



# Optimal monetary policy in a new Keynesian model with job search

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## ABSTRACT

This paper studies the implications for optimal monetary policy of introducing job search into the new Keynesian framework. Using the linear-quadratic approach described by Benigno and Woodford (2008), we derive a utility-based loss function that indicates that the goals of policymakers can be represented by the stabilization of inflation, output, employment, and labor-market tightness. We characterize the policy that is optimal from a timeless perspective. Complete inflation stabilization is optimal if the distortions caused by monopolistic competition and search externalities are eliminated. In cases where search externalities prevail, either in or out of the steady state, complete inflation stabilization is no longer optimal, and the optimal responses of inflation to aggregate shocks may depend on labor-market fundamentals.

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## 1. Introduction

The new Keynesian (NK) framework has been a workhorse in recent research on monetary policy. In its simplest form, the standard NK model (see, e.g., Walsh, 2003) assumes that working hours are the only variable input in production, and that goods are supplied by monopolistically competitive firms whose price adjustments are staggered. It also assumes that the labor market is Walrasian and frictionless. Under these assumptions, the policy goals and constraints facing the central bank can be approximated by functions of inflation and output gap. Thus, labor adjustment is not a concern as long as the fluctuations in inflation and output gap are considered.

The empirical evidence suggests that employment adjustment is crucial to understanding business cycle fluctuations. For example, Lilien and Hall (1986) have demonstrated that the cyclical adjustment of labor input chiefly represents changes in the number of employed workers, rather than adjustment of hours at given jobs.

A growing body of literature has emerged that takes employment adjustment into account by integrating the NK framework with the Mortensen–Pissarides job-search model. The search model departs from the Walrasian assumption in that workers and firms are paired via random matching, the firms must incur certain costs to post vacancies, and wages are determined by Nash bargaining between workers and firms (for a standard treatment on this type of models, see Pissarides, 2000). By incorporating job search, the NK model can account for the cyclical movement of employment.

This growing literature also sheds light on the interplay between labor-market dynamics and monetary policy. One strand of the literature explores the implications of search frictions for the design of the (Ramsey) optimal monetary policy.<sup>1</sup> The optimal policy design hinges on the efficiency of job searching. Search externalities may arise because the rate

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<sup>1</sup> Another strand of the literature focuses on the implications of labor-market frictions for employment and inflation dynamics, while taking monetary policy as exogenously given. For example, Trigari (2009) shows that with job search the NK model can account for the responses of employment, hours worked, and job flows to a monetary policy shock, and can explain better the sluggishness of inflation and the persistence of output

at which searching workers and unfilled vacancies are matched depends on the tightness of the labor market. If the number of vacancies increases relative to that of workers, the probability of matching is higher for an individual worker and lower for an individual vacancy, and vice versa. In the absence of government intervention, as shown by Hosios (1990), search externalities can be internalized through the wage bargain only if the elasticity of the firms' worker-finding rate equals the workers' bargaining power. Inefficiency may arise if the Hosios condition fails or, more generally, if the wage bargain fails to internalize the externalities. If so, the government may use appropriate labor-market policies (e.g., unemployment benefit, distortionary taxes, etc.) to correct such inefficiency. Yet, if the government has limited access to those policies, monetary policy may be used to correct for search externalities. In that case, search inefficiency may play a role in shaping optimal monetary policy.

Recently, Blanchard and Galí (2009) and Thomas (2008) studied the Ramsey optimal monetary policy in NK models with search frictions. In particular, Blanchard and Galí incorporated real wage rigidity, while Thomas embedded nominal wage rigidity into their models. Because of wage rigidities, the wage rate equals the outcome of Nash wage bargaining when the model economy is in the deterministic steady state, but not necessarily so when the economy is off the steady state.

In addition, both papers assume that the Hosios condition holds at all times. This assumption and wage rigidities imply that job search is efficient in the deterministic steady state but inefficient during the course of economic fluctuations. Blanchard and Galí show that due to the inefficiency caused by real wage rigidity, strict inflation stabilization is not optimal because it can lead to inefficient responses of unemployment to exogenous shocks. The optimal monetary policy implies some accommodation of inflation, and limits the size of the fluctuations in unemployment. Thomas shows that similar findings can be obtained in the presence of nominal wage rigidity.

