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On the Dynamic Role of Monopolistic Competition in the Monetary Economy

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Abstract

Much static research on the new Keynesian economics is based on the distortion caused by monopolistic pricing. When the theory of monopolistic competition is extended to monetary dynamics in an overlapping generations (OLG) model (Otaki 2007, 2009), the underemployment problem is resolved by a proper monetary policy. However, even in the full-employment equilibrium, the market mechanism does not attain the socially optimal allocation. Since the rate of population growth is assumed to be zero, the optimal gross inflation rate in the model is unity. There is no such coordination motive in a monetary economy, and hence, the inflation rate may exceed unity. The monopolistic power lowers the inflation rate. The prices of the current goods relative to the future goods increase by virtue of the monopolistic power. This improves the lifetime utility because the lowered inflation rate corrects the consumption stream, which is biased toward the current goods.

Keywords: Overlapping Generations Model with Money, Monopolistic Competition in Dynamics, Inflation, Dynamic Inefficiency

1. Introduction

It is well known that monopolistic competition plays an important role in the new Keynesian economics.[1] The price of goods relative to that of leisure becomes too high, resulting in a shortage of consumption and an excess of leisure. The deadweight loss of monopoly makes room for government intervention. Thus, the results of partial equilibrium analysis can be applied to the general equilibrium of preceding research. However when we extend the theory to monetary economic dynamics in the OLG model (Otaki [1,2]), we see that a proper monetary policy can resolve the underemployment problem.

Nevertheless, another distortion remains. Even when the economy enjoys the full-employment equilibrium, the socially optimal allocation differs not only from monopolistic competition but also from the Walrasian equilibrium.

When the population growth is zero, the optimal gross inflation rate is unity. The reason for this is that the quantity of goods transferred to old individuals is the same as that given by them to the previous generation. Since such coordination is impossible in the monetary economy, where decision making is separated generation by generation, the equilibrium gross inflation rate possibly exceeds unity.

In the dynamic model, the monopolistic competition lowers the inflation rate. Since the workers' reservation wages depend on the current and future price levels, monopolistic pricing heightens the current price relative to the future price, and lowers the inflation rate. Thus, the monopolistic competition dominates the Walrasian equilibrium in the inflationary monetary economy.

The paper is organized as follows. Section 2 constructs a model based on Otaki [1]. The welfare comparison between the monopolistic competition and the Walrasian equilibrium is treated in Section 3. Brief concluding remarks are made in Section 4.

2. Model

2.1. Structure of the Model

We consider a model based on Otaki [1]. Consider a

[1]For example, see Mankiw [3, 4], Blanchard and Kiyotaki [5], and Stratz [6].

standard two-period OLG model with money. There is a continuum of perishable goods indexed by $z \in [0,1]$. There is no fixed cost for production. Numerous potential competitors exist in each industry z. We consider two cases for the market structure. One is that each good is monopolistically produced by a firm. The other is the Walrasian equilibrium where entry is free in each industry and every firm behaves as a price taker. Individuals are born at a continuous density $[0,1]\times[0,1]$. They can supply one unit of labor and do so only when they are young.

2.2. Individuals

Individuals have identical lifetime utility functions, $\widehat{U}$

$$\widehat{U}(C_{t+j}^1, C_{t+j+1}^2, \delta_{t+j}) \equiv U(C_{t+j}^1, C_{t+j+1}^2) - \delta_{t+j}\cdot\beta, \quad (1)$$

$$C_{t+j}^i \equiv \left[\int_0^1 c_{t+j}^i(z)^{1-\eta^{-1}}\,dz\right]^{\frac{1}{1-\eta^{-1}}}. \quad (2)$$

$U(\cdot)$ is a well-behaved linear homogeneous function and $1<\eta$. $c_{t+j}^i(z)$ is the consumption of good z at the *i* th stage of life during period $t+j$. β is the disutility of labor. δ_{t+j} is a definition function that is one when an individual is employed, and zero when unemployed.

We can obtain the following indirect utility function V by solving the optimization problem:

$$V \equiv v(\rho_{t+j})\cdot\left[\frac{\delta_{t+j}\cdot W_{t+j} + \Pi_{t+j}}{P_{t+j}}\right] - \delta_{t+j}\cdot\beta, \quad v' < 0, \quad (3)$$

where

$$P_{t+j} \equiv \left[\int_0^1 p_{t+j}^i(z)^{1-\eta}\,dz\right]^{\frac{1}{1-\eta}}, \quad \rho_{t+j} \equiv \frac{P_{t+j+1}}{P_{t+j}}. \quad (4)$$

W_{t+j} denotes the nominal wage. Π_{t+j} denotes the profit that is equally distributed to each individual independent of employment. Using Equation (3), we can calculate the nominal reservation wage W_{t+j}^R as

$$W_{t+j}^R = \frac{P_{t+j}}{v(\rho_{t+j})}\beta. \quad (5)$$

Because our main concern is an underemployment equilibrium where some individuals are unemployed, the equilibrium nominal wage W_{t+j} is equal to W_{t+j}^R.[2]

