Chapter 2
Price Theory in a Monetary Economy

2.1 Introduction

As discussed in Chap. 1, a monetary economy is a nested structure. That is, the current price level is determined by a rational belief concerning the future price level, which is expressed by the fundamental equation:

$$p_t = \frac{W(p_t, p_{t+1})}{\gamma} \tag{2.1}$$

Where: p_t and p_{t+1} are the current and the future price level, respectively; W is the nominal wage, which depends on these prices; and γ denotes labor productivity.

In Sect. 2.2, the fundamental equation is derived from an individual's rational economic behavior. Based on this, basic Keynesian models under perfect and monopolistic competition are constructed. The perfect competition version aims to show that an imperfect employment equilibrium emerges even in the absence of monopolistic power. The new Keynesian theories entirely rely on this.[1] In addition, the Kahn (1931)–Keynes (1936) fiscal multiplier regarding the monetary economy is derived from developed price theory with rational expectations. The monopolistic competition version is provided to enable welfare analysis of the discretionary fiscal-monetary policy. Although the perfect competition model bears no surplus in the present model, and aggregate demand management policy is neutral from the viewpoint of welfare economics, an expansionary fiscal-monetary policy improves the Pareto efficiency of resource allocations in the monopolistic competition model.

[1] Although equilibrium in the new Keynesian model suggests that resource allocation is second best, and that leisure is excessively long and consumption levels below the optimum, such properties do not emerge from the shortage of effective demand, but from distorted pricing owing to monopolistic behavior. Thus, imperfect unemployment in the new Keynesian models is rooted in distortions found on the supply side, not on the demand side.

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As discussed in detail in Sect. 2.5, the equilibrium of monopolistic competition achieves a relatively superior Pareto allocation compared with the perfect competition case, because of the emergence of an economic surplus derived from monopoly profits, although this seems to be counterintuitive. Such monopolistic profits proportionately increase with aggregate demand, which is enhanced by an expansionary fiscal-monetary policy through the multiplier process. Thus, such policies can improve resource allocation.

In Sect. 2.3, the legitimacy of the functional form of the lifetime utility function is discussed. The following assumptions are made:

I. The lifetime utility function is additively separable between the lifetime consumption stream and the labor supply;
II. The lifetime utility from the consumption stream is homothetic or linear homogenous; and
III. Working hours are assumed to be fixed, and labor demand and supply adjusted according to the number of employees.

Assumptions I and II are compatible with price index number theory, which has been most intensively developed by Dewert (2009). It is common for the consumer price index (CPI) not to contain the price of leisure; that is, the nominal wage. This implies that the disutility function of labor should be additively separable. Moreover, the CPI is an approximation of the true index, and the true index should be independent of an individual's utility level to nullify a change caused by the income effect. A sufficient condition that satisfies such a requirement is Assumption II.[2]

Assumption III is not as straightforward as the first two assumptions. This assumption relates to the concavity of the disutility function of working hours per capita. As discussed in Sect. 2.3, progressive hourly wages are accrued when an employer intends to increase working hours per capita. Thus, an employer would dilute working hours per capita, and instead increase the number of employees as far as possible when business upturns. Thus, in principle, there is no lower limit to working hours per capita. However, in practice, there is a limit on the number of employees, and hence working hours per capita reduce until full employment is automatically achieved, regardless of business condition. Accordingly, the familiar representative individual assumption only explains how working hours per capita vary, and cannot explain the more serious problem pertaining to loss of jobs by individuals.

In Sect. 4, the analysis turns to how Keynesian theory relates to the quantity theory of money (i.e. monetarism). The quantity theory of money is based on the extraneous belief that the equilibrium price during each period is proportionate to the quantity of money. That is, individuals *believe* the following formula:

$$p_t = \kappa^{-1} M_t, \tag{2.2}$$

Where: κ is some positive constant, and M_t is the current quantity of money.

[2] Although it is enough to define the true index by stating that the utility function from the consumption stream is homothetic, this assumption is too weak when the level of the incentivized wage is determined.

