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The State of New Keynesian Economics: A Partial Assessment

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In August 2007, when the first signs emerged of what would come to be the most damaging global financial crisis since the Great Depression, the New Keynesian paradigm was dominant in macroeconomics. It was taught in economics programs all over the world as the framework of reference for understanding fluctuations in economic activity and inflation and their relation to monetary and fiscal policies. It was widely adopted by researchers as a baseline model that could be used flexibly to analyze a variety of macroeconomic phenomena. The New Keynesian model was also at the core of the medium-scale, dynamic stochastic general equilibrium (DSGE) models developed and used by central banks and policy institutions throughout the world.

Ten years later, tons of ammunition has been fired against modern macroeconomics in general, and against dynamic stochastic general equilibrium models that build on the New Keynesian framework in particular. The criticisms have focused on the failure of these models to predict the crisis, a weakness often attributed to their lack of a financial block in the model that could account for the key factors behind the crisis, whose origin was largely financial.[1] Other aspects of the New

[1] See, for example, Lindé, Smets, and Wouters (2016) for an evaluation of the empirical performance of a standard medium-scale DSGE model during the financial crisis and its aftermath, as well as a discussion of the kind of changes needed to improve that performance. Del Negro and Schorfheide (2013) evaluate the forecasting performance of a similar DSGE model during the Great Recession, and conclude that a

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Keynesian model and its extensions that have been the target of criticism include the assumptions of rational expectations, perfect information, and an infinitely-lived representative household.

Those criticisms notwithstanding, the New Keynesian model arguably remains the dominant framework in the classroom, in academic research, and in policy modeling. In fact, one can argue that over the past ten years the scope of New Keynesian economics has kept widening, by encompassing a growing number of phenomena that are analyzed using its basic framework, as well as by addressing some of the criticisms raised against it. Much recent research, for instance, has been devoted to extending the basic model to incorporate financial frictions (as described by Gertler and Gilchrist in this issue). In addition, the New Keynesian model has been the framework of choice in much of the work aimed at evaluating alternative proposals to stimulate the economy in the face of the unusual circumstances triggered by the crisis, including the use of fiscal policy and unconventional monetary policies.[2]

The present paper takes stock of the state of New Keynesian economics by reviewing some of its main insights and by providing an overview of some recent developments. In particular, I discuss some recent work on two very active research programs: the implications of the zero lower bound on nominal interest rates and the interaction of monetary policy and household heterogeneity. Finally, I discuss what I view as some of the main shortcomings of the New Keynesian model and possible areas for future research.

The New Keynesian Model: A Refresher

Modern New Keynesian economics can be interpreted as an effort to combine the methodological tools developed by real business cycle theory with some of the central tenets of Keynesian economics tracing back to Keynes's own *General Theory*, published in 1936.

The hallmark of the approach to modeling economic fluctuations pioneered by real business cycle theorists is a reliance on *dynamic, stochastic, general equilibrium* frameworks. At some level, these terms describe what seem natural features of any model that seeks to explain economic fluctuations, and as such, these features have been fully adopted by New Keynesian economics. (To put it differently: It is easy to imagine the criticisms that modern macro would receive if it relied on models that were static rather than dynamic, deterministic rather than stochastic, and partial

version of that model augmented with financial frictions and external information compares well with Blue Chip consensus forecasts, especially over the medium and long run.

[2] See, for example, Blanchard, Erceg, and Lindé (2016) for an analysis of the effectiveness of fiscal policy to stimulate the recovery of the euro area economy using a DSGE model as a framework of reference. Del Negro, Eggertsson, Ferrero, and Kiyotaki (2017) use a standard DSGE model augmented with liquidity frictions to evaluate some of the quantitative easing policies undertaken by the Fed in the wake of the financial crisis.

rather than general equilibrium!) In practice, the real business cycle approach takes the form of a set of equations that describe, in a highly aggregative manner: 1) the behavior of households, firms, and policymakers, 2) some market clearing and/or resource constraints, and 3) the evolution of one or more exogenous variables that are the ultimate source of fluctuations in the economy. More controversial may be the assumption, widely found in both real business cycle and New Keynesian models, that the behavior of households and firms (and, in some instances, of policymakers as well) is the outcome of an *optimization problem*, solved under the assumption of *rational expectations* (though a strand of the recent literature, not reviewed here, has examined the consequences of relaxing the latter assumption).

What does New Keynesian economics add to the standard real business cycle apparatus? One can pinpoint three significant modifications. First, it introduces nominal variables explicitly: prices, wages, and a nominal interest rate. Second, it departs from the assumption of perfect competition in the goods market, allowing for positive price markups. Third, it introduces nominal rigidities, generally using the formalism proposed by Calvo (1983), whereby only a constant fraction of firms, drawn randomly from the population, are allowed to adjust the price of their good. The assumption of imperfect competition is often extended to the labor market as well, with the introduction of wage rigidities (nominal or real).

The resulting framework has two key properties. Exogenous changes in monetary policy have nontrivial effects on real variables, not only on nominal ones. In addition, and more importantly, the economy's equilibrium response to *any* shock is not independent of the monetary policy rule in place, thus opening the door to a meaningful analysis of alternative monetary policy rules.

To build some intuition for how this framework leads to a breakdown of monetary policy neutrality, it is useful to lay out a simple version of the New Keynesian model (with sticky prices but flexible wages). It is composed of three relationships.

First, the *dynamic IS equation* (named after the IS curve in the celebrated IS-LM model) states that the current output gap is equal to the difference between the expected output gap one period in the future and an amount that is proportional to the gap between the real interest rate and the natural rate of interest. The "output gap" is the difference between output and the potential or "natural" output. Natural output and the natural rate of interest are the values that those variables would take in equilibrium if prices were fully flexible. In algebraic terms, the relationship is

$$\tilde{y}_t = E_t\{\tilde{y}_{t+1}\} - \sigma^{-1}(i_t - E_t\{\pi_{t+1}\} - r_t^n)$$

where $\tilde{y}_t$ is the output gap (given by the difference between log output y_t and log natural output y_t^n), i_t is the nominal rate, π_t denotes inflation, and r_t^n is the natural rate of interest.

