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Macroeconomic Research After the Crisis

Remarks by

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Chair

Board of Governors of the Federal Reserve System

at

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Extreme economic events have often challenged existing views of how the economy works and exposed shortcomings in the collective knowledge of economists. To give two well-known examples, both the Great Depression and the stagflation of the 1970s motivated new ways of thinking about economic phenomena. More recently, the financial crisis and its aftermath might well prove to be a similar sort of turning point. Today I would like to reflect on some ways in which the events of the past few years have revealed limits in economists' understanding of the economy and suggest several important questions I hope the profession will try to answer. Some of these questions are not new, though recent events have made them more urgent. Appropriately, some are addressed by the papers prepared for this conference. Pursuing answers to these questions is vital to the work of Federal Reserve and other economic policymakers, and the Fed is likewise engaged in ongoing research to seek answers.

### **The Influence of Demand on Aggregate Supply**

The first question I would like to pose concerns the distinction between aggregate supply and aggregate demand: *Are there circumstances in which changes in aggregate demand can have an appreciable, persistent effect on aggregate supply?*

Prior to the Great Recession, most economists would probably have answered this question with a qualified "no." They would have broadly agreed with Robert Solow that economic output over the longer term is primarily driven by supply--the amount of output of goods and services the economy is capable of producing, given its labor and capital resources and existing technologies. Aggregate demand, in contrast, was seen as explaining shorter-term fluctuations around the mostly exogenous supply-determined

longer-run trend.<sup>1</sup> This conclusion deserves to be reconsidered in light of the failure of the level of economic activity to return to its pre-recession trend in most advanced economies. This post-crisis experience suggests that changes in aggregate demand may have an appreciable, persistent effect on aggregate supply--that is, on potential output.<sup>2</sup>

The idea that persistent shortfalls in aggregate demand could adversely affect the supply side of the economy--an effect commonly referred to as hysteresis--is not new; for example, the possibility was discussed back in the mid-1980s with regard to the performance of European labor markets.<sup>3</sup> But interest in the topic has increased in light of the persistent slowdown in economic growth seen in many developed economies since the crisis. Several recent studies present cross-country evidence indicating that severe and persistent recessions have historically had these sorts of long-term effects, even for downturns that appear to have resulted largely or entirely from a shock to aggregate demand.<sup>4</sup> With regard to the U.S. experience, one study estimates that the level of potential output is now 7 percent below what would have been expected based on its pre-crisis trajectory, and it argues that much of this supply-side damage is attributable to several developments that likely occurred as a result of the deep recession and slow recovery.<sup>5</sup> In particular, the study finds that in the wake of the crisis, the United States experienced a modest reduction in labor supply as a result of reduced immigration and a fall in labor force participation beyond what can be explained by cyclical conditions and

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<sup>1</sup> See Solow (1997).

<sup>2</sup> Or, as Summers (2014) asked in a pithy inversion of Say's law, is it true that "lack of demand creates lack of supply?" (p. 37).

<sup>3</sup> As Blanchard and Summers (1986) discuss, the question at the time was whether the long-run equilibrium, or "natural," rate of unemployment in European economies had been permanently raised by previous periods of high actual unemployment.

<sup>4</sup> For example, see Cerra and Saxena (2008); Howard, Martin, and Wilson (2011); Martin, Nunyan, and Wilson (2014); and Blanchard, Cerutti, and Summers (2015).

<sup>5</sup> See Reifschneider, Wascher, and Wilcox (2015).

demographic factors, as well as a marked slowdown in the estimated trend growth rate of labor productivity. The latter likely reflects an unusually slow pace of business capital accumulation since the crisis and, more conjecturally, the sharp decline in spending on research and development and the very slow pace of new firm formation in recent years.<sup>6</sup>

If we assume that hysteresis is in fact present to some degree after deep recessions, the natural next question is to ask whether it might be possible to reverse these adverse supply-side effects by temporarily running a “high-pressure economy,” with robust aggregate demand and a tight labor market. One can certainly identify plausible ways in which this might occur. Increased business sales would almost certainly raise the productive capacity of the economy by encouraging additional capital spending, especially if accompanied by reduced uncertainty about future prospects. In addition, a tight labor market might draw in potential workers who would otherwise sit on the sidelines and encourage job-to-job transitions that could also lead to more-efficient--and, hence, more-productive--job matches.<sup>7</sup> Finally, albeit more speculatively, strong demand could potentially yield significant productivity gains by, among other things, prompting higher levels of research and development spending and increasing the incentives to start new, innovative businesses.

