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New Keynesian Economics

The purpose of this chapter is to discuss the following issues:

1. Can we provide microeconomic foundations behind the "Keynesian" multiplier?
2. What are the welfare-theoretic aspects of the monopolistic competition model? What is the link between the output multiplier of government consumption and the marginal cost of public funds (MCPF)?
3. Does monetary neutrality still hold when there exist costs of adjusting prices?
4. What do we mean by nominal and real rigidity and how do the two types of rigidity interact?

13.1 Reconstructing the "Keynesian" Multiplier

The challenge posed by a number of authors in the 1980s is to provide microeconomic foundations for Keynesian multipliers by assuming that the goods market is characterized by monopolistic competition. This is, of course, not the first time such micro-foundations are proposed, a prominent predecessor being the fixed-price disequilibrium approach of the early 1970s (see Chapter 5). The problem with that older literature is that prices are simply assumed to be fixed, which makes these models resemble Shakespeare's *Hamlet* without the Prince, in that the essential market coordination mechanism is left out. Specifically, fixed (disequilibrium) prices imply the existence of unexploited gains from trade between restricted and unrestricted market parties. There are *f* 100 bills lying on the footpath, and this begs the question why this would ever be an equilibrium situation.

Of course some reasons exist for price stickiness, and these will be reviewed here, but a particularly simple way out of the fixity of prices is to assume price-setting behaviour by monopolistically competitive agents.[1] This incidentally also solves Arrow's (1959) famous critical remarks about the absence of an auctioneer in the perfectly competitive framework.

13.1.1 A static model with monopolistic competition

In this subsection we construct a simple model with monopolistic competition in the goods market. There are three types of agents in the economy: households, firms, and the government. The representative household derives utility from consuming goods and leisure and has a Cobb-Douglas utility function:

$$U \equiv C^{\alpha}(1-L)^{1-\alpha}, \quad 0 < \alpha < 1, \tag{13.1}$$

where U is utility, L is labour supply, and C is (composite) consumption. The household has an endowment of one unit of time and all time not spent working is consumed in the form of leisure, $1-L$. The composite consumption good consists of a bundle of closely related product "varieties" which are close but imperfect substitutes for each other (e.g. red, blue, green, and yellow ties). Following the crucial insights of Spence (1976) and Dixit and Stiglitz (1977), a convenient formulation is as follows:

$$C \equiv N^{\eta}\left[N^{-1}\sum_{j=1}^{N} C_j{}^{(\theta-1)/\theta}\right]^{\theta/(\theta-1)}, \quad \theta > 1, \ \eta \geq 1, \tag{13.2}$$

where N is the number of different varieties that exist, C_j is a consumption good of variety j, and θ and η are parameters. This specification, though simple, incorporates two economically meaningful and separate aspects of product differentiation. First, the parameter θ regulates the ease with which any two varieties (C_i and C_j) can be substituted for each other. In formal terms, θ represents the *Allen-Uzawa cross-partial elasticity of substitution* (see Chung, 1994, ch. 5). Intuitively, the higher is θ, the better substitutes the varieties are for each other. In the limiting case (as $\theta \to \infty$), the varieties are perfect substitutes, i.e. they are identical goods from the perspective of the representative household.

The second parameter appearing in (13.2), η, regulates "preference for diversity" (PFD, or "taste for variety" as it is often called alternatively). Intuitively, diversity preference represents the utility gain that is obtained from spreading a certain amount of production over N varieties rather than concentrating it on a single variety (Bénassy, 1996b, p. 42). In formal terms *average* PFD can be computed by comparing the value of composite consumption (C) obtained if N varieties and X/N units per variety are chosen with the value of C if X units of a single variety

[1] See the recent surveys by Bénassy (1993a), Silvestre (1993), Matsuyama (1995), and the collection of papers in Dixon and Rankin (1995).