Second, the *New Keynesian Phillips curve* states that inflation depends on expected inflation one period ahead and the output gap.[3] Thus, it adds an expectation term to the conventional Phillips curve, and can be written out as:

$$\pi_t = \beta E_t\{\pi_{t+1}\} + \kappa \tilde{y}_t.$$

The third relationship is an *interest rate rule*, which describes how the nominal rate of interest is determined. This condition is typically linked to the conduct of monetary policy. Thus, an interest rate rule frequently used in the literature as an approximation to the conduct of monetary policy in advanced economies (at least in normal times) is a Taylor-type rule in which nominal interest rates traditionally rise and fall based on the current inflation rate and detrended output (for example, Taylor 1993), but in which monetary policy at a given time can be tighter or looser than the historical pattern. This relationship can be written as

$$i_t = \phi_\pi \pi_t + \phi_y \hat{y}_t + v_t,$$

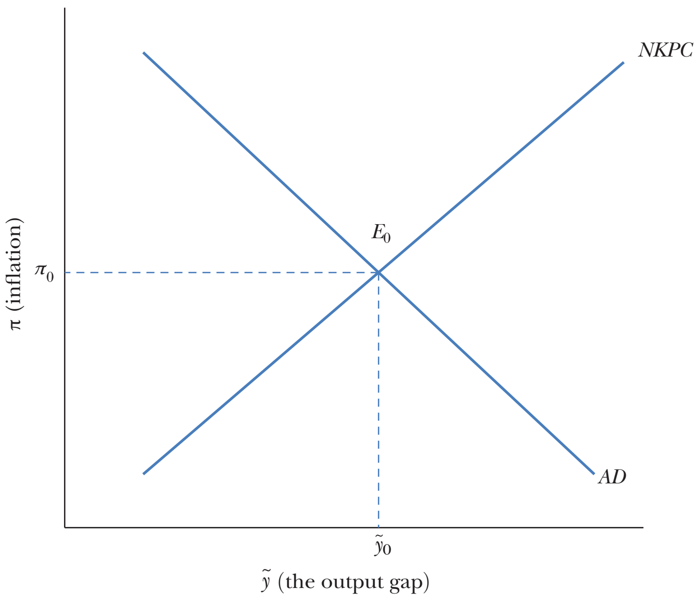
where $\hat{y}_t$ denotes the log deviation of output from steady state, and v_t is an exogenous monetary policy shifter following some stochastic process.

Figure 1 represents the equilibrium of the above economy. The AD schedule (after "aggregate demand") combines the dynamic IS equation and the interest rate rule, giving rise to an inverse relation between inflation and the output gap, for any given expectations. The NKPC (New Keynesian Phillips Curve) schedule represents a positive relation between the same two variables implied by the New Keynesian Phillips curve, given inflation expectations. The economy's equilibrium is determined by the intersection of the two schedules (point E_0).

A New Keynesian model based on these three relationships yields several interesting insights. As noted earlier, the model implies that monetary policy is not neutral. In particular, this non-neutrality has (at least) two dimensions. First, an exogenous monetary policy shock will affect not only nominal variables, but also real ones (like output). In particular, an exogenous tightening of monetary policy (that is, a persistent increase in v_t) raises both nominal and real rates, leading to a fall in output and inflation, while leaving the natural rates unchanged. In Galí (2015), I discuss the implied response of a calibrated New Keynesian model to different types

[3] See Woodford (2003) or Galí (2015) for a detailed derivation of these first two equations and a discussion of the underlying assumptions. The first equation can be derived by combining the Euler equation describing the optimal consumption behavior of the representative household with a goods market clearing condition requiring that output must equal consumption. The second equation can be derived in two stages. In a first stage, a relation between inflation, expected inflation and the markup gap (that is, the log deviation of average markup from the desired markup) can be derived by aggregating the optimal price setting decisions of firms subject to constraints on the frequency with which they can adjust prices. That relation is combined with a labor supply equation, a goods market clearing condition, and an aggregate production function to obtain a simple relation linking the markup gap to the output gap, thus giving rise to the relationship in the text.

Figure 1
The Basic New Keynesian Model



Note: The AD schedule (after "aggregate demand") combines the dynamic IS equation and the interest rate rule, giving rise to an inverse relation between inflation and the output gap, for any given expectations. The NKPC schedule represents the positive relation between the same two variables implied by the New Keynesian Phillips Curve, given inflation expectations. The economy's equilibrium is determined by the intersection of the two schedules (point E_0).

of shocks. In particular, the model's predictions regarding the effects of monetary policy shocks are in line (at least qualitatively), with much of the empirical evidence on the effects of those shocks, as found among others in Christiano, Eichenbaum, and Evans (1999).

Second, monetary non-neutrality in this context also arises because the response of output (and other real variables) to a nonmonetary shock—that is, a shock that changes the natural levels of output y_t^n and/or interest rate r_t^n—is not invariant to the monetary policy rule adopted by the central bank. Interestingly, when the interest rate rule shown above is calibrated in a way consistent with US evidence for the post–1982 period, the model implies responses to technology shocks consistent with the empirical evidence, including a countercyclical response of employment (for example, see Galí 1999; Basu, Fernald, and Kimball 2006).

The New Keynesian model also generates normative insights for the conduct of monetary policy. One finding is that if the central bank applies a rule that adjusts the policy interest rate sufficiently strongly in response to variations in inflation and output (a condition known as the Taylor principle), then the economy will have a unique equilibrium.[4] Otherwise, the equilibrium is locally indeterminate, opening the door to fluctuations driven by self-fulfilling revisions in expectations (sometimes known as "sunspot fluctuations"). Clarida, Galí, and Gertler (2000) provide evidence suggesting that the local uniqueness condition may not have been satisfied during the pre-Volcker era, potentially giving rise to unnecessary instability and providing an explanation for the macroeconomic turbulence of that period.

Beyond simple rules like the Taylor-type rule described above, the literature has sought to characterize the optimal monetary policy, defined as the policy that maximizes welfare for the representative household. One useful formulation suggests that the optimal monetary policy should consider three sources of welfare losses: 1) fluctuations in the gap between output and its efficient level (the so-called "welfare-relevant output gap"); 2) fluctuations in inflation, which generate losses due to the misallocation of resources caused by the associated price dispersion; and 3) an average (steady state) level of output which is itself inefficiently low, due to uncorrected real distortions (as one example, arising from monopolistic competition).

In the *special case* in which the natural level of output corresponds to the efficient level of output at all times, then welfare losses result only from fluctuations in the output gap, $\tilde{y}$, and fluctuations in inflation, π_t. The optimal policy in that special case requires that inflation be fully stabilized at zero. Notice that the New Keynesian Phillips curve implies that such a strict inflation targeting policy has an important byproduct: it stabilizes the output gap at zero, thus making output equal to its natural (and, by assumption, efficient) level. This property is sometimes referred to as the Divine Coincidence (for discussion, see Blanchard and Galí 2007). As a result, welfare losses in this setting will be zero and the economy attains its first-best allocation.

