A NOTE ON THE DYNAMIC ROLE OF MONOPOLISTIC COMPETITION IN THE MONETARY ECONOMY

abstract

In the new Keynesian economics, monopolistic competition plays an important role. Much static research is based on a distortion caused by monopolistic pricing: the price of goods relative to that of leisure becomes too high, resulting in a shortage of consumption and an excess of leisure.

When the theory of monopolistic competition is extended to monetary dynamics in the overlapping generations model (OLG) (Otaki 2007, 2009), the unemployment (excess leisure) problem is entirely resolved by proper monetary–fiscal policy. However, there emerges another distortion. Even in full-employment equilibrium, the socially optimal allocation diverges not only from monopolistic competition, but also from Walrasian equilibrium.

The optimal net inflation rate in the model is zero, because the same quantity of goods is transferred to old individuals as they gave to the previous generation. Since there exists no such coordination motive in a monetary economy, the inflation rate possibly exceeds zero.

Monopolistic power lowers the inflation rate; a nominal wage depends on current and future prices. Consequently, the prices of current goods relative to future goods become higher by virtue of the monopolistic power. This improves lifetime utility because the units of current labor supply can buy more future goods. Thus, monopolistic competition possibly dominates Walrasian equilibrium in the monetary economy.

1. Introduction

It is well known that monopolistic competition plays an important role in the new Keynesian economics.[1] The deadweight loss of monopoly makes room for government intervention. Thus, results of partial equilibrium analysis can apply to the general equilibrium of preceding research. However when we extend the theory to monetary economic dynamics in the OLG model (Otaki 2007, 2009), we see that proper monetary policy can resolve the underemployment problem.

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

When population growth is zero, the optimal net inflation rate is zero. The reason is that old individuals receive the same quantity of goods as they donated to the previous generation. Since such coordination is impossible in the monetary economy, where decision making is separated generation by generation, the equilibrium net inflation rate possibly exceeds zero.[2]

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

The paper is organized as follows. Section 2 briefly summarizes the model of Otaki (2007). Welfare comparison between monopolistic competition and Walrasian equilibrium is treated in Section 3. This section also contains discussion on the welfare loss intrinsic to the monetary economy. Brief concluding remarks are contained in Section 4.

[1] For example see Mankiw (1985, 1988); Blanchard and Kiyotaki (1987); and Stratz (1989).

[2] Diamond (1965) already shows that the economy fails to attain the Golden Age Paths where the total consumption is maximized because of the lack of intergenerational coordination. The essence of the discussion here is analogous to Diamond model.

2. The Basic Model

2.1 The Structure of the Model

We briefly sketch the dynamic equilibrium Keynesian model in Otaki (2007). Consider a standard two-period overlapping generations model with money. There exists a continuum of perishable goods indexed by $z \in [0, 1]$. Each good is monopolistically produced by firm z. 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.

- **Individuals**

Individuals have identical lifetime utility functions

$$U(C^1_{t+j}, C^2_{t+j+1}, \delta_{t+j}) \equiv (C^1_{t+j})^{\alpha}(C^2_{t+j+1})^{1-\alpha} - \delta_{t+j} \cdot \beta, \tag{1}$$

$$C^i_{t+j} \equiv \Big[\int_0^1 c^i_{t+j}(z)^{1-\eta^{-1}} dz\Big]^{\frac{1}{1-\eta^{-1}}} \tag{2}$$

where $0 < \alpha < 1$ and $1 < \eta$. $c^i_{t+j}(z)$ 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 takes a value of one when employed and zero when unemployed.

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

$$IU(P_{t+j}, P_{t+j+1}, \delta \cdot W_{t+j} + \Pi_{t+j}) \equiv A\Big(\frac{\delta_{t+j} \cdot W_{t+j} + \Pi_{t+j}}{P^{\alpha}_{t+j} P^{1-\alpha}_{t+j+1}}\Big) - \delta_{t+j} \cdot \beta \tag{3}$$

where

$$A \equiv \alpha^{\alpha}(1-\alpha)^{1-\alpha}, \quad P_{t+j} \equiv \Big[\int_0^1 p^i_{t+j}(z)^{1-\eta} dz\Big]^{\frac{1}{1-\eta}}.$$

W_{t+j}, Π_{t+j} denote the nominal wage and profits equally distributed to each individual. Using equation (3), we can calculate the nominal reservation wage W^R_{t+j} as

$$W^R_{t+j} = A^{-1} P^{\alpha}_{t+j} P^{1-\alpha}_{t+j+1} \beta. \tag{4}$$

Since our main concern is imperfect employment equilibrium where some individuals are unemployed, the equilibrium nominal wage W_{t+j} is equal to W^R_{t+j}.