Hysteresis effects--and the possibility they might be reversed--could have important implications for the conduct of monetary and fiscal policy. For example, hysteresis would seem to make it even more important for policymakers to act quickly

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<sup>6</sup> Fernald (2015), however, argues that much of the apparent slowdown in U.S. potential GDP growth began prior to the 2007-09 recession.

<sup>7</sup> See Okun (1973) for an early discussion of the benefits of a high-pressure economy. Importantly, not all of these benefits might show up as measured output, but they would nonetheless be welfare improving--for example, higher job satisfaction from better matches between workers and employers, as noted by Akerlof, Rose, and Yellen (1988).

and aggressively in response to a recession, because doing so would help to reduce the depth and persistence of the downturn, thereby limiting the supply-side damage that might otherwise ensue. In addition, if strong economic conditions can partially reverse supply-side damage after it has occurred, then policymakers may want to aim at being more accommodative during recoveries than would be called for under the traditional view that supply is largely independent of demand.

More research is needed, however, to better understand the influence of movements in aggregate demand on aggregate supply.<sup>8</sup> From a policy perspective, we of course need to bear in mind that an accommodative monetary stance, if maintained too long, could have costs that exceed the benefits by increasing the risk of financial instability or undermining price stability. More generally, the benefits and potential costs of pursuing such a strategy remain hard to quantify, and other policies might be better suited to address damage to the supply side of the economy.

### **Heterogeneity**

My second question asks whether individual differences within broad groups of actors in the economy can influence aggregate economic outcomes--in particular, *what effect does such heterogeneity have on aggregate demand?*

Many macroeconomists work with models where groups of individual actors, such as households or firms, are treated as a single “representative” agent whose behavior stands in for that of the group as a whole. For example, rather than explicitly modeling

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<sup>8</sup> For example, the experience of the 1990s might seem to provide a natural case study of whether reverse hysteresis is possible. Unfortunately, most studies of the labor market during this period do not directly speak to this issue, although Holzer, Raphael, and Stoll (2006) investigate changes in employers’ willingness to hire less-skilled workers during these years, while Katz and Krueger (1999) and my own study with Blinder (2001) explore the somewhat related question of how the U.S. economy was able to simultaneously experience rapid growth, low unemployment, and low inflation in the late 1990s.

and then adding up the separate actions of a large number of different households, a macro model might instead assume that the behavior of a single “average” household can describe the aggregate behavior of all households.

Prior to the financial crisis, these so-called representative-agent models were the dominant paradigm for analyzing many macroeconomic questions. However, a disaggregated approach seems needed to understand some key aspects of the Great Recession. To give one example, consider the effects of negative housing equity on consumption. Although households typically reduce their spending in response to wealth declines, the many households whose equity positions in their homes were actually driven negative by the reduction in house prices may have curtailed their spending even more sharply because of a markedly reduced ability to borrow. Such a development, in turn, would shift the relationship between housing equity (which remained solidly positive in the aggregate) and consumer spending for the economy as a whole. Such a shift in an aggregate relationship would be difficult to understand or predict without using disaggregated data and models.

More generally, studying the effects of household and firm heterogeneity might help us better account for the severity of the recession and the slow recovery. At the household level, recent research finds that heterogeneity can amplify the effects of adverse shocks, a result that is largely driven by households with very little net worth that sharply increase their savings in a recession.<sup>9</sup> At the firm level, there is evidence that financial constraints had a particularly large adverse effect on employment at small firms and the start-up of new firms, factors that may be part of the explanation for the Great

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<sup>9</sup> See Krueger, Mitman, and Perri (2016).