However, the previous extreme result holds only when the flexible price (or natural) equilibrium allocation is optimal—that is, when nominal rigidities are the only distortion in the economy. More generally, the presence of real frictions is likely to drive a wedge between the natural and efficient levels of output. As a result, the steady state itself may be inefficient, or the presence of real frictions may imply an inefficient response of natural output to some shocks, or both. As a result, a trade-off emerges between price stability and the attainment of an efficient level of economic activity, thus giving rise to a nontrivial optimal monetary policy problem. It turns out that the optimal policy—along with its associated output gap and inflation outcomes—depends on the assumptions regarding the extent to which the central bank can credibly commit to a state-contingent plan. Standard treatments of the optimal monetary policy problem and its consequences have focused on the extreme cases of full discretion (period-by-period re-optimization) and full commitment (a once-and-for-all choice of an optimal plan, which is subsequently followed

[4] As shown by Bullard and Mitra (2002), the required condition takes the form $\kappa(\phi_\pi - 1) + (1 - \beta)\phi_y > 0$.

through even if the policymaker may be tempted to renege from it, the so-called "time-inconsistency problem").[5]

The study of the optimal interest rate policy in the context of the New Keynesian model has yielded several interesting insights, and in particular about the nature of the gains from commitment and the kind of inefficient outcomes or biases implied by discretionary policies. For example, the presence of an inefficiently low steady state output, combined with the lack of commitment, generates a (suboptimal) positive *inflation bias*, similar to that uncovered by Kydland and Prescott (1980) and Barro and Gordon (1983) in the context of an earlier generation of monetary models with non-neutralities. Most interestingly, even when the steady state is efficient, gains from commitment arise in the presence of shocks that imply an inefficient response of natural output, as would arise in the presence of certain real imperfections. Those gains result from the ability of a central bank with commitment to influence expectations of future inflation and output gaps, which makes it possible to smooth over time the deviations from the first-best allocation, thus reducing the implied losses. By contrast, in the absence of commitment, the central bank has to rely exclusively on its ability to affect the *current* output gap, which leads to excessive fluctuations in both inflation and the gap between output and its efficient level, and hence to larger welfare losses. The resulting excess volatility associated with the discretionary policy is sometimes referred to as *stabilization bias,* and it may coexist with an optimal *average* level of inflation (in contrast with the case of an inflation bias).

While the notion of a once-and-for-all commitment to an optimal state-contingent monetary policy plan is of course unrealistic as a practical policy strategy, the analysis of the optimal policy under commitment establishes a useful benchmark that can be used to inform the search for simpler rules that can approximate such a policy. Specifically, the analysis of the properties of the equilibrium under the optimal monetary policy with commitment often seem to imply a stationary price level, which in turn provides a possible rationale for the adoption of a price-level–targeting interest rate rule (as one example, see Vestin 2006).

Many other interesting insights regarding the optimal design of monetary policy have emerged from the analyses of relatively straightforward extensions of the basic New Keynesian model described above. A selection of examples of such extensions include allowances for staggered wage setting (Erceg, Henderson, and Levin 2000), some backward-looking price setting (Steinsson 2003), open economy considerations (Clarida, Galí, and Gertler 2002; Galí and Monacelli 2005), deviations from rational expectations (Evans and Honkapohja 2003; Woodford 2010), labor market frictions (Trigari 2009; Blanchard and Galí 2010), uncertainty shocks (Basu and Bundick 2017), and others. The next two sections focus on two specific extensions of the basic New Keynesian model that have drawn considerable attention

[5] See Clarida, Galí, and Gertler (1999) for an analysis and discussion of the resulting optimal monetary policy problem under discretion and under commitment. For an analysis of some intermediate cases, see Schamburg and Tambalotti (2007) and Debortoli and Lakdawala (2016).

in recent years and triggered a good amount of research: the zero lower bound on the nominal interest rate and the heterogeneity of households.

The Zero Lower Bound

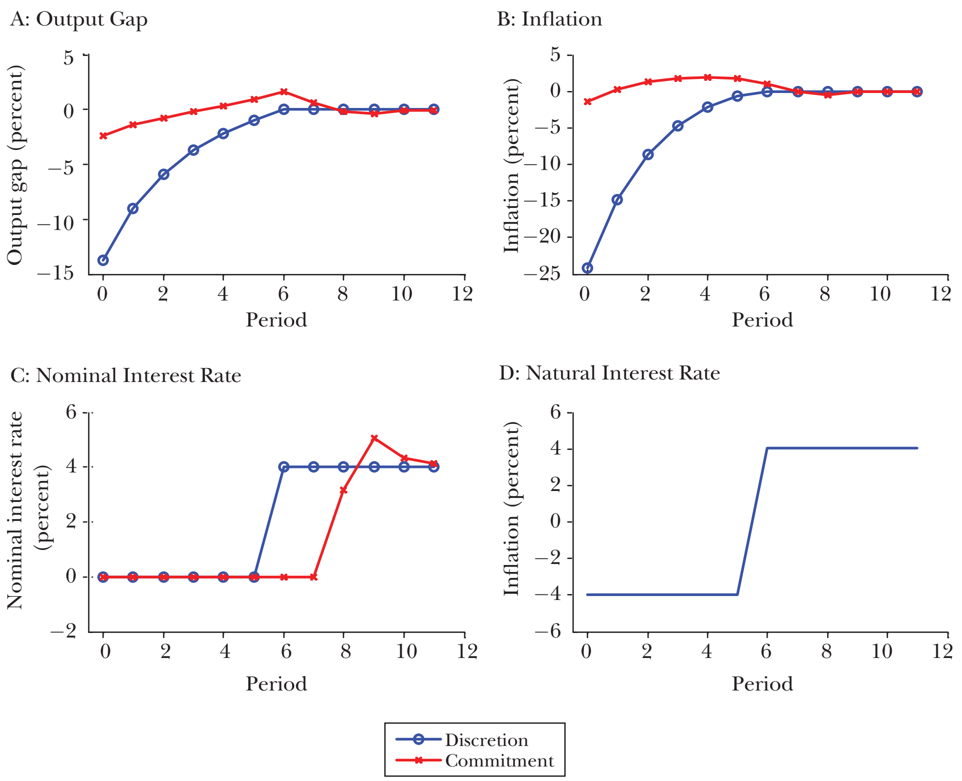
The possibility of a nimble response of central banks to the recessionary and deflationary forces triggered by the financial crisis was seemingly jeopardized when, after being successively reduced, policy rates attained the lower bound of (nearly) zero percent. The basic New Keynesian model, described in the previous section, ignores the existence of the zero lower bound. However, a number of papers, originally motivated by the Japanese experience with a liquidity trap starting in the 1990s, adopted the New Keynesian framework to analyze the implications of a binding zero lower bound.

To illustrate some of the insights of that analysis, let us consider the case of an efficient natural equilibrium (that is, the gap between the efficient and the natural rate of output is zero). In the absence of the zero lower bound constraint, the optimal policy implies full stabilization of the output gap and inflation, as discussed above.

Now consider an economy that is at a zero-inflation, zero-output-gap steady state. Then a one-off episode occurs, with a temporary, but persistent adverse shock to the natural rate of interest, r_t^n, that brings that variable into negative territory. With a zero lower bound constraint, there is an inability to match the drop in the natural rate of interest with a commensurate reduction in the policy interest rate. Using the dynamic IS relationship shown earlier, the result of a nominal interest rate stuck above its natural rate will generate a persistent negative output gap (given the initial zero inflation). In turn, the New Keynesian Phillips curve relationship shows that a negative output gap will be a source of persistent deflation. Indeed, this leads to a higher real interest rate and, thus, to an even larger gap between that variable and its natural counterpart, deepening further the initial recession. An analysis of the optimal design of monetary policy in the presence of a zero lower bound on the nominal rate closely related to this description can be found in Jung, Teranishi, and Watanabe (2005) and Eggertsson and Woodford (2003). Both papers study the case of a fully unanticipated, once-and-for-all adverse shock to the natural rates, which pushes the optimizing central bank against the zero lower bound.

