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Alternating offers with asymmetric information and the unemployment volatility puzzle

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A B S T R A C T

To provide micro-founded real wage rigidities, the literature on the unemployment volatility puzzle has considered alternating offers on one side, and asymmetric information on the other. Separately, however, these two frameworks deliver a limited amount of wage stickiness and thus require questionable calibrations to raise unemployment fluctuations. In this paper, we argue that the alternating offers model with one-sided asymmetric information, which combines the two frameworks, gives a more satisfactory answer to the puzzle. The results are improved along two dimensions. First, we show that this model is capable to generate large unemployment movements for a realistic calibration. Secondly, the model produces a right degree of real wage pro-cyclicality for such a calibration and therefore delivers a micro-founded explanation to real wage rigidities.

1. Introduction

The incapacity of the canonical search-and-matching model to replicate labor market dynamics has triggered a substantial literature. Among the myriad of solutions proposed to solve this "unemployment volatility puzzle" raised by Shimer (2005), real wage rigidities have received the most attention. In order to give micro-foundations to real wage stickiness, the literature related to this puzzle has investigated mainly two ways: alternating wage offers (Hall and Milgrom, 2008) and asymmetric information during the wage bargaining (Kennan, 2010). These two frameworks, however, display only a weak amount of wage stickiness and therefore need questionable calibrations to amplify unemployment fluctuations. Particularly, very high labor shares and large additional hiring costs are required to reproduce the volatility of the unemployment rate in the United States. In this paper, we argue that the alternating offers model with one-sided asymmetric information, which combines the two frameworks, provides a more satisfactory answer to the puzzle pointed out by Shimer. Notably, the higher degree of wage stickiness makes this model able to produce large unemployment movements for realistic labor shares and without assuming additional costs for firms.

The alternating offers model with one-sided asymmetric information (henceforth "AOMOSAI") initially considers a seller of an item and a potential buyer who bargain over the item's price. Both parties alternate in making proposals in a Rubinstein (1982) fashion. Moreover, information is asymmetric since the seller's valuation is common knowledge whereas the buyer's valuation is known only to herself. In such a framework, there is a multiplicity of equilibria which explains that a literature was addressed to narrow down the range of predicted bargaining outcomes. Grossman and Perry (1986) and Gul et al. (1986) develop respectively the concepts of stationary equilibrium and perfect sequential equilibrium. Gul and Sonnenschein (1988) refine the conditions over strategies and time interval between successive offers that ensure a single equilibrium.

The wage bargaining is a natural implementation of that framework. In this case, the worker and the employer alternate in making wage proposals but the productivity of the match is observed only by the employer. Within this set-up, Menzio (2007) determines the conditions under which vague non-contractual statements (found in help wanted ads) by the firms are correlated to actual wages and partially direct the search strategy of the workers. However, the AOMOSAI was not considered by the large literature that follows the seminal paper by Shimer (2005) on the unemployment volatility puzzle. Instead, this literature focuses on each component separately, i.e. alternating offers on one hand, and asymmetric information on the other.

In the canonical search-and-matching model, the real wage is determined by the standard Nash Bargaining for which information is perfect and the threat points of the parties are their pro-cyclical outside options. The resulting real wage is thus flexible with respect to both labor productivity and labor-market conditions. Hall and Milgrom (2008) replace

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the Nash Bargaining by the Alternating Offers Bargaining. They point out that on a frictional labor market, the pro-cyclical outside options are not credible threat points. The credible threat points in a sequential bargaining are the a-cyclical payments obtained during the bargaining, which implies some rigidity of the real wage with respect to labor-market conditions. The Asymmetric Information Game was investigated by Kennan (2010). Firms would be subject to both aggregate and specific productivity shocks and the latter are supposed to be pro-cyclical. It is also assumed that only employers are able to observe the specific productivity component. Kennan shows, in a generalization of the Nash Bargaining to cases with private information, that it is rational for workers to be prudent by considering that the specific productivity is the lowest. The bargained real wage is therefore insensitive to the larger number of matches realizing a high specific productivity in cyclical booms, and then delivers some rigidity with respect to labor productivity.

In this paper, we stress that the Alternating Offers Bargaining and the Asymmetric Information Game, separately, display only a limited real wage stickiness. These frameworks thus require implausible calibration values, most notably labor shares much higher than their empirical counterpart and large additional hiring and training costs, to amplify labor-market fluctuations. We show that once these models are calibrated to match the empirical labor share in the US, and without additional costs, the volatility of the labor market collapses. By combining the two frameworks, the AOMOSAI brings a higher level of wage stickiness that considerably magnifies the labor-market response to aggregate shocks. The results are improved along two dimensions. First, the model almost completely replicates unemployment volatility when calibrated to match the empirical labor share, and without assuming additional costs. Secondly, the model produces a right amount of pro-cyclicality for the real wage with this calibration and then provides a micro-founded explanation of the real wage rigidities which characterize labor markets.

The rest of this paper is organized as follows. In the next section, we derive the equations of the model. In Section 3, we calibrate and assess its quantitative properties. Section 4 concludes.