- **Firms**

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

$$c_{t+j}(z) = \Big[\frac{p_{t+j}(z)}{P_{t+j}}\Big]^{-\eta}\frac{Y^d_{t+j}}{P_{t+j}} \tag{5}$$

where $\dfrac{Y^d_{t+j}}{P_{t+j}}$ is the real effective demand defined by

$$\frac{Y^d_{t+j}}{P_{t+j}} \equiv \alpha\Big(\frac{W_{t+j}}{P_{t+j}}L_{t+j} + \frac{\Pi_{t+j}}{P_{t+j}}\Big) + \frac{G_{t+j}}{P_{t+j}} + \frac{M_{t+j}}{P_{t+j}}. \tag{6}$$

L_{t+j} is the current employment level and G_{t+j} denotes the nominal government expenditure. M_{t+j} is the nominal money stock that is carried over from the previous period. Thus, the first term on the right-hand side of equation (6) is the aggregate consumption function of the young generation. The second term is real government consumption, and the third is aggregate consumption by the old generation.

For simplicity, assume that one unit of labor produces one unit of goods. Then, the profit maximization problem of firm z is

$$\max_{p_{t+j}(z)} \Pi_{t+j}(z) = \max_{p_{t+j}(z)} [p_{t+j}(z) - W^R_{t+j}]c_{t+j}(z). \tag{7}$$

The solution is

$$p_{t+j}(z) = \frac{W^R_{t+j}}{1-\eta^{-1}}, \quad \forall z. \tag{8}$$

Substituting (4) into (8), we obtain

$$P_{t+j} = \Big(\frac{A^{-1}\beta}{1-\eta^{-1}}\Big)^{\frac{1}{1-\alpha}} P_{t+j+1}. \tag{9}$$

(9) is the difference equation that 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 nonneutrality of money in the sense that real cash balance, $\dfrac{M_{t+j}}{P_{t+j}}$, can be determined independently of the price level, P_{t+j}. In addition, we assume η is large enough and β is sufficiently small that the equilibrium inflation rate, ρ, is no less than unity. Thus

$$\rho \equiv \frac{P_{t+j+1}}{P_{t+j}} = [A(1-\eta^{-1})\beta^{-1}]^{\frac{1}{1-\alpha}} \geq 1 \tag{10}$$

holds.

- **The Government**

The government finances its fiscal expenditure by seigniorage. That is

$$M_{t+j+1} - M_{t+j} = G_{t+j}, \quad \forall\, j \geq 0. \tag{11}$$

We specify the money supply rules as follows.

1. The government adjusts M_{t+1} in accordance with the current fiscal expenditure G_t (Rule 1).

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

By Rule 1 and equation (11), the current budget constraint of the government is

$$\rho m_{t+1} - m_t = \frac{G_t}{P_t} \equiv g_t. \tag{12}$$

Rule 2 and equation (11) require that the real government expenditure from the next period, g, must satisfy

$$(\rho - 1) m_{t+1} = \frac{G_{t+j}}{P_{t+j}} \equiv g, \quad \forall\, j \geq 1. \tag{13}$$

2.2 Market Equilibrium

There exist three kinds of markets: goods markets, labor markets, and the money market. We confine our attention to the first two markets. Labor markets are in equilibrium when the equilibrium nominal wage is equal to the nominal reservation wage. The equilibrium condition for goods markets is

$$\frac{Y^d_{t+j}}{P_{t+j}} = \alpha \frac{Y^d_{t+j}}{P_{t+j}} + g_t + m_t = \alpha \frac{Y^d_{t+j}}{P_{t+j}} + \rho m_{t+1}. \tag{14}$$

Equation (14) is the Keynesian cross in this model. Suppose that initial nominal money supply, M_t, and the government expenditure, G_t, are sufficiently small for an arbitrary fixed equilibrium price sequence that satisfies (9). Then, the solution of (14), $\left(\frac{Y^d_{t+j}}{P_{t+j}}\right)^*$, is possibly located within $(0, 1]$. Such a case corresponds to the *stationary* imperfect employment equilibrium.

3. Welfare Analysis

In this section we shall firstly show that the allocation by monopolistic competition dominates that by Walrasian equilibrium. Secondly, we shall show that market equilibrium in the monetary economy generally diverges from the socially optimal allocation. In this sense there exists the welfare loss intrinsic to monetary economy.