It should be emphasized that in the last two papers, the optimal policies are obtained using the linear-quadratic (LQ) approach that was introduced by Rotemberg and Woodford (1997) and extended by Woodford (2003) and Benigno and Woodford (2005, 2008). By this approach, the optimal policy is obtained from maximizing the quadratic approximation of the welfare objective subject to the constraints that are first-order approximations of the model's equilibrium conditions.

Using a similar LQ method, Ravenna and Walsh (2009) analyze optimal policies under commitment and discretion in an NK model with search frictions. While assuming that wage is flexible, they assume that the Hosios condition may fail due to some shocks to the bargaining power. They show that the policymaker's goals can be expressed in quadratic terms of inflation and welfare-relevant gaps of consumption and market tightness. The bargaining power shock acts as a cost-push shock and leads to trade-offs between stabilizing inflation and real activities, whereas, productivity shock does not induce a policy trade-off. The optimal policy requires greater inflation stability if the labor market becomes less flexible.

Faia (2008) focuses on the policy that belongs to a class of feedback rules à la Taylor (1993). This paper does not assume an efficient steady state; meanwhile, it considers the distortions due to monopolistic competition, the failure of the Hosios condition, and real wage rigidity. Instead of using the LQ approach, the welfare cost of a given policy is evaluated by solving for the evolution of endogenous variables using a second-order approximation to the equilibrium conditions. The optimal rule requires that the interest rate responds positively and aggressively to inflation and unemployment. This paper also characterizes the Ramsey optimal policy by solving a system of linearized optimality conditions to the policymaker's optimization problem. The impulse-response functions implied by the Ramsey optimal policy are displayed and compared to those implied by some simple rules. However, the welfare loss implied by the Ramsey policy is not considered. Thus, the evaluation of alternative policy rules does not take the Ramsey policy as a point of comparison.

Motivated by the articles just cited, we would also like to explore the implications for monetary policy of search inefficiency in an NK model with job search. However, the present paper is distinct from previous studies in several aspects.

In the present paper, the Ramsey optimal policy is obtained using the LQ method expounded by Benigno and Woodford (2005, 2008). In contrast to the aforementioned studies that adopt the LQ approach, the present paper does not require the steady state to be efficient.<sup>2</sup> This extension allows us to calibrate the steady state in a more flexible way.<sup>3</sup> Moreover, as will be shown in Section 3.5.2, exogenous shocks may exert influences on the aggregate supply relation and act as a cost-push shock if the steady state is distorted. In that case, exogenous shocks may lead to policy trade-offs through the cost channel. This result suggests that the calibration of the steady state may affect the design of optimal policy.

(footnote continued)

that are observed in the data. Walsh (2005) shows that search frictions amplify the real impact and reduce the inflation impact of an interest-rate policy shock. This strand of literature also includes Chéron and Langot (2000), Moyen and Sahuc (2005), Sala et al. (2008), Christoffel et al. (2008), and Gertler and Trigari (2009), among others.

<sup>2</sup> In Blanchard and Galí (2009), Thomas (2008), and Ravenna and Walsh (2009), the steady state of each model economy is assumed to be efficient. This assumption simplifies the analysis greatly. Specifically, under this assumption, the approximated welfare objective involves quadratic terms only, and the first-order approximations to the equilibrium conditions are enough to evaluate the welfare effects of alternative policies with second-order accuracy. In contrast, if the steady state is distorted, the approximated policy objective involves linear terms. The linear terms complicate analysis because they must be replaced by second-order approximations of the equilibrium conditions so that the LQ approach can correctly evaluate alternative policies. See Benigno and Woodford (2008) for details.

<sup>3</sup> However, if the steady state is distorted, the LQ method used here cannot be applied to analyze the optimal policy under discretion.

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