Figure 2, based on the analysis in Galí (2015), illustrates some of the implications of the zero lower bound for the conduct of monetary policy. It simulates the response to an unanticipated negative demand shock that lowers the natural rate of interest from its normal steady state level of 4 percent to −4 percent (both in annual terms) between periods 0 through 5 (see panel D). In period 6, the natural rate returns to its initial value, something that is assumed to be (correctly) anticipated as of period 0, when the shock hits. In the absence of a zero lower bound, price stability and a zero output gap could be maintained in the face of the adverse disturbance if only the central bank were to lower the interest rate to −4 percent for the duration of the shock, thus tracking the path of the

Figure 2
Discretion versus Commitment in the Presence of the Zero Lower Bound



natural rate. However, the existence of the zero lower bound makes that option unfeasible.

Given this setting, the nature of the optimal interest rate policy depends on the extent to which the central bank can commit to future actions. The line with circles plots the response of the output gap, inflation, and the nominal interest rate (panels A, B, and C) under the optimal discretionary policy—that is, a policy without commitment. In response to the adverse shock, the central bank lowers the nominal rate to zero and keeps it there until the shock goes away, and then returns the interest rate to its initial level of 4 percent, consistent with price stability. Both output and inflation experience large declines in response to the shock and take persistent negative values until the adverse disturbance vanishes, at which point the central bank can fully restore price stability and close the output gap.

Also in the first three panels, the line with crosses displays the equilibrium responses under the optimal policy with commitment. In this case, the central bank credibly promises that it will keep the nominal rate at zero even after the shock is no longer effective (in this simulated example, for two periods longer). That policy leads to a small deviation from zero inflation and zero output gap in subsequent periods, implying a welfare loss relative to that first-best outcome. But that loss is more than offset by the gains resulting from the much greater stability in earlier periods, when the disturbance is active. That optimal policy with commitment can be interpreted as an illustration of the power of *forward guidance* policies, which are policies that aim at influencing current macro outcomes through the management of expectations about future policy settings. Such policies have been openly adopted by central banks like the European Central Bank and the Federal Reserve in the aftermath of the Great Recession, in the face of the slow recovery.[6]

The previous example illustrates the monetary policy implications of a fully unanticipated, one-off temporary drop in the natural rate of interest to a negative level. A number of authors have instead analyzed an economy where the natural rate of interest is subject to recurrent shocks. In those economies, the possibility of hitting the zero lower bound constraint in the future affects how the economy responds to shocks (and to policy) even when the zero lower bound is not binding. Adam and Billi (2006, 2007) and Nakov (2008) study the implications of the zero lower bound for the optimal design of monetary policy in a stochastic setting, with and without commitment, when that constraint is occasionally (but recurrently) binding.

Several insights emerge from that line of analysis. First, the optimal policy implies a nonlinear response to shocks, with the central bank reducing nominal rates more aggressively in response to adverse shocks, in order to reduce the probability of a binding zero lower bound down the road and to counteract the adverse effects of that possibility (and their anticipation) on aggregate demand. Second, under commitment, the optimal policy calls for sustained monetary easing even when the natural rate is no longer negative. Third, the gains from commitment (relative to discretion) are much larger when the possibility of a zero lower bound exists than in the absence of such a constraint. Finally, as stressed by Nakov (2008), a large fraction of the gains from commitment can be reaped by adopting a price-level targeting rule. Because this rule targets the level of prices, rather than the inflationary change in price level, it calls for a period of "catching up" after inflation has been below its target level for a time—not just a return to the target level. Such a rule also reduces the incidence of a binding zero lower bound considerably.

Rogoff (1985) made a case for appointing a "conservative" central banker (that is, one that puts more weight than society on inflation stabilization), in the presence of a conventional inflation bias. Nakata and Schmidt (2016) provide a new rationale, connected to the zero lower bound, for such a policy, even in the absence of an inflation bias. They show that, under an optimal discretionary policy, the anticipation of an occasionally binding zero lower bound implies that on average inflation falls below target and the output gap is positive, even when the zero lower bound is not binding. Delegating monetary policy to a "conservative" central banker is generally desirable since the latter will keep inflation closer to target (at the cost of an even larger output gap) when the zero lower bound is not binding, with the

[6] For example, Woodford (2013) discusses the forward guidance policies implemented by different central banks and their connection with the theoretical analyses in the literature.

anticipation of that policy providing a highly welcome additional stimulus when the zero lower bound is binding, and improving social welfare.

The Forward Guidance Puzzle

The forward guidance puzzle can be stated as follows: In the context of the basic New Keynesian model, and under the assumption of rigid prices, the effect on output of an anticipated change in the policy rate of a given size and duration is independent of the timing of its implementation. In other words, the effects of a temporary 1 percent increase in the policy rate 100 years from now is predicted in the basic New Keynesian model to be the same as if the increase were to take place immediately or in the near future. This forward guidance puzzle was first discussed by Carlstrom, Fuerst, and Paustian (2015) and Del Negro, Giannoni, and Patterson (2012).

The reason behind that prediction is that the dynamic IS relationship presented earlier implies no discounting of the expected output gap and, hence, no discounting of future interest rates. To see this, iterate that dynamic IS relationship forward, noting that the expected output gap in the next period depends on the expected interest gap one period ahead and the expected output gap in following period, and so on. Moreover, assume that the output gap is expected to converge to zero asymptotically, and that the price level is rigid (with inflation equal to zero), then the forward guidance puzzle arises: the current output gap depends on the sum of current and future interest rates, all of them having the same weight.

The puzzle is amplified if we relax the assumption of fully rigid prices and let inflation be determined by a New Keynesian Phillips curve relationship. In that case, the farther is the horizon of implementation of a given change in the policy interest rate, the longer are its effects on output, and hence the larger and more persistent is the response of inflation. For any given path of the nominal interest rate, the persistent effect of inflation works in the direction of changing the real interest rate in a way that further amplifies the effects on output and inflation—leading to a strong nonlinear effect due to the accumulation of feedback effects.

Several authors have sought to address the forward guidance puzzle with modifications to the benchmark New Keynesian model. Typically, such modifications lead to some kind of discounting by households. Examples of such modifications include the introduction of finite lives (Del Negro, Giannoni, and Patterson 2012), incomplete markets with bounded rationality (Farhi and Werning 2017) or without bounded rationality (McKay, Nakamura, and Steinsson 2016, 2017), lack of common knowledge (Angeletos and Lian forthcoming), and behavioral discounting (Gabaix 2017).

With such modifications, the effects of anticipated changes in the policy interest rate on current output do decline with the horizon of implementation, given the path of inflation. However, once inflation is allowed to respond, the presence of discounting reduces the effect on the output gap or inflation of any anticipated change in the real interest rate, but it does not overturn the prediction that the size of such an effect increases with the horizon of implementation.

Self-Fulfilling Deflation Traps and the Zero Lower Bound

Much of the analysis based on the New Keynesian model has a local nature: specifically, it is carried out using a linear approximation to the equilibrium conditions around a steady state consistent with the inflation target (which is typically zero). By construction, that analysis limits our understanding of the economy's behavior far from the assumed steady state. Several papers have explored the properties of equilibria of the New Keynesian model from a global perspective.

