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Macroeconomic dynamics in a model with heterogeneous wage contracts☆

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ABSTRACT

In the present paper, we constructed a DSGE model with two types of workers with heterogeneous wage contracts, unionized and non-unionized wages, to investigate macroeconomic dynamics and welfare implications. The innovative feature of this paper is to examine direct substitution effects between workers with both types of wage contracts by introducing firms that jointly employ them. It is revealed that the macroeconomic volatility and welfare loss to asymmetric labor productivity shock increased and decreased with the elasticity of substitution between two types of workers and labor unions' bargaining power, respectively. Furthermore, those of monetary policy shock increased with labor unions' bargaining power, which implies that better monetary policy design is more important when unions are more influential.

1. Introduction

To capture the sluggish changes of economic variables, New Keynesian models have examined frictions and rigidity in either the goods or the labor market, or both.[2] Regarding the rigid adjustment of wages, authors such as Zanetti (2007) and Mattesini and Rossi (2008) have given much importance to the role of labor unions. In their *non-Walrasian* economies where wages are not determined so as to match real wages and the marginal disutility of labor, unions negotiate their wages with the corresponding firms and, as a result, wage rigidity takes place. They introduced wage negotiation through Nash bargaining into standard new Keynesian models, and showed that non-Walrasian models succeeded to reproduce many key features of the European business cycles where labor unions played a significant role.

Our focus in this paper is to consider the existence of heterogeneity in wage contracts, and derive insights on the transmission mechanism of productivity and monetary policy shocks. Although the above studies have succeeded in investigating the role of wage negotiation between firms and employees, they have not dealt with the fact that there exist varieties of wage contracts even in one company. Mattesini and Rossi (2009), which is one of the most closely related papers to ours, introduced dual (unionized and non-unionized) labor market to observe that the degree of unionization had strong implications for macroeconomic dynamics and welfare. They assumed that each company was categorized as either unionized or non-unionized, and multiple wage contracts coexisted in the economy as a whole. Following these authors, we also assume that unionized and non-unionized workers, respectively, work for the Nash-bargaining and Walrasian wage. However, in contrast to them, we consider companies that jointly employ unionized and non-unionized workers through the production technology specified with the constant elasticity of substitution (CES) function. This enables us to directly consider the effect of substitution between both types of workers to macroeconomic dynamics and welfare.

To examine the substitution effect between those two types of workers, we implement our simulation analyses focusing on two elements that are supposed to affect the substitution effect. The first element is the elasticity of substitution between unionized and non-unionized workers. The use of CES production technology over these two types of workers enables us to directly examine the degree of substitution between them. The answer to the question of whether unionized and non-unionized workers are substitutable or not totally depends on the structure of the union. Weinstein's (1994) classic study pointed out that firms and enterprise unions prevailed in Japan, while trade or industrial unions did the same in the United States. If unions are organized in each company regardless of workers' skills and positions, unionized and non-unionized workers are supposed to be substitutable. In contrast, if unions are organized over companies

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[2] For instance, Erceg et al. (2000) and Galí (2011) jointly considered wage and price stickiness. For labor market friction, Hall (2005), Shimer (2005), and Galí (2011) applied the standard search theory pioneered by Diamond (1982), Mortensen (1982), and Pissarides (1985) to DSGE models. Many recent studies including Ciccarone et al. (2014), Shin and Subramanian (2014), and Raissi (2015) have shown further extensions.

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such as so-called craft unions, unionized and non-unionized workers can be less substitutable than those within a company. In this study, we abstract away from this complicated issue, and simply examine how the elasticity of substitution between unionized and non-unionized workers affects the consequences.[3]

The second element is the bargaining power of unionized workers. Empirical studies such as Cahuc et al. (2006), Antonczyk et al. (2010), and Dumont et al. (2012) showed that the bargaining power of labor unions varied depending on many factors such as the country, the industry, and the workers' skill. The bargaining power directly defines relative levels and dynamics of bargained wages to the benchmark wage, which is defined as the Walrasian wage in our study. Note that we may regard the wages of non-unionized workers the same as those of unionized workers without bargaining power. Therefore, our model replicates a standard New Keynesian model without labor unions when the union bargaining power is close to zero. Given the above empirical evidences, we examine how changes in unions' bargaining power affect the substitution effect between multiple types of workers and their consequences on macroeconomic dynamics and welfare implications.