Since additional money is unable to purchase additional goods whenever the relationship described by Eq. (2.2) is upheld, the level of real GDP is unrelated to the quantity of money. This implies that the economy should be at its full capacity, and there should be no idle resources whenever this extraneous belief is self-fulfilling. In Sect. 2.4, a rigorous proof is advanced that the quantity theory of money, which is sustained by the baseless extraneous belief encapsulated in Eq. (2.2), becomes relevant only when full employment is kept intact throughout time.

In Sect. 2.5, the properties of the theories in Sect. 2.2 are reconsidered. These theories reveal that resource allocation under monopolistic competition dominates resource allocation under perfect competition. This assertion is counterintuitive from the point of view of the first fundamental theorem of welfare economics. However, the following presumptions and properties must be noted: (1) The first fundamental theorem is upheld only within the range of a finite number of individuals and goods. This is because the proof requires the feasibility of adding up budget constraints of individuals. As mentioned above, the *dynamic* economy comprises an infinite number of individuals and goods. Thus, the presumption of the first fundamental theorem is violated; and (2) While current prices become dearer under monopolistic competition, the required information, which the intertemporal decision needs, is the relative price of future goods to current goods (i.e. the inflation rate). Whenever individuals are confident of the future value of money, the inflation rate is lowered by monopolistic competition. Since inflation is a kind of tax incurred by money hoarding, monopolistic competition appeases such an excess burden intrinsic to the monetary economy. Relying on these intuitive points, this section rigorously proves the Pareto dominance of monopolistic competition over perfect competition. Section 2.6 summarizes and concludes this chapter.

2.2 The Fundamental Equation

In this section, the *fundamental equation* in the monetary economy is derived, and this governs the motion of the price level. This is used to develop a Keynesian economic model with: (i) optimization of economic agents, (ii) no exogenous price stickiness, and (iii) rational expectations excluding extraneous belief-like quantity theoretical expectations. The models are based on the same structure. This exposition basically adopts the overlapping generations (OLG) model in the production economy developed by Lucas (1972). An individual lives for two periods; deciding whether to work when young, and what to do after this. In this period, labor productivity is denoted by γ .

Since income-earning ability is concentrated in the years prior to 65 for most consumers, and goods are assumed to be perishable, an individual worker must save fiat money obtained from the older (post-65) generation in exchange for produced goods to prepare for future consumption. Thus, there is an incentive for the circulation of money as long as the economy is *dynamic*, as defined in Sect. 1.1.

2.2.1 The Keynes–Walras Model

In this model it is assumed that only one kind of good is produced and the goods market operates under perfect competition (i.e. every firm behaves as a price taker).

The Decisions of Individuals The lifetime utility function U_t is identified as follows:

$$U_t \equiv u(c_{1t}, c_{2t+1}) - \delta_t \cdot \alpha, \tag{2.3}$$

Where: c_{1t} and c_{2t+1} are the current and future consumptions of the individual born in period t; δ_t is a definition function that takes vale unity when the individual is employed and zero when unemployed; and α denotes the disutility of labor. In this case $u(\cdot)$ is a homothetic utility function concerning lifetime consumption and can be written as follows:

$$u(c_{1t}, c_{2t+1}) \equiv f(v(c_{1t}, c_{2t+1})),$$

Where: f is a monotonously increasing continuous function, and v is a linear homogenous function.

The budget constraint faced by the individual is therefore:

$$\delta_t \cdot W_t \geq p_t c_{1t} + M_t, M_t \geq p_{t+1} c_{2t+1}, \tag{2.4}$$

Where: W_t and M_t are the nominal wage and nominal money demand, respectively; and (p_t, p_{t+1}) is the vector of good prices. The constraint (2.4) is equivalent to:

$$\delta_t \cdot W_t \geq p_t \cdot c_{1t} + p_{t+1} \cdot c_{2t+1}. \tag{2.5}$$

An individual maximizes (2.3) subject to (2.5) on $(c_{1t}, c_{2t+1}, \delta_t)$. This problem decomposes into the following two-step problem:

i. Given the level of labor income, optimize lifetime utility from the consumption stream; and
ii. Decide whether to work by conferring the optimized utility from the lifetime consumption.