are chosen ($N = 1$):

$$\text{average PFD} \equiv \frac{C(X/N, X/N, ..., X/N)}{C(X, 0, ..., 0)} = N^{\eta-1}. \tag{13.3}$$

The elasticity of this function with respect to the number of varieties represents the *marginal* taste for additional variety[2] which plays an important role in the monopolistic competition model. By using (13.3) we obtain the expression for the marginal preference for diversity (MPFD):

$$\text{MPFD} = \eta - 1. \tag{13.4}$$

It is now clear how and to what extent η regulates MPFD: if η exceeds unity MPFD is strictly positive and the representative agent exhibits a love of variety. The agent does not enjoy diversity if $\eta = 1$ and MPFD $= 0$ in that case.

The household faces the following budget constraint:

$$\sum_{j=1}^{N} P_j C_j = W^N L + \Pi - T, \tag{13.5}$$

where P_j is the price of variety j, W^N is the nominal wage rate (labour is used as the numeraire later on in this section), Π is the total profit income that the household receives from the monopolistically competitive firms, and T is a lump-sum tax paid to the government. The household chooses its labour supply and consumption levels for each available product variety (L and C_j, $j = 1, \ldots, N$) in order to maximize utility (13.1), given the definition of composite consumption in (13.2), the budget constraint (13.5), and taking as given all prices (P_j, $j = 1, \ldots, N$), the nominal wage rate, profit income, and the lump-sum tax.

By using the convenient trick of *two-stage budgeting*, the solutions for composite consumption, consumption of variety j, and labour supply are obtained:

$$PC = \alpha \left[W^N + \Pi - T\right], \tag{13.6}$$

$$\left(\frac{C_j}{C}\right) = N^{-(\theta+\eta)+\eta\theta} \left(\frac{P_j}{P}\right)^{-\theta}, \quad j = 1, \ldots, N, \tag{13.7}$$

$$W^N [1 - L] = (1 - \alpha) \left[W^N + \Pi - T\right], \tag{13.8}$$

where P is the so-called *true price index* of the composite consumption good C. Intuitively, P represents the price of one unit of C given that the quantities of all varieties are chosen in an optimal (utility-maximizing) fashion by the household. It is defined as follows:

$$P \equiv N^{-\eta} \left[N^{-\theta} \sum_{j=1}^{N} P_j{}^{1-\theta}\right]^{1/(1-\theta)}. \tag{13.9}$$

[2] As is often the case in economics, the marginal rather than the average concept is most relevant. Bénassy presents a clear discussion of average and marginal preference for diversity (1996, p. 42).

Intermezzo

Two-stage budgeting. As indeed its name strongly suggests, the technique of two-stage budgeting (or more generally, multi-stage budgeting) solves a relatively complex maximization problem by breaking it up into two (or more) much less complex sub-problems (or "stages"). An exhaustive treatment of two-stage budgeting is far beyond the scope of this book. Interested readers are referred to Deaton and Muellbauer (1980, pp. 123–137) which contains a more advanced discussion plus references to key publications in the area.

We illustrate the technique of two-stage budgeting with the aid of the maximization problem discussed in the text. Since C and $1-L$ appear in the utility function (13.1) and only C_j ($j = 1, \ldots, N$) appear in the definition of C in (13.2) it is natural to subdivide the problem into two stages. In stage 1 the choice is made (at the "top level" of the problem) between composite consumption and leisure, and in stage 2 (at the "bottom" level) the different varieties are chosen optimally, conditional upon the level of C chosen in the first stage.