The work of Benhabib, Schmitt-Grohé, and Uribe (2001) triggered much of the research on this front. They showed that a Taylor-type interest rate rule satisfying the zero lower bound constraint and consistent with a locally unique equilibrium around the steady state associated with the targeted inflation rate necessarily implies the existence of another steady state. They label this other steady state as a "liquidity trap," in which the interest rate is zero or near-zero and inflation is below the targeted level and possibly negative. Furthermore, and more worrisome, they showed that an infinite number of equilibrium trajectories exist that converge to the liquidity trap steady state. Accordingly, a central bank's adoption of a Taylor rule is not a guarantee of stability, even if the rule satisfies the conditions for a locally unique equilibrium. In a companion paper, Benhabib, Schmitt-Grohé, and Uribe (2002) propose a set of alternative monetary and fiscal rules that can be activated when the economy enters a path leading to the liquidity trap steady state. For example, in one case the proposed rule features a strong fiscal stimulus in the form of lower taxes; in another, a switch to a rule that would peg the rate of money growth. Under those rules, any path converging to the liquidity trap would violate the intertemporal budget constraints of the government and households, and can thus be ruled out as an equilibrium path.[7]

Several papers have provided "quantitative" applications of the multiplicity of global equilibrium implied by the zero lower bound in the New Keynesian model. Schmitt-Grohé and Uribe (2017), Aruoba, Cuba-Borda, and Schorfheide (2018), and Jarociński and Maćkowiak (2018) use a quantitative New Keynesian model with global multiplicity to interpret the prolonged recession and persistently low inflation in many advanced economies in the wake of their financial crises, which persisted despite highly expansionary monetary policies with near-zero policy interest rates. Those papers interpret the crises and subsequent persistent slump as an equilibrium path converging to a liquidity trap steady state. For a policy to exit the liquidity trap, Schmitt-Grohé and Uribe (2017) and Jarocinski and Maćkowiak (2018) propose an exogenous path for the policy interest rate converging to its value in the intended steady state. Under the equilibrium dynamics implied by the liquidity trap, that policy is shown to raise inflation expectations and to stimulate aggregate

[7] Cochrane (2011) criticizes this approach to ruling out equilibria that deviate from the intended steady state (including equilibria involving hyperinflations). Instead, he proposes the specification of policies that are consistent with a unique equilibrium that remains well defined, near or farther away from the intended steady state. A non-Ricardian fiscal policy, combined with a passive monetary policy, is an example of an alternative fiscal–monetary regime that avoids the problems of global multiplicity of the New Keynesian model with an active Taylor rule.

demand and output. The price-level indeterminacy implied by the exogenous path for the nominal rate can be eliminated by a switch to an active fiscal policy. Benigno and Fornaro (2017) develop a model that includes downward nominal wage rigidities and a zero lower bound constraint similar to that of Schmitt-Grohé and Uribe (2017), but in which they embed an endogenous growth mechanism. Under some conditions, two different balanced growth paths may be consistent with equilibrium. One of those paths, which they refer to as a stagnation trap, is characterized by involuntary unemployment and low growth, while the other features high growth and full employment. Expectations about future growth prospects determine which equilibrium obtains.

In this branch of the literature, monetary policy is described by some (generally suboptimal) Taylor-type rule. But the multiplicity of equilibria generated by the zero lower bound is not restricted to that case: as shown in Armenter (2018) and Nakata and Schmidt (2016), it also emerges under the assumption of a central bank optimizing under discretion.[8] Even if such multiplicity is clearly suboptimal, there is little that a central bank operating under discretion can do about it, because the zero lower bound limits its ability to stabilize inflation. As a result, the central bank may find it optimal in some circumstances to accommodate revisions in the private sector's expectations, thus minimizing the damage given the unavoidable deviation from its stabilization targets.

Fiscal Policy and the Zero Lower Bound

In addition to its implications for the design of monetary policy, the zero lower bound also has ramifications for the effects of other shocks, including fiscal policy shocks. This is a consequence of a fairly general principle: In the presence of nominal rigidities, the effects of any fiscal policy intervention are not invariant to the monetary policy rule in place and, more precisely, to the (endogenous) response of nominal and real interest rates to those interventions. By shaping that response, the presence of a zero lower bound constraint has an impact on the effects of fiscal policy shocks.

Eggertsson (2010) and Christiano, Eichenbaum, and Rebelo (2011) analyze the interaction of fiscal policy and the zero lower bound using a New Keynesian model as a reference framework. In particular, Eggertsson (2010) considers an environment in which an adverse demand shock pushes the natural rate into negative territory and makes the zero lower bound binding. In that context, he shows that a reduction in taxes on labor or capital income is expansionary, whereas an increase in government purchases has a strong expansionary effect on output. The reason is that tax cuts (as well as other supply-side policies) generate disinflationary pressures that are not matched by a policy interest rate cut, leading to an increase in the real interest rate and a drop in aggregate demand. On the other hand, an increase

[8] Earlier papers examining optimal discretionary policy under the zero lower bound constraint (for example, Adam and Billi 2007) implicitly make an equilibrium selection by constraining the equilibrium to stay in the neighborhood of the targeted (zero) inflation steady state.

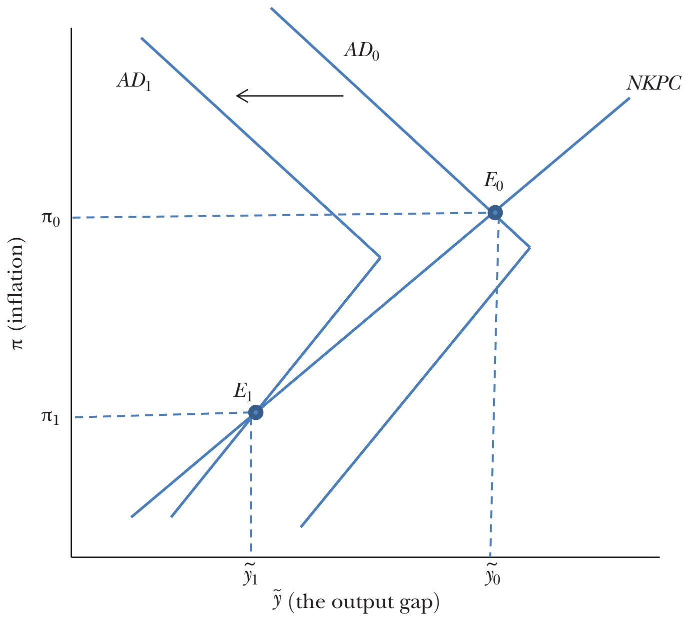
in government purchases has a stronger expansionary effect under a binding zero lower bound than in "normal" times, because the inflationary pressures generated by the fiscal expansion, combined with the absence of a nominal rate adjustment, lead to a drop in the real rate, thus amplifying the effect of the fiscal stimulus.