Recession's long duration and the subsequent slow recovery.<sup>10</sup> More generally, if larger firms seeking to expand have better access to credit than smaller ones, overall growth in investment and employment could depend in part on the distribution of sales across different types of businesses. Modeling any of these issues quantitatively will likely require the use of a heterogeneous-agent framework.

Economists' understanding of how changes in fiscal and monetary policy affect the economy might also benefit from the recognition that households and firms are heterogeneous. For example, in simple textbook models of the monetary transmission mechanism, central banks operate largely through the effect of real interest rates on consumption and investment. Once heterogeneity is taken into account, other important channels emerge. For example, spending by many households and firms appears to be quite sensitive to changes in labor income, business sales, or the value of collateral that in turn affects their access to credit--conditions that monetary policy affects only indirectly. Studying monetary models with heterogeneous agents more closely could help us shed new light on these aspects of the monetary transmission mechanism.

While the economics profession has long been aware that these issues matter, their effects had been incorporated into macro models only to a very limited extent prior to the financial crisis.<sup>11</sup> I am glad to now see a greater emphasis on the possible macroeconomic consequences of heterogeneity, including in work by economists at the

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<sup>10</sup> On the role of financing constraints for firm employment, see Siemer (2014); Chodorow-Reich (2014); and Duygan-Bump, Levkov, and Montoriol-Garriga (2015). A general-equilibrium model with heterogeneity among firms and credit frictions is studied in Khan and Thomas (2013). For the role of entry and exit in macroeconomic dynamics, see Clementi and Palazzo (2016) as well as Gourio, Messer, and Siemer (2016).

<sup>11</sup> For early quantitative work on the relationship between income and wealth heterogeneity and the macroeconomy, see Krusell and Smith (1998).

Federal Reserve.<sup>12</sup> Nevertheless, the various linkages between heterogeneity and aggregate demand are not yet well understood, either empirically or theoretically. More broadly, even though the tools of monetary policy are generally not well suited to achieve distributional objectives, it is important for policymakers to understand and monitor the effects of macroeconomic developments on different groups within society.

### **Financial Linkages to the Real Economy**

My third question concerns a key issue for monetary policy and macroeconomics that is less directly addressed by this conference: *How does the financial sector interact with the broader economy?*

In light of the housing bubble and subsequent events, policymakers clearly need to better understand what kinds of developments contribute to financial crises. What is the relationship between the buildup of excessive leverage and the value of real estate and other types of collateral, and what factors impede or facilitate the deleveraging process that follows? Does the economic fallout from a financial crisis depend on the particulars of the crisis, such as whether it involves widespread damage to household balance sheets? How does the nature and degree of the interconnections between financial firms affect the propagation and amplification of stress through the financial system and overall economy? Finally--and most importantly--what can monetary policy and financial oversight do to reduce the frequency and severity of future crises?

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<sup>12</sup> Guvenen (2011) reviews several issues related to macroeconomics with heterogeneity. For an overview of the interactions between distribution and aggregate outcomes, see the work by Quadrini and Rios-Rull (2015). For recent work on the effects of monetary policy in models with heterogeneous agents, see Kaplan, Moll, and Violante (2016); Gornemann, Kuester, and Nakajima (2016); Auclert (2016); and Sterk and Tenreyro (2016).

Although the scope of these questions extends beyond the themes of this conference, it does include issues that are closely related. Consider the influence of balance sheet conditions and noninterest credit terms on spending and overall activity--an area where it is important to take account of differences across individual households and firms, as I just noted. Research on this topic has, of course, been ongoing for some time, and it has expanded greatly in the wake of the financial crisis.<sup>13</sup> But I believe we have a lot more to learn about the ways in which changes in underwriting standards and other determinants of credit availability interact with interest rates to affect such things as consumer spending, housing demand and home prices, business investment (especially for small firms), and the formation of new firms.<sup>14</sup> For example, is the persistent increase in the personal saving rate that we have observed since the collapse of the housing bubble primarily a result of a sustained shift toward more prudent underwriting standards by