Stage 1. We postulate the existence of a price index for composite consumption and denote it by P. By definition total spending on differentiated goods is then equal to $\sum_j P_j C_j = PC$ so that (13.5) can be re-written as:

$$PC + W^N(1-L) = W^N + \Pi - T \equiv I_F, \tag{a}$$

which says that spending on consumption goods plus leisure (the left-hand side) must equal full income (I_F on the right-hand side). The top-level maximization problem is now to maximize (13.1) subject to (a) by choice of C and $1-L$. The first-order conditions for this problem are the budget constraint (a) and:

$$\frac{U_{1-L}}{U_C} = \frac{W^N}{P} \Rightarrow \frac{W^N}{P} = \frac{1-\alpha}{\alpha}\frac{C}{1-L}. \tag{b}$$

The marginal rate of substitution between leisure and composite consumption must be equated to the real wage rate which is computed by deflating the nominal wage rate with the price index of composite consumption (and not just the price of an individual product variety!). By substituting the right-hand expression of (b) into the budget identity (a), we obtain the optimal choices of C and $1-L$ in terms of full income:

$$PC = \alpha I_F, \ \ W^N(1-L) = (1-\alpha)I_F. \tag{c}$$

Finally, by substituting these expressions into the (*direct*) utility function (13.1) we obtain the *indirect* utility function expressing utility in terms of full income and a cost-of-living index:

$$V \equiv \frac{I_F}{P_V}, \tag{d}$$

where P_V is the true price index for utility, i.e. it is the cost of purchasing one unit of utility (a "util"):

$$P_V \equiv \left(\frac{P}{\alpha}\right)^{\alpha} \left(\frac{W^N}{1-\alpha}\right)^{1-\alpha}. \tag{e}$$

Stage 2. In the second stage the agent chooses varieties, C_j ($j = 1, 2, ..., N$), in order to "construct" composite consumption in an optimal, cost-minimizing, fashion. The formal problem is:

$$\underset{\{C_j\}}{\text{Max}}\ N^{\eta} \left[N^{-1} \sum_{j=1}^{N} C_j^{(\theta-1)/\theta}\right]^{\theta/(\theta-1)} \quad \text{subject to} \quad \sum_{j=1}^{N} P_j C_j = PC, \tag{f}$$

for which the first-order conditions are the constraint in (f) and:

$$\frac{\partial C/\partial C_j}{\partial C/\partial C_k} = \frac{P_j}{P_k} \ \Rightarrow\ \left(\frac{C_k}{C_j}\right)^{1/\theta} = \frac{P_j}{P_k}, \quad \text{for } j, k = 1, 2, ..., N. \tag{g}$$

The marginal rate of substitution between any two product varieties must be equated to the relative price of these two varieties. By repeatedly substituting the first-order condition (g) into the definition of C (given in (13.2)), we obtain the following expression for C_j:

$$C_j = \frac{N^{-\eta} C P_j^{-\theta}}{\left[\sum_{k=1}^{N} N^{-1} P_k{}^{1-\theta}\right]^{-\theta/(1-\theta)}}. \tag{h}$$

By substituting (h) into the constraint given in (f) the expression for the price index P is obtained:

$$\sum_{j=1}^{N} P_j C_j = \frac{N^{\theta/(\theta-1)-\eta} C \left[\sum_{j=1}^{N} P_j^{1-\theta}\right]}{\left[\sum_{j=1}^{N} P_j{}^{1-\theta}\right]^{-\theta/(1-\theta)}} = PC \quad \Rightarrow$$

$$P \equiv N^{\eta} \left[N^{-\theta} \sum_{j=1}^{N} P_j^{1-\theta}\right]^{1/(1-\theta)}. \tag{i}$$

By using this price index we can re-express the demand for variety j of the consumption good (given in (h)) in a more compact form as:

$$\left(\frac{C_j}{C}\right) = N^{-(\theta+\eta)+\eta\theta} \left(\frac{P_j}{P}\right)^{-\theta}, \quad j = 1, \ldots, N, \tag{j}$$

which is the expression used in the text (namely equation (13.7)).

It must be pointed out that we could have solved the choice problem facing the consumer in one single (and rather large) maximization problem, instead of by means of two-stage budgeting, and we would, of course, have obtained the same solutions. The advantages of two-stage budgeting are twofold: (i) it makes the computations more straightforward and mistakes easier to avoid, and (ii) it automatically yields useful definitions for true price indexes as by-products.