Since $u(\cdot)$ is homothetic, the first problem is solved as the following indirect utility function:

$$ID \equiv f\left(\frac{\delta_t \cdot W_t}{\psi\left(p_t, p_{t+1}\right)}\right), \tag{2.6}$$

Where: ψ is a linear homogenous function.

Based on Eq. (2.6), it is possible to solve the second problem concerning the decisions made in relation to the labor supply of the individual. If $ID \geq \alpha$ holds, the lifetime utility from consumption exceeds the disutility of labor, and thus every individual wishes to work; that is, $\delta_t = 1$. Otherwise, no one wants to participate; that is, $\delta_t = 0$.

The following assumption about the equilibrium of the labor market can then be made:

Assumption 2.1
Equilibrium in the labor market is always interior. That is, there are some individuals who are unemployed.

The equilibrium nominal wage is determined by this assumption such that $ID = \alpha$. This is because if $ID > \alpha$, there are ceaseless applications to the lower wage offers, and as a result, the nominal wage falls to a level that satisfies $ID = \alpha$. That is, the equilibrium nominal wage W_t is determined as being equal to the reservation wage:

$$W_t = f^{-1}(\alpha) \cdot \psi(p_t, p_{t+1}). \tag{2.7}$$

It must be noted that Eq. (2.7) is the equilibrium condition for the labor market in this model.

The Decision of Firms: The Fundamental Equation We have assumed that firms are price takers and that no fixed costs prevent their entry/exit decisions. Consequently, at equilibrium, the zero-profit condition should be held, and:

$$p_t = \frac{W_t}{\gamma}. \tag{2.8}$$

Substituting Eq. (2.7) into Eq. (2.8) gives:

$$p_t = \frac{f^{-1}(\alpha) \cdot \psi(p_t, p_{t+1})}{\gamma}. \tag{2.9}$$

This is the exact form of the *fundamental equation* in the monetary economy, which was described as Eq. (2.1) in Sect. 1 under the situation of perfect competition; that is, the Walrasian equilibrium. The fundamental equation depicts the nested structure of the monetary economy, as outlined in Sect. 1.1. Individuals call for their nominal wage W_t by conferring the future price level p_{t+1}. The equilibrium current price p_t is determined to equalize the unit revenue p_t to the unit labor cost $\frac{f^{-1}(\alpha) \cdot \psi(p_t, p_{t+1})}{\gamma}$. This implies that since individuals *believe* and confer the future value of money (i.e. the inverse of p_{t+1} is not zero), the current value of money is determined by that value. This represents the nested structure of the monetary economy in that the current value of money is always affected by the future values of money. Accordingly, it is not necessary to determine a price level to equalize the demand for goods with supply. In this sense, price theory in the monetary economy is quite different from that in the barter economy.

The most prominent property of the fundamental equation is that it does not contain the stream of the nominal money supply $\{M_{t+j}\}_{j=0}^{\infty}$. This implies that price levels are determined, in principle, regardless of the quantity of money. Thus, the real cash balance $\left\{\frac{M_{t+j}}{p_{t+j}}\right\}_{k=0}^{\infty}$ can be manipulated by a change in the quantity of money, as long as there are idle resources for additional money to purchase additional goods; that is, Assumption 2.1 is satisfied. As shown below, this implies the non-neutrality of money without the assumption of any exogenous price stickiness.