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<sup>13</sup> For an example of early research on this topic, see Bernanke and Gertler (1989). Other important pre-crisis studies include the development of the financial accelerator model by Bernanke and others (1999a) and work by Kashyap and Stein (2000) and Peek, Rosengren, and Tootell (2003) on the bank balance sheet channel and the effects of bank loan supply shocks. For a more recent summary of the role of banks in the monetary transmission mechanism, see Peek and Rosengren (2013). Chaney, Sraer, and Thesmer (2012) provide evidence for the collateral channel of real estate for corporate investment, while Mian, Rao, and Sufi (2013) examine the influence of household balance sheets on consumption.

<sup>14</sup> More empirical work would be useful to disentangle the spending effects that result from changes in credit conditions from those that result from movements in interest rates, as estimates of the latter likely often inadvertently incorporate the former. Most empirical models of the overall economy do not explicitly control for the influence of noninterest credit factors on consumption and investment; as a result, estimated interest rate effects will partially reflect the influence of these factors to the extent these factors are correlated with interest rates. There are many reasons to suspect that this is the case. Movements in interest rates influence a firm's cash flow and the value of its collateral, all else being equal. Higher interest rates also adversely affect consumer spending and especially residential investment, both by forcing households to devote a greater portion of their income to debt service and by making it more difficult to qualify for a loan because of maximum payment-to-income rules. Evidence for these effects is provided by Gertler and Karadi (2015), who show that relatively small changes in short-term interest rates are correlated with large movements in credit costs. Such correlations and interactions may explain why some types of spending appear to be more correlated with movements in *nominal* interest rates than with real interest rates; see Fair (2004, ch. 3) for evidence on this point. Finally, the relative contributions of relaxed lending standards, low interest rates, and other factors to housing bubbles, both in the United States and abroad, remains an open and unsettled topic; Agnello and Shucknecht (2011) present cross-country evidence that monetary policy plays an important role, while Dokko and others (2011) argue that monetary policy was a minor influence in the most recent episode.

lenders? Is it something that will ultimately prove transitory once households finish repairing their balance sheets or become more confident about their future prospects for employment and income?<sup>15</sup> The answer to this latter question could have significant implications for the longer-run normal, or neutral, level of interest rates and thus for the conduct of monetary policy.

### **Inflation Dynamics**

My fourth question goes to the heart of monetary policy: *What determines inflation?*

From my perspective, the standard framework for thinking about inflation dynamics used by central bank economists and others prior to the financial crisis remains conceptually useful today. A simple description of this framework might go something like this:<sup>16</sup> Inflation is characterized by an underlying trend that has been essentially constant since the mid-1990s; previously, this trend seemed to drift over time, influenced by actual past inflation or other economic conditions. Theory and evidence suggest that this trend is strongly influenced by inflation expectations that, in turn, depend on monetary policy. In particular, the remarkable stability of various measures of expected inflation in recent years presumably represents the fruits of the Federal Reserve's sustained efforts since the early 1980s to bring down and then stabilize inflation at a low level. The anchoring of inflation expectations that has resulted from this policy does not, however, prevent actual inflation from fluctuating from year to year in response to the temporary influence of movements in energy prices and other disturbances. In addition,

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<sup>15</sup> See Mian, Rao, and Sufi (2013) for an assessment of the role of leverage and housing wealth shocks in driving consumption during the Great Recession. Work by Justiniano, Primiceri, and Tambalotti (2015) suggests that debt overhang alone cannot explain the slow recovery from the Great Recession.