2.3. Firms

The demand function of good z during period $t+j$ is

$$c_{t+j}(z) = \left[\frac{p_{t+j}(z)}{P_{t+j}}\right]^{-\eta}\frac{Y_{t+j}^d}{P_{t+j}}, \quad (6)$$

where $\frac{Y_{t+j}^d}{P_{t+j}}$ is the real effective demand defined by

$$y_{t+j} \equiv \frac{Y_{t+j}^d}{P_{t+j}} \equiv a(\rho_{t+j})\cdot\left[\frac{W_{t+j}}{P_{t+j}}L_{t+j} + \frac{\Pi_{t+j}}{P_{t+j}}\right] + \frac{M_{t+j-1}}{P_{t+j}} + \frac{G_t}{P_t}, \quad (7)$$

where $a(\rho_{t+j})$ is the marginal propensity to consume. L_{t+j} is the current employment level. M_{t+j-1} denotes the nominal money stock carried over from the previous period. Thus, the first term on the right-hand side of Equation (7) is the aggregate consumption function of the younger generation. The second is the aggregate consumption of the older generation. The last term is the government expenditure.

2.3.1. Case for Monopolistic Competition

The profit maximization problem of a monopoly firm for good z is

$$\max_{p_{t+j}(z)} \Pi_{t+j}(z) = \max_{p_{t+j}(z)} [p_{t+j}(z)c_{t+j}(z) - W_{t+j}^R\Psi(c_{t+j}(z))], \quad \Psi' > 0, \ \Psi'' \ge 0, \quad (8)$$

where $\Psi(\cdot)$ is the inverse of the production function. The solution is

$$p_{t+j}^*(z) = \frac{W_{t+j}^R}{1-\eta^{-1}}\Psi'(c_{t+j}^*(z)), \quad \forall z. \quad (9)$$

Substituting (5) into (9), we obtain

$$P_{t+j}^* = \frac{\beta P_{t+j}^*}{v(\rho_{M,t+j}^*)}\frac{\Psi'(y_{t+j}^*)}{1-\eta^{-1}} \Leftrightarrow v(\rho_{M,t+j}^*) = \frac{\beta\Psi'(y_{t+j}^*)}{1-\eta^{-1}}. \quad (10)$$

Thus the equilibrium inflation rate, ρ_M^*, is the non-increasing function of the real GDP per firm y_{t+j}^*.

[2]The nominal wage is negotiated between a firm and the employed individuals when the economy attains the full-employment equilibrium. If the nominal wage is determined by an asymmetric Nash bargaining solution where the threat point is $(0, W_{t+j}^R)$, the equilibrium nominal wage, W_{t+j}^*, becomes

$$W_{t+j}^*(z) = \theta W_{t+j}^R + (1-\theta)\frac{p_{t+j}(z)c_{t+j}(z)}{\Psi}.$$

θ denotes the parameter that represents the firm's bargaining power. Ψ is the inverse of the production function with a decreasing marginal product. The profit function of a firm, $\Pi_{t+j}(z)$, is

$$\Pi_{t+j}(z) = [p_{t+j}(z)c_{t+j}(z) - W_{t+j}^*(z)\Psi(c_{t+j}(z))] = \theta\cdot[p_{t+j}(z)c_{t+j}(z) - W_{t+j}^R\Psi(c_{t+j}(z))].$$

Thus, the production decision process of the firms in 2.3 can be applied intact independent of the aggregate demand level. See Otaki [2] for more details.

(10) is the difference equation that the equilibrium price sequence, $\{P^*_{t+j}\}_{j\geq 0}$, must satisfy. It is noteworthy that $\{P^*_{t+j}\}_{j\geq 0}$ has no relationship with the sequence of nominal money supply, $\{M_{t+j}\}_{j\geq 0}$. This implies the non-neutrality of money in the sense that real cash balance, $\frac{M_{t+j}}{P^*_{t+j}}$, can be determined independently of the price level, P^*_{t+j}.

2.3.2. Case for the Walrasian Equilibrium

We assume that every firm in any industry behaves as a price taker. It is clear from Equation (8) that the maximization yields $p^*_{t+j}(z) = W^R_{t+j}\Psi'(y^*_{t+j})$. Substituting (5) into this result, the equilibrium inflation rate, ρ^*_W, satisfies

$$v(\rho^*_W) = \beta\Psi'(y^*_{t+j}). \tag{11}$$

Because v is a decreasing function of ρ, it is straightforward from Equations (10) and (11) that

$$\rho^*_W(y^*_{t+j}) \geq \rho^*_M(y^*_{t+j}), \quad \forall\, y^*_{t+j}. \tag{12}$$

The equality holds when $\rho^*_W(y^*_{t+j})$ is not larger than unity. Thus, the inflation rate in the monopolistic competition is lower than that in the Walrasian equilibrium when inflation occurs.[3]

2.4. Government

The role of the government in this model is very simple. It finances the wasteful expenditure G_{t+j} by seigniorage S_{t+j}. Namely,

$$G_{t+j} = S_{t+j} \equiv M_{t+j} - M_{t+j-1}, \quad \forall\, j \geq 0. \tag{13}$$

We specify the money supply rules as follows:

1). The government arbitrarily chooses the current money supply M_t. This decision does not affect the initial price level, P_t, because the equilibrium price sequence, $\{P^*_{t+j}\}_{j\geq 0}$, is determined by Equation (10) or Equation (11) (Rule 1).