2. The alternating offers model with one-sided asymmetric information

2.1. The basic structure

We consider an economy populated by a continuum of workers and a continuum of firms with measures 1. Every agent is risk-neutral and has a life of indefinite length. The current state is denoted by i. A job match of type j produces an output at flow rate $p_i + y_j$, where p_i is an aggregate component common to all matches, and y_j is a random idiosyncratic variable drawn from a commonly known state varying CDF $F_i(y)$ that has strictly positive density $f_i(y)$ over the fixed interval $[y_L, y_H]$, with $y_L > 0$ and $\int_{y_L}^{y_H} f_i(y)dy = 1$.

We assume that there is a positive covariance between p_i and the average (or expected) idiosyncratic productivity $\int_{y_L}^{y_H} y f_i(y)dy$, which is an important feature of Kennan (2010). This positive covariance means that the average idiosyncratic productivity is pro-cyclical: during an economic expansion, there is an improvement in the distribution of the idiosyncratic productivity and the amount of matches with higher types increases. Kennan (2010) gives some evidence[2] that supports this assumption.

The average value of total productivity (henceforth the "average productivity") in this economy at state i is given by:

$$\rho_i = p_i + \int_{y_L}^{y_H} y f_i(y)dy \tag{1}$$

Following a positive shock on aggregate productivity, ρ_i rises both because p_i and the proportion of matches with higher types increase. Note that ρ_i is the productivity that we observe in the empirical data.

[2] From Dunne et al. (2004).

The rest of the framework is analogous to the standard search and matching model. The opportunity cost of employment to the worker and the cost of posting a vacancy to a firm are denoted by z and c, respectively. The number of new matches each period is given by a matching function $m(u_i, v_i)$, where u_i and v_i represent the number of unemployed workers and the number of open job vacancies, respectively. Since the number of workers is normalized to 1, u_i and v_i also represent the unemployment and vacancy rates. The job-finding rate $f(\theta_i) = \frac{m(u_i,v_i)}{u_i} = m(1, \theta_i)$ is increasing in market tightness θ_i, the ratio of vacancies to unemployment. The rate at which vacancies are filled is denoted by $q(\theta_i) = \frac{m(u_i,v_i)}{v_i} = \frac{f(\theta_i)}{\theta_i}$, and is decreasing in θ_i. The form of the matching function is assumed to be Cobb-Douglas, with $m(u_i, v_i) = m_0 u_i^{\eta} v_i^{1-\eta}$. This implies $f(\theta_i) = m_0 \theta_i^{1-\eta}$ and $q(\theta_i) = m_0 \theta_i^{-\eta}$. Finally, matches are destroyed at the exogenous rate s and all agents have the same discount rate r.

We denote by U_i the value of unemployment, W_{ij} the worker's value of a match of type j, J_{ij} and V_{ij} the employer's values of a filled job and a vacancy of type j, respectively. All these values are determined by the Bellman equations:

$$rU_i = z + f(\theta_i)(W_{ij} - U_i) + \lambda(E_i U_{i'} - U_i) \tag{2}$$

$$rW_{ij} = w_i(y_j) - s(W_{ij} - U_i) + \lambda(E_i W_{i'j} - W_{ij}) \tag{3}$$

$$rJ_{ij} = p_i + y_j - w_i(y_j) - sJ_{ij} + \lambda(E_i J_{i'j} - J_{ij}) \tag{4}$$

$$rV_{ij} = -c + q(\theta_i)(J_{ij} - V_{ij}) + \lambda(E_i V_{i'j} - V_{ij}) \tag{5}$$

where λ represents the arrival rate of aggregate productivity shocks and E_i the expectation operator conditional on the current state i.

Free entry is assumed on the goods market, such that the expected profit of opening a vacancy is zero ($V_{ij} = 0$). For a type j match, the zero-profit condition is:

$$\frac{c}{q(\theta_i)} = \frac{p_i + y_j - w_i(y_j) + \lambda E_i J_{i'j}}{r + s + \lambda}$$

For the whole economy, this condition is:

$$\frac{c}{q(\theta_i)} = \frac{\rho_i - \omega_i + \lambda E_i J_{i'}}{r + s + \lambda} \tag{6}$$

with ω_i the average wage (the wage observed in the data) given by:

$$\omega_i = \int_{y_L}^{y_H} w_i(y) f_i(y) dy \tag{7}$$

Wages are assumed to be renegotiated after every aggregate shock, so the real wages determined in the next subsection only depend on the current state i.

2.2. The wage bargaining

Nash Bargaining. Before Shimer (2005), the Nash Bargaining was traditionally applied by the search-and-matching literature to get the real wage. In this case, the equilibrium wage is determined by the Generalized Nash Solution with the outside options as threat points. The outside options are U_i for the worker and $V_{ij} = 0$ for the employer. The surplus (in flow rates) of the worker for a type j match is therefore $w_i(y_j) - rU_i$ while the surplus of the employer for the same match is $p_i + y_j - w_{ij}$. Denoting by β the worker's bargaining power, the real wage of a type j match is:

$$w_i^{NB}(y_j) = (1 - \beta)z + \beta(p_i + y_j + c\theta_i)$$

The average wage is:

$$\omega_i^{NB} = (1 - \beta)z + \beta(\rho_i + c\theta_i) \tag{8}$$