<sup>16</sup> See Yellen (2015) for a more extensive discussion.

inflation will tend to run above or below its underlying trend to the extent that resource utilization--which may serve as an indicator of firms' marginal costs--is persistently high or low.<sup>17</sup>

While this general framework for thinking about the inflation process remains useful, questions about some of its quantitative features have arisen in the wake of the Great Recession and the subsequent slow recovery. For example, the influence of labor market conditions on inflation in recent years seems to be weaker than had been commonly thought prior to the financial crisis. Although inflation fell during the recession, the decline was quite modest given how high unemployment rose; likewise, wages and prices rose comparatively little as the labor market gradually recovered. Whether this reduction in sensitivity was somehow caused by the recession or instead pre-dated it and was merely revealed under extreme conditions is unclear.<sup>18</sup> Either way, the underlying cause is unknown. Does the reduced sensitivity reflect structural changes, such as globalization or a greater role for intangible capital in production that have reduced the importance of cyclical swings in domestic activity for firms' marginal costs and pricing power? Or does it perhaps reflect the well-documented reluctance--or,

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<sup>17</sup> In the economic literature, this general description of the inflation process is referred to as the expectations-augmented Phillips curve. In its simplest form, the Phillips curve relates inflation to expected inflation and the intensity of resource utilization in the economy. In practice, however, empirical specifications also typically include measures of supply shocks, such as changes in the relative prices of energy or imported goods, as additional determinants. Two well-known variants of the Phillips curve are the traditional "accelerationist" specification and the so-called New Keynesian Phillips curve; the former approximates inflation expectations using a moving average of past inflation, while the latter assumes that inflation expectations are "rational" and consistent with the predictions of a structural model of the entire economy. Some adherents of either type of Phillips curve argue that their preferred model can explain the behavior of inflation during and after the financial crisis. For example, Gordon (2013) presents evidence in favor of an accelerationist model, while Del Negro, Giannoni, and Schorfheide (2015) make this claim for a New Keynesian model.

<sup>18</sup> See Blanchard (2016) for evidence on how the responsiveness of inflation to resource utilization has changed over time. Interestingly, research suggests that this sensitivity began declining well before the crisis.

alternatively, limited ability--of firms to cut the nominal wages of their employees, which could help to explain the relatively moderate movements in inflation we saw during and after the recession?<sup>19</sup>

Another gap in our knowledge about the nature of the inflation process concerns expectations. Although many theoretical models suggest that actual inflation should be most closely related to *short-run* inflation expectations, as an empirical matter, measures of *long-run* expectations appear to explain the data better.<sup>20</sup> Yet another unresolved issue concerns *whose* expectations--those of consumers, firms, or investors--are most relevant for wage and price setting, a point on which theory provides no clear-cut guidance. More generally, the precise manner in which expectations influence inflation deserves further study.<sup>21</sup>

Perhaps most importantly, we need to know more about the manner in which inflation expectations are formed and how monetary policy influences them. Ultimately, both actual and expected inflation are tied to the central bank's inflation target, whether that target is explicit or implicit.<sup>22</sup> But how does this anchoring process occur? Does a central bank have to keep actual inflation near the target rate for many years before inflation expectations completely conform? Can policymakers instead materially

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<sup>19</sup> For an early discussion of the potential macroeconomic effects of downward nominal wage rigidity, see Akerlof, Dickens, and Perry (1996). More recently, Daly and Hobijn (2014) develop a model in which the reluctance or inability of firms to cut nominal wages (or both) creates important nonlinearities in the relationship between labor utilization and wage inflation. Finally, Fallick, Lettau, and Wascher (2015) review the evidence for downward nominal wage rigidity in recent years and explore the ways in which it has interacted with labor market stress over time.

<sup>20</sup> Specifically, survey measures of long-run inflation expectations are broadly correlated with estimates of inflation's longer-term trend. See Clark and Davig (2008); see also Faust and Wright (2013, who make a related point in the context of inflation forecasting).

<sup>21</sup> As Mavroeidis, Plagborg-Moller, and Stock (2014) conclude from their exhaustive survey, empirical estimates of the New Keynesian inflation equation are "unable to pin down the role of expectations in the inflation process sufficiently accurately for the results to be useful for policy analysis" (p. 172).