Christiano, Eichenbaum, and Rebelo (2011) analyze the determinants of the size of the government spending multiplier in connection with a binding zero lower bound. In particular, they show that the multiplier is very sensitive to how long the zero lower bound is expected to be a binding constraint. When they extend the basic New Keynesian model to allow for endogenous capital accumulation, the size of the government spending multiplier becomes even larger, since investment—which is inversely related to the real interest rate—responds procyclically to the fiscal shock thus amplifying the effect of the latter. Using an estimated dynamic stochastic general equilibrium model, they quantify the value of the fiscal multiplier under a binding zero lower bound to be in a neighborhood of 2 for an increase in spending lasting 12 quarters. This contrasts with a multiplier smaller than one when the model is simulated under "normal" times, with the central bank responding to a fiscal expansion according to a conventional Taylor rule.

Figure 3 illustrates the implications of the zero lower bound constraint in the face of a negative aggregate demand shock (for example, resulting from a reduction in government purchases). Note that with the zero lower bound constraint, the AD schedule becomes upward-sloping when inflation reaches a level that makes the zero lower bound constraint binding, given the interest rate rule: Further reductions in inflation raise the real interest rate and lower aggregate demand and the output gap. A leftward shift in the AD schedule, if sufficiently large, pulls the economy into the region in which the decline in inflation cannot be offset by a more-than-proportional reduction in the policy interest rate, thus amplifying the negative impact of the shock on both inflation and the output gap.

The effectiveness of different fiscal policies at stimulating the economy under a binding zero lower bound is not invariant to the reason why the constraint has become binding. In the papers discussed above, the zero lower bound becomes binding as a result of an adverse fundamental shock that is sufficiently large to push the policy rate against the zero lower bound constraint, making it impossible for the central bank to stabilize inflation and the output gap. Mertens and Ravn (2014) focus instead on expectational or nonfundamental liquidity traps, which may emerge as a result of self-fulfilling expectations, due to the global indeterminacy discussed in the previous subsection. In the case of an expectational liquidity trap, they show that an increase in government purchases has a small effect on output (smaller than in normal times), whereas a tax cut is expansionary. The main factor behind those predictions is the differential effect on inflation, which in this model is positive in the case of a tax cut, but negative for a spending increase. Given that these predictions are exactly the opposite to those arising in the case of a fundamental liquidity trap, it follows that a good diagnosis of the nature of a liquidity trap is essential in order to evaluate the effects of a given fiscal policy response.

Figure 3
The Basic New Keynesian Model with Zero Lower Bound Constraint



Note: Figure 3 illustrates the implications of the zero lower bound constraint in the face of a negative aggregate demand shock (for example, resulting from a reduction in government purchases). The AD schedule (after "aggregate demand") combines the dynamic IS equation, the interest rate rule, and the zero lower bound constraint. The NKPC schedule represents the positive relation between the same two variables implied by the New Keynesian Phillips Curve, given inflation expectations. The economy's equilibrium is determined by the intersection of the two schedules.

Heterogeneity

The standard New Keynesian model, like most of its predecessors in the real business cycle literature, represents an economy inhabited by an infinitely-lived representative household. That assumption is obviously unrealistic. But of course, all models involve some simplification of reality so as to focus on the specific issue at hand. In macroeconomics, one specific question is how to explain aggregate fluctuations and their interaction with monetary policy in a relatively compact and tractable manner. It is not immediately obvious why the finiteness of human life is an aspect of reality that will be especially important in building such a model. After all, individuals are heterogenous in their economic behavior along a number of dimensions: education, wealth, income, preference for leisure, risk-taking, perceptions of relevant time horizons, and many more. For tractability, a macroeconomic model will of necessity leave out many of these ways in which people vary. In this spirit, one can perhaps argue that a representative household is a defensible starting point for a macro model.

This section will discuss a growing literature that argues that the representative household assumption is less innocuous than may appear, even when the focus is to understand aggregate fluctuations and macroeconomic policy.[9]

An important problem (though not the only one) that arises with representative household models is that in equilibrium there are neither savers nor borrowers, even in the absence of financial frictions, since everyone is identical. Thus, in order to understand whether the presence and nature of financial frictions have nontrivial implications for economic fluctuations and monetary policy, it is necessary to relax the representative household assumption. A large (and growing) number of papers have undertaken this approach in recent years, using a suitably modified New Keynesian model as a reference framework.

Here, I will focus on the latest generation of New Keynesian models with heterogeneous agents and financial frictions, models generally referred to as HANK (for Heterogeneous Agent New Keynesian).[10] A first feature shared by the recent wave of HANK models, which differentiates them from the baseline New Keynesian model, is the assumption of idiosyncratic shocks to households' labor productivity and hence to their wage. Those shocks are often assumed to follow a stochastic process that is consistent with some features of the microdata. Secondly, it is generally assumed that only a small number of assets can be traded, and that some exogenous borrowing limit exists. As a result, households cannot perfectly insure themselves against idiosyncratic risk. Furthermore, a (time-varying) fraction of households face a binding borrowing constraint, which makes their consumption respond strongly to fluctuations in current income. The previous features imply that no simple dynamic IS equation like the one described earlier can be derived. However, the other two main elements of the basic New Keynesian framework—the New Keynesian Phillips curve and the interest rate rule—are not directly affected by the introduction of heterogeneity.

One of the main lessons emerging from the analysis of heterogenous agent New Keynesian (HANK) models can be summarized as follows: The presence of uninsurable idiosyncratic shocks, combined with the existence of borrowing limits, implies that different households, even if they otherwise appear identical before the shocks arise, may have at any point in time very different marginal propensities to consume. As a result, the macroeconomic effects of any aggregate shock will be amplified or dampened depending on the way the shock (and the changes that it triggers) affects the distribution of income and wealth across households.

Several recent papers provide an insightful analysis of that mechanism. Auclert (2017) studies the different channels through which heterogeneity shapes the effect

[9] The bulk of the recent literature on heterogeneity has focused on the household sector. For an example of the implications of firm-level heterogeneity, see Adam and Weber (2018).

[10] Guerrieri and Lorenzoni (2017), Oh and Reis (2012), and McKay and Reis (2016) were among the first contributions to this literature, focusing, respectively, on the effects of credit crunches, transfers, and automatic stabilizers. Subsequent contributions include Auclert (2017), Kaplan, Moll, and Violante (2018), Ravn and Sterk (2016), Gornemann, Kuester, and Nakajima (2016), Farhi and Werning (2017), Werning (2015), and Debortoli and Galí (2017), among many others.

of an exogenous monetary policy shock on individual and aggregate consumption. Two of those channels are already present in the Representative Agent New Keynesian model (henceforth, RANK, for short): 1) intertemporal substitution, in response to changes in real interest rates; and 2) the change in consumption induced by the resulting changes in aggregate income, which is a source of a multiplier effect. A HANK economy, on the other hand, provides three additional channels that occur as a consequence of the *redistribution* that takes place in response to a monetary policy change: 1) the *earnings heterogeneity* channel is associated with the fact that some households see their income increase more than proportionally to aggregate income, while others lose in relative terms; 2) the *Fisher channel* refers to the fact that different households have at any point in time different net positions in nominal assets, whose real value will be affected by the change in the price level resulting from the monetary policy intervention; and 3) the *unhedged interest rate exposure* channel arises because of likely differences across households in the mismatch between durations of assets and liabilities (including planned consumption among the latter).