3.1 Monopolistic Competition vs Walrasian Equilibrium

Here we consider two types of fiscal policy. One is the wasteful policy that the government consumes all seigniorage and does not directly affect the utility of individuals. The other is the first-best policy that the government transfers all seigniorage to the younger generation.

- **The Case for the Wasteful Policy**

From equations (3), (4), (7), (8), and (10), the utility of each individual IU, which is independent of whether they are employed or not, is represented as

$$IU\Big((\frac{Y_{t+j}^d}{P_{t+j}})^* \Big) = \frac{\eta^{-1}\beta}{1-\eta^{-1}} \cdot (\frac{Y_{t+j}^d}{P_{t+j}})^*. \tag{15}$$

Since it is apparent from (15) that the full-employment equilibrium is desirable, we confine our attention to the case that $\Big(\frac{Y_{t+j}^d}{P_{t+j}}\Big)^* = 1$. Then we obtain

$$IU(1) = \frac{\eta^{-1}}{1-\eta^{-1}}\beta. \tag{16}$$

The numerator of (16), η^{-1}, represents the utility derived from the monopoly rent. The denominator, $1-\eta^{-1}$, represents the welfare effect of the monopolistic power through the inflation rate. It is straightforward from (16) that there exists positive surplus by producing goods when the price elasticity of demand η is finite. In addition, note that labor supply bears no positive surplus, since the equilibrium wage remains at the reservation level.[3]

[3] To put it another way, the inflation rate in monopolistic competition is lower than that in Walrasian equilibrium. It economizes the fiscal expenditure for sustaining the full-employment equilibrium in stationary state, $(\rho-1)m_{t+1}$, and hence increases disposable income. Such income is attributed to the form of monopoly rent.

The limit case that η is equal to $+\infty$ corresponds to the Walrasian equilibrium in which each firm behaves as price taker. In this case there exists no surplus.[4] The reason is that wages go down to the reservation level in equilibrium, and that output prices are equal to the equilibrium nominal wage: *i.e.*, zero-profit condition in Walrasian equilibrium.

Thus, the resource allocation of monopolistic competition dominates that of Walrasian equilibrium just as much as the monopoly rent. Such a result is significant for economics: free entry to each differentiated good is not always desirable in the dynamic model, and some firm should monopolistically supply the good.

• **The Case for the First-Best Policy**

Next we consider the first-best fiscal policy in the stationary state. The policy satisfies the following two conditions.

1. The government transfers all seigniorage to young individuals equally.
2. The amount of transfer, g^*, is determined so as to keep the full-employment equilibrium.

The above conditions induce the following equations

$$1 = \alpha(1 + g^*) + m^*, \tag{17}$$

$$g^* = (\rho - 1)m^*. \tag{18}$$

Equation (17) is the equilibrium condition for the aggregate goods market under full employment. (18) represents the government's budget constraint. Solving equations, we obtain

$$m^* = \frac{1 - \alpha}{1 + \alpha(\rho - 1)}, \quad 1 + g^* = \frac{\rho}{1 + \alpha(\rho - 1)}. \tag{19}$$

Substituting (4) and (10) into (3), the lifetime utility of each individual, $IU(1 + g^*)$, is represented as

$$IU(1 + g^*) = \frac{\eta^{-1} + g^*}{1 - \eta^{-1}}\beta. \tag{20}$$

[4] We do not mean that taking the limit $\eta \to +\infty$ changes the form of the utility function. The equilibrium solution when firms are price takers for *any fixed* η happens to correspond to the case $\eta \to +\infty$. This is convenient for calculation purposes. Only comparison between some finite and infinite η is meaningful. The seeming change of utility caused by varying η does not possess any economic meaning in itself.

The first term of the numerator of (20) corresponds to the contribution of the monopoly rent, and the second term represents the utility derived from the seigniorage. The denominator is the inflation factor that affects the utility. Comparing (20) with (16), it is clear that the first-best policy dominates the wasteful case just by the seigniorage g^*.

Equation (20) can be rewritten using (3) and (19) as

$$IU(1+g^*) = \frac{A(1+g^*)}{\rho^{1-\alpha}} - \beta = \frac{A\rho^{\alpha}}{1+\alpha(\rho-1)} - \beta. \tag{21}$$

Differentiating (21) with respect to ρ, we obtain

$$\frac{d}{d\rho} IU(1+g^*) = \frac{A\rho^{\alpha-1}(1-\rho)}{[1+\alpha(\rho-1)]^2}.$$

We can easily ascertain that IU is a decreasing function of ρ as far as $\rho \geq 1$. It is also apparent from (10) that ρ is increasing on η. Accordingly, the life-time utility IU is a decreasing function of η. Since Walrasian equilibrium is the case for $\eta \to +\infty$, it has been shown that the allocation by monopolistic competition dominates that by Walrasian equilibrium also in the first-best policy.

