by FOMC participants after excluding the three highest and three lowest responses. At times, even though the range is quite large, the bottom of the range lies above the CBO estimate of full employment, as it does from mid-2011 through 2015.

How reasonable are the estimates of the natural rate? The range of estimates highlights the uncertainty entailed in measuring this key variable. While the natural rate will change over time, most of those changes reflect gradual but significant changes in demographic characteristics of the labor force. For example, when (typically) younger workers first enter the workforce, they are more likely to be unemployed, as they may not as yet have developed marketable skills, and are thus more likely to shift jobs. In addition, they are more likely to leave the workforce to gain additional skills through higher education or training. The opposite is true of more experienced and older workers, who have developed job-specific capital and are

therefore more attached to their work and less likely to become unemployed or leave the labor force. So historically, when demographics have resulted in a higher share of younger workers in the labor force, the natural rate appears to have risen – relative to times when young workers are a smaller share of the labor force.

Figure 4 shows the share of the labor force between the ages of 16 and 24 and the CBO's estimate of the natural rate of long-term unemployment. The chart shows that with the aging of the baby boom generation, younger workers have become a relatively smaller share of the labor force. And, at the same time, the CBO's estimate of the natural rate has declined.

Figure 5 provides the share of the labor force – age 25 years and older – with at least a college degree, which has trended up over time. Better educated workers tend to have lower unemployment rates when compared with those with less educational attainment. As a result, one might expect this trend to be reflected in a lower natural rate of unemployment.

While these figures provide possible explanations for why the natural rate may change, it is important to realize that broad demographic trends are generally slow moving, well-known in advance, and thus straightforward to predict. While these trends can make a difference and do seem consistent with the moves seen in the CBO estimate of the natural rate, it is hard to match these broader demographic changes with relatively rapid and recent changes in the estimates of the natural rate seen in the SEP forecasts.

An alternative explanation of the degree of movement in the presumed natural rate may be that forecasters are overly sensitive to current economic conditions when estimating the current natural rate. When the unemployment rate is quite high, we may associate too much of

the higher unemployment rate to difficulties in matching workers to jobs. Similarly, when labor markets are very tight, as is the case presently, estimates of the natural rate may fall too much.

Figure 6 shows the actual unemployment rate with the median SEP estimate of the natural rate, and the CBO estimate of the natural rate since mid-2014. The actual unemployment rate is now below both estimates of the natural rate – and estimates of the natural rate are now lower than they were just three years ago. The SEP estimates, reflecting real-time estimates of the natural rate, move more closely with actual unemployment than the CBO estimate, which has the benefit of hindsight. This suggests exercising caution in making our natural rate estimate too responsive to incoming data.⁶

A Second Puzzle: The Low Equilibrium Rate of Interest

A second foundational concept that is difficult to estimate is the “normal” level for the federal funds rate – or what policymakers call the equilibrium nominal interest rate. As with the natural unemployment rate, the equilibrium interest rate is a concept that cannot be directly observed, but must be estimated. Also similar to the natural rate, a good proxy for estimates by FOMC members of the equilibrium funds rate is their SEP estimates for the nominal federal funds rate “in the longer run.”

Figure 7 provides the SEP forecasts since 2012. While the funds rate in the longer run was estimated at 4.25 percent early in the recovery, the estimate in the most recent SEP had fallen to 2.75 percent. Like the natural rate, there is significant variation in these estimates over time, as well as significant disagreement among SEP participants at any point in time. As the

shaded region shows, the lower boundary of the central tendency of the estimates of the equilibrium interest rate early in the sample are well above most estimates just a few years later.

As with the natural rate, there are good reasons to expect the equilibrium interest rate to change over time. In fact, in this case the level may actually be more responsive to current economic data. If we think of the interest rate as determined by the balance between savings and investment, then changes in the equilibrium interest rate will occur when the key factors determining aggregate saving and investment decisions change. These include demographic changes, which can affect global saving behavior (generally younger workers save less, older workers save more), and changes in productivity, which affect the demand for investment goods (higher productivity generally spurs investment, as it implies higher returns per dollar spent on invested goods). Increases in the propensity to save will place downward pressure on equilibrium interest rates, as the higher demand for saving implies a lower required interest rate.

In this case, one might expect to see more significant changes as, for example, variables that impact aggregate savings and investment can change. In fact, SEP participants' estimates of the equilibrium interest rate have fallen significantly over a relatively short period of time. While there may be more responsiveness to incoming economic data, and changes like much lower current estimates of productivity should impact this calculation, one should be cautious given the inherent difficulty in inferring where the equilibrium interest rate will be in the long run.

Concluding Observations

While it is important that monetary policy be “data dependent,” it is equally important that it not be too sensitive to incoming data – especially when estimating important underlying economic concepts like the natural rate of unemployment and the equilibrium interest rate. While underlying economic relationships can and do change, one should not be too quick to assume that relationships are unhinged as a result of expectation errors for “high frequency” data. It is certainly important to adjust estimates of underlying relationships when there are large persistent variations from estimated values, but too much sensitivity to incoming data can cause monetary policy to be too easy in expansions and too slow to respond to recessions.

In the current environment, the low inflation readings have provided monetary policymakers the opportunity to take a more patient approach to removing accommodation than in recent recoveries, allowing a prolonged period of recovery in labor markets. A gradual approach has many benefits, including the possibility of a long sustained recovery without risking a significant over-reaction by monetary policymakers.

However, estimates of the natural rate of unemployment and the equilibrium interest rate can be too low as well as too high. In my own view, failing to respond to very tight labor markets with rates remaining negative in real terms could potentially risk unnecessarily shortening the economic recovery, as rising inflation or an episode of financial instability eventually causes monetary policymakers to have to act more forcefully.

Thank you.

¹ That is, of the level of unemployment associated with full employment in the economy.

² See Federal Reserve Bank of Chicago study, [*Changing Labor Force Composition and the Natural Rate of Unemployment*](#), by Daniel Aaronson, Luojia Hu, Arian Seifoddini, and Daniel G. Sullivan.

³ For example, if central bankers had assumed in 2010 that the natural rate of unemployment had risen toward 9 percent, they would have been incorrect, as the data since then has shown.

⁴ For additional perspective on the economic recovery in the wake of the financial crisis, see October 2016 remarks by Eric S. Rosengren, [*After the Great Recession, a Not-So-Great Recovery*](#).

⁵ A common concept of slack employed in this context is the amount of labor market slack, usually taken as the difference between the actual unemployment rate and the rate that is consistent with full employment, called the natural rate. When unemployment is at the natural rate, the labor market does not exert pressure to move the inflation rate away from the central bank's goal for inflation (2 percent in the U.S.). Thus, this definition of slack depends on obtaining an estimate of the natural rate of unemployment, a well-defined but difficult-to-measure quantity.

⁶ Such movements in the estimates of an important underlying variable for measuring tightness in the labor market highlight that estimates can be too sensitive to recent underlying data. The CBO estimate of the natural rate tends to move only gradually, consistent with slow moving demographic variables, while the SEP estimates move much more. This suggests some caution in being too sensitive to incoming data relative to economic relationships that generally are believed to move only slowly.