A key determinant of the impact of each of the three redistribution channels is given by the size and sign of their covariance with marginal propensities of consumption across households—that is, by the extent to which the redistribution caused by a monetary policy intervention favors households with a relatively high or a relatively low marginal propensity to consume. In principle, those covariances can be estimated using microdata on households' consumption, income, and balance sheets. The evidence reported in Auclert (2017) suggests that such redistribution channels are likely to amplify the effects of monetary policy on aggregate consumption. To see this, consider an expansionary policy that lowers real interest rates and raises output and inflation. We know that households with relatively low income and wealth also tend to have relatively high marginal propensities to consume. Furthermore, those households will tend to benefit more from the expansionary policy for several reasons backed up by micro evidence: 1) their earnings increase more than proportionally during output expansions; 2) they tend to have relatively large negative net nominal asset positions, and hence experience a relatively larger increase in their net wealth (in real terms) when the price level rises; and 3) they have a lower interest rate exposure (because they tend to have high current consumption and debt repayments relative to income) and thus benefit more from the reduction in real interest rates. Thus, by redistributing income and wealth towards households with a high marginal propensity to consume, the three channels above work in the direction of amplifying the response of aggregate consumption to an interest rate reduction. Interestingly, Auclert (2017) also shows that these empirical properties emerge, at least in qualitative terms, as an equilibrium outcome in a standard incomplete markets model (à la Bewley–Hugget–Aiyagari) calibrated to the US economy. Auclert's analysis thus points to the need to introduce realistic heterogeneity in monetary models in order to capture better the effects of monetary policy, though further work is needed to assess empirically the quantitative importance of each of those channels.

Werning (2015) develops a general framework to identify some of the channels through which heterogeneity and incomplete markets imply a departure from the aggregate implications of the standard representative agent approach. For example, he first considers an economy with idiosyncratic risk but no borrowing or lending, and no outside assets (for example, no government debt or physical capital), and in which household income is proportional to aggregate income. In that setting, the relation between aggregate consumption and interest rates turns out to be identical to that in the RANK model. A similar "as if" result holds for an economy with borrowing and lending and outside assets if liquidity is acyclical—that is, if asset prices and/or borrowing limits move in proportion to income.

Werning's (2015) framework can be seen as a useful benchmark to understand the properties of different HANK models in the literature in which some of the above assumptions are relaxed. Two examples, discussed by Werning, illustrate that point. The model in Ravn and Sterk (2016) combines rigidities in price-setting, characteristic of New Keynesian models, with search and matching in the labor market. In that framework, the rise in unemployment resulting from a tightening of monetary policy leads to an increase in precautionary savings and, hence, an amplification of the effects of monetary policy relative to a RANK economy. By contrast, McKay, Nakamura, and Steinsson (2016) analyze a model with idiosyncratic shocks in which the effects of interest changes are dampened relative to the RANK benchmark, as a result of a built-in procyclical earnings risk (caused by the assumption of an even distribution of countercyclical profits among workers) and countercyclical liquidity (resulting from constant government debt). The implied dampening of the response to monetary policy is presented by McKay et al. as a possible explanation for the forward guidance puzzle discussed in the previous section.

A distinct feature of the HANK model developed in Kaplan, Moll, and Violante (2018) is the coexistence of two assets: a low-return liquid asset and a high-return illiquid asset (think of housing) whose conversion into the liquid asset is subject to convex transaction costs. An implication of the latter assumption is the presence, at any point in time, of a sizable fraction of households that are wealthy but consume in a hand-to-mouth fashion, because the bulk of their wealth is held in the illiquid asset. The presence of those households, combined with those who consume hand-to-mouth because they have low incomes (and are subject to borrowing constraints), implies that a large fraction of the population is highly sensitive to labor income shocks (idiosyncratic and aggregate) but not very responsive to interest rate changes. As Kaplan et al. show, this shift dramatically changes the nature of the monetary policy transmission mechanism as compared to the RANK model. In the HANK model, the *direct* effect of changes in the interest rate on consumption (its effect conditional on an unchanged path for aggregate income) is much less important than its *indirect* effect (resulting from the induced changes in aggregate income). That property is in stark contrast with the RANK model, in which the direct effect is overwhelmingly dominant, because the representative household can substitute consumption intertemporally and, under any plausible calibration, will have a very small marginal propensity to consume out of current income.

In addition, the analysis in Kaplan, Moll, and Violante (2018) highlights an important property of HANK models: the aggregate effects of monetary policy shocks (or for that matter, of any other disturbance) will be shaped by the fiscal policy response to it, and, in particular, by the extent and nature of the redistributional effects of that response.

If we accept that some heterogeneity is useful, we still face a question of how much. The Two-Agent New Keynesian model (TANK, for short) is a relatively simple way of introducing heterogeneity. In this approach, a constant fraction of households is assumed to have no access to financial markets and just consume their current labor income, while the remaining fraction can buy and sell assets in an unconstrained way, as in the basic New Keynesian model. There are no other sources of heterogeneity within each type of households. Early applications of the TANK framework include Galí, López-Salido, and Vallés (2007) and Bilbiie (2008). In Debortoli and Galí (2017), my coauthor and I seek to understand the extent to which TANK models can provide a tractable approximation to their HANK counterparts.[11] Both alternatives share a key feature missing from representative agent models, namely, the fact that at any point in time a fraction of agents face a binding borrowing constraint (or behave as if they did), but TANK models assume a constant fraction of constrained agents, rather than allowing that fraction to vary endogenously as in in richer HANK models. Also, TANK models ignore the impact on agents' current decisions of the likelihood of being financially constrained in the future. Finally, credit-constrained households in HANK models have a marginal propensity to consume below one, especially in response to positive shocks, in contrast with hand-to-mouth households in TANK models, whose marginal propensity to consume is one at all times. Of course, the main advantage of TANK models relative to HANK models lies in their tractability, since there is no need to keep track of the wealth distribution and its changes over time.

Perhaps surprisingly, in Debortoli and Galí (2017) we show that a simple TANK model approximates well, both from a qualitative and a quantitative viewpoint, the aggregate dynamics of a canonical HANK model in response to aggregate shocks. Firstly, a properly calibrated TANK model approximates well the heterogeneity of consumption between constrained and unconstrained households. Secondly, for standard calibrations of the HANK model, consumption heterogeneity within the subset of unconstrained households (which the TANK model abstracts from) remains roughly constant, since those agents are able to limit consumption fluctuations by borrowing and saving.

Overlapping Generations

The assumption of an infinitely-lived representative household found in the standard New Keynesian model has implications that go beyond those emphasized

[11] See also Bilbiie (2017) and Bilbiie and Ragot (2017).

in the literature discussed in the previous section. The discussion to this point has focused on the interaction of idiosyncratic shocks and borrowing constraints as a source of heterogeneity in marginal propensities to consume across households, with its consequent implications for the transmission of monetary and fiscal policies. Less discussed but equally important are, in my opinion, other implications of the infinitely-lived representative household assumption.