Confidence in Money: An Exclusion Method of Extraneous Beliefs Since $\psi(\cdot)$ in Eq. (2.9) takes a linear homogenous form, it can be transformed into:

$$\gamma = f^{-1}(\alpha)\cdot\psi\left(1, \frac{p_{t+1}}{p_t}\right). \tag{2.10}$$

Accordingly, the equilibrium inflation rate $\frac{p_{t+1}}{p_t}$ is constant over time. Let this value be denoted as ρ^*. It is apparent from Eq. (2.10) that the fundamental equation by itself cannot determine price levels and only ρ^* is determined. This means that there is an arbitrary constant value for determination of the price sequence *per se*. Such arbitrariness or indeterminacy makes room for rational extraneous belief, which connects the price level with an intrinsically unrelated economic variable such as the quantity of money. This will be rigorously discussed in Sect. 2.4.

To eliminate this inconvenience, an assumption is made concerning *confidence* in money.

Definition 2.1
Money is confident if and only if:

$$\frac{dp_{t+1}}{dM_t} = 0. \tag{2.11}$$

C*onfidence* in money implies that younger individuals believe in the intrinsic value of money, which is unrelated to the quantity of money. Although this seems to be a curious assumption for those who are captives in the quantity theory of money, the condition expressed in Eq. (2.11) is deeply rooted in our daily lives. For example, every individual deposits money in banks and funds consumer credits without any anxiety. This suggests that individuals believe in the future intrinsic value of money, and rationally anticipate that the future value of money will not be affected by monetary policy.

Equation (2.11) excludes extraneous beliefs in the following manner. Let us denote the historically given rational expectation concerning the future price as $\overline{p_{t+1}}$, which is not the function of the quantity of money M_t. Thereafter, the equilibrium prices are expressed as $\overline{p_{t+1}}\cdot[\rho]^{j-1}$. The current equilibrium price can be solved by backward induction as $\overline{p_{t+1}} \cdot [\rho]^{-1}$. Thus, the following theorem is obtained:

Theorem 2.1
If money is confident, according to the condition expressed in (2.9), the all-equilibrium price sequence $\{p_{t+j}\}_{j=0}^{\infty}$ *becomes independent of the quantity of money* M_t.

This theorem is presumed throughout this chapter.

The Role of the Government The government issues fiat money to finance wasteful public expenditure. The budget constraint of the government becomes:

$$p_t \cdot g \equiv M_t - M_{t-1}, \tag{2.12}$$

Where: g denotes real public expenditure. (2.12) is transformed into:

$$g + \frac{M_{t-1}}{p_t} \equiv \frac{M_t}{p_t}. \tag{2.13}$$

Equation (2.13) implies that the sum of real public expenditure and the consumption of the current older individuals are equal to the current real cash balance. Furthermore, it must be noted that the real cash balance $\frac{M_t}{p_t}$ can be manipulated by a change in the quantity of money M_t under Theorem 2.1.

The Dynamic Keynesian Cross: Market Equilibrium There are three markets in this model: the goods market, the labor market, and the money market. The labor market is in equilibrium when Eq. (2.10) is satisfied. The goods and money markets are mutually dependent, and if one of these markets is in equilibrium, so is the other. Here, the equilibrium condition for the goods market is analyzed. From the zero-profit condition of the firms as expressed by Eq. (2.9), real GDP y_t is equal to the total labor income. Thus, we obtain the following equilibrium condition:

$$y_t = c\left(\rho^*\right) \cdot y_t + \frac{M_t}{p_{t-1}} + g. \tag{2.14}$$

The first term on the right-hand side of Eq. (2.14) represents the consumption function of the younger generation, which is derived from the homothetic utility function $u(\cdot)$. The second term represents the consumption of the older generation, and the third term represents the real wasteful public expenditure. Substituting Eq. (2.13) into (2.14) gives:

$$y_t = c\left(\rho^*\right) \cdot y_t + \frac{M_t}{p_t}. \tag{2.15}$$

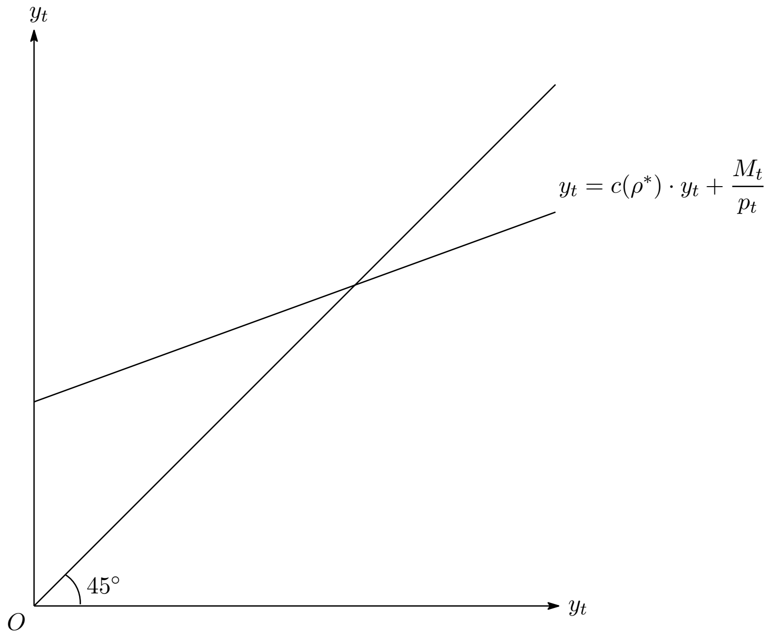

Fig. 2.1 The dynamic Keynesian cross

Equation (2.15) is illustrated in Fig. 2.1. This is the dynamic Keynesian cross in the sense that the intertemporal decision on the consumption stream is woven into it. Moreover, and differing from Mankiw (1988),[3] Eq. (2.14) represents the causality from effective demand to aggregate supply. That is, an increase in the real cash balance as a result of the fact that expansionary fiscal policy forces up real GDP and the multiplier $\frac{1}{1-c\left(\rho^*\right)}$ has the same value as that expressed in Kahn (1931) and Keynes (1936).

Finally, it must be noted that if the government keeps the real cash balance constant over time except for the initial period, the equilibrium becomes stationary, in the sense that real GDP and inflation rate do not depend on time. Hence, the Keynes–Walras equilibrium formulated here can become the long-run equilibrium. That is, the economic situation to which Keynesian economics can be applied is never limited to short-run analysis. Indeed, contrary to the new Keynesian and the

[3] The spurious multiplier of Mankiw (1988) is derived by the following economic causality. Since he assumes static monopolistic competition, the real wage is lower than the Walrasian equilibrium, and thus excess leisure (underemployment) occurs. When the government levies a lump-sum tax, the income effect reduces the leisure and people begin to work more. Thus, government expenditure is not essential for this model. However, it is apparent that such a policy reduces economic welfare unless the government expenditure brings about some additional utility, as shown by Startz (1994).

real business cycle schools, the prevalence of idle resources is the ordinal case for the market economy.

2.2.2 *The Keynes–Chamberlin Model: The Welfare Economics Foundation of Aggregate Demand Management Policies*

In the previous section, it was assumed that the same goods are produced and every firm behaves as a price taker. In such a setting, there is no surplus in terms of both employees and employers. Hence, although fiscal-monetary policy will affect real GDP and employment levels, this type of policy does not contribute to economic welfare. In this section, instead it is assumed that goods are differentiated and each firm monopolistically produces its intrinsic good. However, it is also assumed that its economic behavior does not directly affect macroeconomic variables such as real GDP and the aggregate price level. That is, macroeconomic variables are exogenous for each firm but endogenous for the economy as a whole. This equilibrium concept is known as monopolistic competition and was developed mainly by Chamberlin (1933).

By deploying the concept of monopolistic competition, monopolistic rent emerges for each firm. That is, an economic surplus, which does not exist in the Walrasian equilibrium, occurs as a reward for producing a good that no other firm can imitate. As such, the economy under monopolistic competition achieves a superior allocation to that in the Walrasian equilibrium (Otaki and Tamai 2011) when the economy is dynamic in the sense of the definition provided in Sect. 1.1.