We consider two types of shocks in this study: asymmetric labor productivity shock and monetary policy shock. Our key findings on these disturbances are summarized in the following manner. Firstly, for asymmetric labor productivity shocks, it is revealed that volatilities of consumption and hours worked increase with the elasticity of substitution between the two types of workers. This implies that the welfare loss caused by asymmetric labor productivity shocks is larger when the two types of workers are more substitutable. These are natural consequences, as higher substitutability leads to aggressive shift of firms' input in their production from one type of labor to another when firms face heterogeneous changes in labor productivity. This leads to larger volatilities of hours worked, production, and consumption and, as a result, amplifies the welfare loss. Here, it is worth noting that the steady-state GDP is improved with higher elasticity of substitution by efficient resource allocation. Furthermore, we find that if the bargaining power of unionized workers is strong enough, bargained wages are well stabilized to asymmetric labor productivity shocks. This results in stabilizing the hours worked by unionized workers. In this study, firms are assumed to jointly employ both unionized and non-unionized workers. Consequently, stabilization of hours worked by unionized workers leads to stabilization of hours worked by non-unionized workers through the substitution effect. As a result, hours worked, production, and consumption are well stabilized to asymmetric labor productivity shocks in an economy where the bargaining power of unionized workers is strong enough to imply moderate welfare loss.

Secondly, for monetary policy shock, we find that volatilities of consumption and hours worked and the welfare loss to monetary policy shocks increase with the union bargaining power. The unionized wage is found to be less volatile to monetary policy shocks when the union bargaining power is stronger. An exogenous shock to policy interest rates leads to a negative correlation between interest and inflation rates. For instance, positive monetary policy shock results in a fall of inflation rates. Suppose that the unionized wage and the economy-wide wage index that generally fall to positive monetary policy shocks are stabilized more, and the extents of their negative responses to such a shock are smaller due to stronger union bargaining power. In this case, firms' marginal cost and inflation rate become more stable, and negative responses to them are found to be smaller. As interest rate endogenously responds to inflation as a policy reaction, a fall of inflation rate generates downward pressure on interest rate. This pressure becomes smaller when the union bargaining power is stronger and a fall of inflation rate is smaller. To a positive shock to the policy interest rate, inflation rate negatively responds. The policy interest rate endogenously responds to this fall in inflation rate. This endogenous response mitigates the positive response of interest rate to a positive shock to it. In an economy where the union bargaining power is stronger, this mitigating effect becomes smaller. As a result, consumption, labor and production become more volatile and the welfare loss becomes larger in such an economy. Regarding this type of economic disturbance, our findings imply the importance of better monetary policy design and implementation in an economy where those two types of workers are more substitutable or the bargaining power of labor unions is stronger.

This paper is structured in the following manner. The following section presents the model that forms the basis of the analysis in this paper. Section 3 shows the second moments of variables and welfare implications. Section 4 briefly discusses the remaining issues and concludes this paper.

2. Model

2.1. Representative household

In the economy, we assume that members of the representative household work under two different wage contracts, called Type N and Type U. Workers with a Type-N contract, or Type-N workers, are paid the Walrasian wage, whereas those with a Type-U contract, or Type-U workers, belong to labor unions, negotiate their wages with firms and work under determined wages. Following Goodfriend and McCallum (2007), we define the representative household's utility as a simple log-linear function over consumption and hours worked under two types of wage contracts in the following manner:

$$v\left(e_t, l_{U,t}, l_{N,t}\right) = \ln e_t + O \ln\left(1-l_{U,t}-l_{N,t}\right),$$

where $l_{U,t}$ and $l_{N,t}$ denote the aggregated working hours of workers under Type-U and Type-N contracts, respectively, and O is the weight on the leisure in the utility. The notation e_t denotes the aggregated consumption of goods z continuously distributed on [0, 1] such that it satisfies a Dixit–Stiglitz preference:

$$e_t = \left(\int_0^1 [e_t(z)]^{\frac{\epsilon-1}{\epsilon}} dz\right)^{\frac{\epsilon}{\epsilon-1}}, \ \epsilon > 1.$$

The optimal allocation of any given expenditure to each variety of goods yields the following demand functions:

$$e_t(z) = \left(\frac{p_t(z)}{p_t}\right)^{-\epsilon} e_t,$$

where the consumer price index (CPI) is given by

$$p_t = \left(\int_0^1 [p_t(z)]^{1-\epsilon} dz\right)^{\frac{1}{1-\epsilon}}.$$

Each firm z produces the variety z scattered on [0, 1]; i.e., firms are continuously distributed in the unit interval, and hence aggregate labor inputs are given:

$$l_{i,t} = \int_0^1 l_{i,t}(z) dz, \quad i = N, U.$$

We now formulate the household maximization problem as

$$\max_{e_t,\, b_t} E\left\{\sum_{t=1}^{\infty} \beta^t v\left(e_t, l_{U,t}, l_{N,t}\right)\right\}$$

subject to

$$p_t e_t + q_t b_t \le b_{t-1} + \int_0^1 w_{N,t} l_{N,t}(z) dz + \int_0^1 w_{U,t}(z) l_{U,t}(z) dz + f_t,$$

[3] There has been a long debate on the difference between unionized and non-unionized workers. See Allen (1984), Sverke and Hellgren (2001), and Picault (2013) for example.