<sup>22</sup> For a discussion of the theoretical and empirical influence of monetary policy on inflation in the context of a formal inflation-targeting regime, see Bernanke and others (1999b).

influence inflation expectations directly and quickly by simply announcing their intention to pursue a particular inflation goal in the future? Or does the truth lie somewhere in between, with a change in expectations requiring some combination of clear communications about policymakers' inflation goal, concrete policy actions to demonstrate their commitment to that goal, and at least some success in moving actual inflation toward its desired level in order to demonstrate the feasibility of the strategy? Although historical experience suggests that changing the public's inflation expectations would be neither quick nor easy, it is not clear which of these possibilities is correct.<sup>23</sup>

With nominal short-term interest rates at or close to their effective lower bound in many countries, the broader question of how expectations are formed has taken on heightened importance. Under such circumstances, many central banks have sought additional ways to stimulate their economies, including adopting policies that are directly aimed at influencing expectations of future interest rates and inflation. The unusually explicit and extended guidance about the likely future path of the federal funds rate that was provided by the FOMC from 2011 through 2014 is an example of such a policy, as is the Bank of Japan's upward revision to its official inflation objective in 2013. Moreover, these and other expectational strategies may be needed again in the future, given the likelihood that the global economy may continue to experience historically low interest rates, thereby making it unlikely that reductions in short-term interest rates alone would be an adequate response to a future recession.<sup>24</sup>

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<sup>23</sup> See Kiley (2008) for a discussion of the relationship between U.S. monetary policy and survey measures of long-run inflation expectations; his results suggest that it took many years for the Federal Reserve to succeed in anchoring long-run expectations at a low level. In a similar vein, Bernanke and others (1999b) conclude that inflation expectations "respond only after a lag following declines in [actual] inflation" (p. 298) based on their study of the effects of adopting inflation targeting in different countries.

<sup>24</sup> I discussed this likelihood in a recent speech (Yellen, 2016).

For all of these reasons, I hope that researchers will strive to improve our understanding of inflation dynamics and its interactions with monetary policy.

### **International Linkages**

Before closing, let me mention one additional area where more study is needed--the effects of changes in U.S. monetary policy on financial and economic conditions in the rest of the world and the ways in which those foreign effects can feed back to influence conditions here at home. Of course, cross-country monetary policy spillovers have been the subject of scholarly debate since the Great Depression, and much of the formal analysis of this topic dates back to the early 1960s.<sup>25</sup> But this issue has received renewed interest with the advent of unconventional monetary policies after the Great Recession and, more recently, the divergence of monetary policies among major advanced-economy central banks.

Broadly speaking, monetary policy actions in one country spill over to other economies through three main channels: changes in exchange rates; changes in domestic demand, which alter the economy's imports; and changes in domestic financial conditions--such as interest rates and asset prices--that, through portfolio balance and other channels, affect financial conditions abroad. Research by Federal Reserve staff suggests that, all told, U.S. monetary policy spillovers to other economies are positive--that is, policies designed to provide stimulus to the U.S. economy also boost activity abroad, as negative effects of dollar depreciation are offset by positive effects of higher U.S. imports and easier foreign financial conditions.<sup>26</sup> However, this issue is far from

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<sup>25</sup> See Mundell (1963) and Fleming (1962).

<sup>26</sup> See Ammer, De Pooter, Erceg, and Kamin (2016). Other recent research on this topic includes Fukuda, Kimura, Sudo, and Ugai (2013); Georgiadis (2015); Glick and Leduc (2015); and Ilzetski and Jin (2013).

settled, as are a host of other related questions, including the following: Do U.S. monetary policy actions affect advanced and emerging market countries differently? Do conventional and unconventional monetary policies spill over to other countries differently? And to what extent are U.S. interest rates and financial conditions influenced by easing measures abroad?

### **Conclusion**

In closing, I would like to commend the Federal Reserve Bank of Boston for organizing this conference and fostering research and debate on questions vital to our understanding of the economy. Answering these questions will help the Federal Reserve's efforts to promote a healthy economy, and I am grateful for the opportunity to speak to you today and be part of this important discussion.

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