It might be argued that monopolistic behavior lessens production. However, such excessively small production never occurs whenever the marginal cost is constant (this assumption will be justified in Sect. 2.3). This is because, as opposed to the pure monopoly case, the relevant price tied to the demand function of each firm is the *relative* price of the firm's goods to the price index, and always takes the value unity under the symmetric equilibrium assumption. The reason why shortages in production emerge in static monopolistic competition models (e.g. Blanchard and Kiyotaki 1987) is entirely due to the assumption that the marginal cost (the marginal disutility of labor) is an increasing function of working hours. Nonetheless, as shown in Sect. 2.3, unemployment cannot be explained under such an assumption.

Since monopolistic pricing establishes the following relationship between the price level and the nominal wage is:

$$p_t = \frac{W_t}{\gamma\left[1-\eta^{-1}\right]} \Rightarrow W_t = \gamma\left[1-\eta^{-1}\right]p_t,$$

The real profits that a firm can earn are:

$$\frac{1}{p_t}\left[p_t - \frac{W_t}{\gamma}\right]y_t \Rightarrow \eta^{-1}y_t, \tag{2.16}$$

Where: η is the price elasticity of demand and y_t is the real effective demand per firm, which is always equal to its production.

Equation (2.16) shows that the surplus (the monopoly rent) emerging within a firm is proportionate to the real effective demand that the firm faces. If the equilibrium is symmetric and the total effective demand is distributed to each firm equally, the total effective demand increases proportionately, y_t. Thus, whenever the total effective demand is stimulated by some expansionary fiscal-monetary policy, there is an increase in real profits per firm, which forms the only economic surplus within this economy. Equally, since there is no surplus from labor income as long as the economy is located at imperfect employment, as shown by Eq. (2.6) in Sect. 2.2, an upturn in the profits of each firm always improves economic welfare. To summarize, an expansionary fiscal-monetary policy improves economic welfare whenever the economy falls into imperfect employment equilibrium. This theorem, which will be proved below, can be regarded as a rigorous microeconomic foundation for the legitimacy of Keynesian aggregate demand management policies.

The Model Assume that goods are differentiated as far as the density of the interval $B \equiv [0,1]$. Each firm $z, z \in B$ monopolistically produces good z without fixed costs. The other settings of the model are the same as those in the previous section. Otaki (2007) reached the same conclusions, although this study was limited to a confined class of the utility function. The extension was completed by Otaki (2011).

The Decision of Individuals The instantaneous utility c_{it+j} is the continuous constant elasticity of substitution form. That is:

$$c_{1t} \equiv \left[\int_0^1 \left[c_{1t}(z)\right]^{1-\eta^{-1}} dz\right]^{\frac{1}{1-\eta^{-1}}}, c_{2t+1} \equiv \left[\int_0^1 \left[c_{2t+1}(z)\right]^{1-\eta^{-1}} dz\right]^{\frac{1}{1-\eta^{-1}}}. \tag{2.17}$$

Where: $c_{it+j}(z)$ is the demand for good z during period $t+j$ of an individual in the i th stage of life, who is born at the beginning period t. The lifetime utility function U_t is defined by:

$$U_t \equiv u(c_{1t}, c_{2t+1}) - \delta_t \cdot \alpha. \tag{2.18}$$

At this time, $u(\cdot)$ is a linear homogenous function. The optimization problem for each individual then comprises the following three-step backward induction:

i. For given $E_{i,t+j} \equiv \int_0^1 p_{t+j}(z) \cdot c_{i,t+j}(z) dz$, maximize Eq. (2.17) on the path of $c_{t+j,i}(z)$.
ii. $p_{t+j} \cdot c_{i,t+j} \equiv \int_0^1 p_{t+j}(z) \cdot c_{i,t+j}(z) dz$ holds when evaluating consumption on the optimal path, and:

$$p_{t+j} \equiv \left[\int_0^1 \left[p_{t+j}(z)\right]^{1-\eta} dz\right]^{\frac{1}{1-\eta}}. \tag{2.19}$$

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