3.2 Welfare Loss Intrinsic to the Monetary Economy

We here deal with the welfare loss intrinsic to the monetary economy. This problem closely relates to the following question: does the first-best fiscal policy above attain the highest utility?

To analyze the problem, let us consider the socially optimal problem in this model. Suppose that all young individuals are employed and some quantity of goods is transferred to the current older generation. In addition, every generation is assumed to be equally treated.

By the symmetry of the model, it is apparent that all goods should be produced in the same quantities. Accordingly, the constraint of resource allocation during period $t+j$ is

$$C^1_{t+j} + C^2_{t+j} = 1, \quad \forall\, j \geq 0.$$

Since $C^2_{t+j} = C^2_{t+j+1}$, the maximization problem becomes

$$\max_{C^1_{t+j}, C^2_{t+j+1}} (C^1_{t+j})^{\alpha}(C^2_{t+j+1})^{1-\alpha} - \beta, \quad s.t.\ C^1_{t+j} + C^2_{t+j+1} = 1. \tag{22}$$

The solution is

$$C^1_{t+j} = \alpha, \quad C^2_{t+j+1} = 1 - \alpha, \quad IU = A - \beta > 0.$$

It is noteworthy that the socially optimal solution is independent of the price elasticity of each good, η. The utility derived from the first-best fiscal policy (21) takes the maximum $IU = A - \beta$ at $\rho = 1$. Hence resource allocation in the monetary economy diverges from the optimal allocation except for the special case. It is apparent that the monetary economy possesses intrinsic distortion. Furthermore, the distortion is more serious when the elasticity, η, is infinite, *i.e.*, firms behave as price takers.

In the social planning problem (22), each consumption level of the older generation is equally treated. The current younger generation is guaranteed that they can receive the same future goods as those they give the current older generation. This implies that intergenerational coordination becomes possible through the existence of the social planner.

Nevertheless, in the monetary economy, decision making is diversified generation by generation. There exists no motive to coordinate between generations except for the convention of using money. Individuals plan their consumption saving and labor supply decisions, taking into account the next generation's behavior, which is summarized by the future price level, P_{t+j+1}, as given.

Therefore, the equilibrium inflation rate, as shown by equation (10), diverges from unity where the current and future prices are equal. When it exceeds unity, the current consumption becomes larger than the social optimum, and the future consumption is excessively small, as appears in equation (19). Namely, inflation biases the individual consumption stream towards the current. This phenomenon is considered to be an intrinsic deadweight loss to the monetary economy that cannot be resolved by income policies.

In the dynamic model, unlike in static analyses, underemployment by monopolistic pricing is not a crucial problem if the fiscal policy is properly executed. Inflation is a true social cost incurred by using money, and hence monopolistic competition contributes to economic welfare through the reduction of such a cost.

4. Concluding Remarks

This note has investigated the dynamic role of monopolistic competition in the monetary economy. The results are as follows.

Firstly, monopolistic competition lowers the inflation rate. Such a positive effect dominates the detrimental one that the real wage in terms of current goods is cut down by the monopolistic power. Thus, in the dynamic model, monopolistic competition attains higher utility than that in Walrasian equilibrium. This result is independent of whether the seigniorage is wasted by the government or transferred to the younger generation.

Secondly, there exists some deadweight loss intrinsic to the monetary economy, which cannot be remedied by macroeconomic policies. If coordination between generations is possible, the marginal transformation rate of goods becomes unity. This is because the younger generation can obtain the same quantity of future goods as they donate to the current old generation. In other words, the social planner can set the price of future goods relative to current goods to unity and attain highest utility.

In the monetary economy, however, decision making is diversified with each generation. Hence the inflation rate is not necessarily unity, except for the special case. Compared with the social optimum, the consumption stream is biased towards the current when the inflation rate is higher than unity. Thus, inflation is the deadweight loss intrinsic to the monetary economy. To sum up, monopolistic competition contributes to economic welfare through the reduction of the inflation rate. The welfare-economic results of dynamic monopolistic competition contrast sharply with those of preceding static analyses.

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