Firstly, the assumption of an infinitely-lived representative consumer implies a tight link between the real interest rate and the consumer's time discount rate along a balanced growth path. That relation all but rules out the possibility of a persistently negative natural rate of interest, with the consequent challenges that the latter would pose on a price-stability–oriented monetary policy due to the zero lower bound on nominal interest rates. Notice that in the examples from the literature on the zero lower bound discussed earlier, the natural rate is assumed to be negative temporarily and, possibly, recurrently, but not permanently.

Secondly, the assumption of an infinitely-lived representative household rules out the existence of rational bubbles in equilibrium. After all, if a rational bubble exists in equilibrium, it must grow at the rate of interest and must necessarily be in assets held by the representative household. But the optimal path for consumption and savings of a representative household is inconsistent with holding assets in the long-run that grow at the rate of interest, which rules out the possibility of a rational bubble in that environment (for a proof, see Santos and Woodford 1997). On the other hand, there is a widespread view among policymakers and commentators that bubbles, like the housing bubble experienced in the 2000s, can play a role in financial crises and economic fluctuations. There is also a persistent debate about how monetary policy should respond to the emergence of those bubbles. The fact that the New Keynesian model cannot account for the phenomenon of bubbles seems like a potentially important shortcoming of that framework.

Several recent papers have sought to overcome the limitations of the infinitely-lived household assumption by introducing overlapping generations of finitely-lived individuals in models with nominal rigidities. Thus, Eggertsson et al. (2017) develop a "quantitative" overlapping generations framework with nominal rigidities in order to understand the sources of the decline in the natural rate of interest in the US economy, and to analyze the implications of that decline for monetary policy.[12]

In Galí (2014, 2017a), I develop two alternative models with overlapping generations, monopolistic competition, and sticky prices, and show that asset price bubbles may emerge in equilibria.[13] In both models, a necessary condition for the existence of such bubbly equilibria is a natural rate of interest below the balanced growth path for

[12] A permanent negative natural rate may also arise in models with infinitely-lived agents in the presence of heterogeneity and incomplete markets. For example, Auclert and Rognlie (2018) provide a model to illustrate that possibility.

[13] In Galí (2014), I assume a two-period-lived households and an inelastic labor supply (implying a constant output in equilibrium). Bubble fluctuations imply a stochastic redistribution of consumption across cohorts. By contrast, in Galí (2017a), I introduce asset price bubbles in a perpetual youth model à la Blanchard–Yaari, in which individuals die with a constant probability.

the economy. When bubbles exist, changes in their size can generate aggregate fluctuations, even in the absence of shocks to fundamentals. In that context, one can analyze the implications of alternative monetary policy rules on fluctuations and welfare, since the evolution of bubbles is not independent of the interest rate. A central message of both papers is that a "leaning against the bubble" monetary policy, modeled as an interest rate rule that includes the size of the bubble as one of its arguments, is generally suboptimal and dominated by a policy that focuses on stabilizing inflation.[14]

The Road Ahead

The standard New Keynesian framework as it existed a decade ago has faced challenges in the aftermath of the financial crisis of 2007–2009. Much of the work extending that framework over the past few years has aimed at overcoming some of those challenges. In the present paper, I have described a sample of recent research that extends the standard New Keynesian framework along different dimensions, with a focus on adapting it to take into account the zero lower bound constraint on the nominal interest rates, and household heterogeneity. [15]

However, none of the extensions of the New Keynesian model proposed in recent years seem to capture an important aspect of most financial crises—namely, a gradual build-up of financial imbalances leading to an eventual "crash" characterized by defaults, sudden-stops of credit flows, asset price declines, and a large contraction in aggregate demand, output, and employment. Most of the extensions found in the literature share with their predecessors a focus on equilibria that take the form of stationary fluctuations driven by exogenous shocks. This is also the case in variants of those models that allow for financial frictions of different kinds (for example, Bernanke, Gertler, and Gilchrist 1999; Christiano, Motto, and Rostagno 2014). In those models, financial frictions often lead to an amplification of the effects of nonfinancial shocks. Also, the presence of financial frictions can lead to additional sources of fluctuations: for example, via risk shocks in Christiano et al. (2014) or exogenous changes in the tightness of borrowing constraints in Guerrieri and Lorenzoni (2017). Overall, it's fair to say that most attempts to use a version of the New Keynesian models to explain the "financial crisis" end up relying on a *large exogenous shock* that impinges on the economy unexpectedly, triggering a large recession, possibly amplified by a financial accelerator mechanism embedded in the model.

There have been a few attempts to model economies that are less subject to the previous criticism. As one example, Boissay, Collard, and Smets (2016) analyze a real model with asymmetric information in the interbank market, in which a sequence of small shocks may pull an economy towards a region with multiple equilibria,

[14] Nonrational bubbles may exist also in economies with an infinitely-lived representative household. For example, see Adam and Woodford (2013) for an analysis of optimal policy in the context of a New Keynesian model with nonrational housing bubbles.
[15] The discussion in this section draws heavily on Galí (2017b).

including equilibria characterized by a freeze in the interbank market, a credit crunch, and a prolonged recession. A monetary extension of such a framework would seem highly welcome.

As another example, in Galí (2017a), I explore the possibility of fluctuations driven by stochastic bubbles in a New Keynesian model with overlapping generations. Stochastic bubbles grow at a rate above the long-term growth of the economy, generating a boom in output and employment. But these bubbles may collapse at any time with some (exogenously given) probability, pulling down aggregate demand and output when they do. Despite the highly stylized nature of the model, the implied equilibrium appears consistent with the pattern of asset price booms followed by sudden busts (and the induced recession) that has characterized historical financial crises. However, the framework abstracts from financial frictions and, in particular, from the important role that high credit growth seems to have played in bubble episodes (Jordà, Schularick, and Taylor 2015). It also leaves unexplained the factors that ultimately drive the innovations in the aggregate bubble, as well as its eventual bursting.

As yet another example, Basu and Bundick (2017) analyze a nonlinear version of the New Keynesian model where large and persistent slumps may arise as a result of the strong feedback between aggregate demand and (endogenous) volatility, resulting from the interaction of precautionary savings and a zero lower bound constraint. With a zero lower bound constraint, there is no guarantee that the central bank will manage to stabilize the economy *on the downside*, which in turn raises households' perceived volatility of future consumption (as well as its negative skewness), leading to higher precautionary savings, a reduction in output, a higher probability of falling into a liquidity trap and an additional feedback effect on volatility and skewness.

These are only examples of efforts to introduce mechanisms that may generate patterns that one may relate, at least qualitatively, to those observed in actual financial crises. In the years ahead, I expect further research along these lines, incorporating stronger endogenous propagation mechanisms that may help account for large and persistent fluctuations in output and inflation without the need to rely on large (and largely unexplained) exogenous shocks.

But in the meantime, New Keynesian economics is alive and well. The New Keynesian model has proved to be quite flexible, with a growing number of extensions being developed by researchers in order to incorporate new assumptions or account for new phenomena. Indeed, it is hard to think of an alternative macroeconomic paradigm that would do away with the two defining features of the New Keynesian model: nominal rigidities and monetary non-neutralities.

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