2). From period $t+1$ onward, M_{t+j} is controlled so as to keep the real cash balance equal to $m \equiv \frac{M_t}{P_t}$. Namely, $m = \frac{M_{t+j}}{P_{t+j}}, \ \forall j \geq 1$ holds (Rule 2).

From rules 1 and 2, and Equation (13), the current budget constraint of the government is

$$\frac{S_{t+j}}{P_{t+j}} = m - \frac{m}{\rho} = g \equiv \frac{G_t}{P_t}. \tag{14}$$

2.5. Market Equilibrium

There are three kinds of markets: goods, labor, and money. We focus on the first two. The labor markets are in equilibrium when the equilibrium nominal wage is equal to the nominal reservation wage. It is expressed by Equation (10) or Equation (11). The equilibrium condition for the goods markets in the stationary state is

$$y^* = a(\rho^*_j)\cdot y^* + m. \tag{15}$$

Equation (15) is the Keynesian cross in this model. Suppose that real money supply, m, is sufficiently small. Then, the solution for (15), y^*, is located within $(0,1)$. Such a case corresponds to the stationary underemployment equilibrium.

To sum up, for the arbitrarily given initial price level, P_t, (ρ^*_j, y^*) is determined by Equations (10) and (15) or by Equations (12) and (15).

3. Welfare Analysis

In this section, we first show that the allocation by the monopolistic competition dominates that by the Walrasian equilibrium for all production levels y^*. Second, we explain the reason for this by considering the socially optimal allocation.

To keep the GDP level at y^*, the real money supply, m^*_j, must satisfy the following equation: [3]

$$m^*_j = [1 - a(\rho_j(y^*))]y^*, \quad j = M \text{ or } W.$$

Using Equations (3) and (5), the lifetime utility at the stationary underemployment equilibrium, V^*_j, is represented as

$$\begin{aligned} V^*_j(y^*) &= v(\rho_j(y^*))\frac{\Pi^*_t}{P^*_t} \\ &= v(\rho_j(y^*))y^* - \beta\Psi(y^*), \quad j = M \text{ or } W. \end{aligned} \tag{16}$$

From Inequality (12), we obtain the following theorem.

Theorem 1 *In any stationary equilibrium,* y^*, *the allocation of the monopolistic competition weakly dominates that of the Walrasian equilibrium. Namely,*

[3]When an equilibrium falls into deflation, *i.e.*, ρ^*_j becomes less than unity, the effective inflation rate that the individuals face is fixed at unity. This is because the deflation levies the money holding of the old generation proportionately to its negative inflation rate. See money supply rule 2 and Equation (14) below.

[4]Although the sign of the first derivative of $a(\cdot)$ is ambiguous, the real money supply m^*_j for attaining some fixed y^* can be determined, independent of the sign.

$$V_M^*(y^*) \geq V_W^*(y^*), \quad \forall\, y^* \in (0,1],$$

where V_M^* is the utility of each individual in the monopolistic competition, and V_W^* is that in the Walrasian equilibrium.

Inflation, which makes the Walrasian equilibrium *dynamically inefficient*, is a true social cost incurred from using money, and hence, the monopolistic competition can contribute to the economic welfare through a reduction in such cost.

In addition, the gain obtained by the monopolistic competition is actually attributed to the monopoly rent $\frac{\Pi_t^*}{P_t^*}$, because the real reservation wage is reduced by the disinflation as appears in Equation (16). It is also noteworthy that although the increasing marginal cost is the only cause of underemployment in the static monopolistic competition model, it is not a crucial factor in the dynamic model as long as the fiscal monetary policy is properly executed.

4. Concluding Remarks

This paper investigated the dynamic role of the monopolistic competition in the monetary economy. The following results are obtained.

First, the monopolistic competition lowers the inflation rate. This is because the monopolistic power increases the current price level relative to the future price level, which is woven into the nominal reservation wage.

Second, the monopolistic competition weakly dominates the Walrasian equilibrium in resource allocation. If coordination between generations is possible, the marginal transformation rate is unity. In the monetary economy, however, decision making is diversified with each generation. Hence, there is no guarantee that the inflation rate is equal to the marginal transformation rate, except for in the special case. As compared to the social optimum, the current consumption becomes too large under inflation. Thus, inflation is the deadweight loss intrinsic to the monetary economy. To sum up, the monopolistic competition contributes to economic welfare through a reduction in the inflation rate.

It is also noteworthy that the source of distortion shifts from the relative price between the goods and leisure in statics to the intertemporal relative price of the goods in dynamics. The welfare-economic results of the dynamic monopolistic competition contrast sharply with those of the preceding static analyses.

5. References

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