Finally, although we did not explicitly use the terminology, the observant reader will have noted that we have already used the method of two-stage budgeting before in Chapter 10. There we discussed the Armington approach to modelling international trade flows and assumed that a domestic composite good consists of a domestically produced good and a good produced abroad.

The firm sector is characterized by monopolistic competition, i.e. there are very many small firms each producing a variety of the differentiated good and each enjoying market power in its own output market. The individual firm j uses labour to produce variety j and faces the following production function:

$$Y_j = \begin{cases} 0 & \text{if } L_j \leq F \\ (1/k)\left[L_j - F\right] & \text{if } L_j \geq F \end{cases}, \tag{13.10}$$

where Y_j is the marketable output of firm j, L_j is labour used by the firm, F is fixed cost in terms of units of labour, and k is the (constant) marginal labour requirement. The formulation captures the notion that the firm must expend a minimum amount of labour ("overhead labour") before it can produce any output at all (see Mankiw, 1988, p. 9). As a result, there are *increasing returns to scale* at firm level as average cost declines with output.

The profit of firm j is denoted by Π_j and equals revenue minus total costs:

$$\Pi_j \equiv P_j Y_j - W^N\left[kY_j + F\right], \tag{13.11}$$

which incorporates the assumption that labour is perfectly mobile across firms, so that all firms are forced to pay a common wage (W^N does not feature an index j). The firm chooses output in order to maximize its profits (13.11) subject to its price-elastic demand curve. We assume that it acts as a *Cournot* competitor in that firm j takes other firms' output levels as given, i.e. there is no strategic interaction between producers of different product varieties.

In formal terms, the choice problem takes the following form:

$$\underset{\{Y_j\}}{\text{Max}}\ \Pi_j = P_j(Y_j)Y_j - W^N\left[kY_j + F\right], \tag{13.12}$$

where the notation $P_j(Y_j)$ is used to indicate that the choice of output affects the price which firm j will fetch (downward-sloping demand implies $\partial P_j/\partial Y_j < 0$).

The first-order condition yields the *pricing rule* familiar from first-year microeconomic texts:

$$\frac{d\Pi_j}{dY_j} = P_j + Y_j\left(\frac{\partial P_j}{\partial Y_j}\right) - W^N k = 0 \quad \Rightarrow$$
$$P_j = \mu_j W^N k, \tag{13.13}$$

where μ_j is the markup of price over marginal cost (i.e. variable labour cost) and ϵ_j is the (absolute value of the) price elasticity of demand facing firm j:

$$\mu_j \equiv \frac{\epsilon_j}{\epsilon_j - 1}, \quad \epsilon_j \equiv -\frac{\partial Y_j}{\partial P_j}\frac{P_j}{Y_j}. \tag{13.14}$$

The higher is the elasticity of demand, the smaller is the markup and the closer is the solution to the perfectly competitive one. Clearly, the pricing rule in (13.13) is only sensible if μ_j is positive, i.e. demand must be elastic and ϵ_j must exceed unity.

The government does three things in this model: it consumes a composite good (G, given below), it levies lump-sum taxes on the representative household (T), and it employs civil servants (L_G). To keep things simple we assume that G is defined analogously to C in (13.2):

$$G \equiv N^{\eta}\left[N^{-1}\sum_{j=1}^{N} G_j^{(\theta-1)/\theta}\right]^{\theta/(\theta-1)}, \tag{13.15}$$

where G_j is the government's demand for variety j. It is assumed that the government is efficient in the sense that it chooses varieties G_j ($j = 1, \ldots, N$) in an optimal, cost-minimizing, fashion, taking a certain level of composite public consumption (G) as given. This implies that the government's demand for variety j is:

$$\frac{G_j}{G} = N^{-(\theta+\eta)+\eta\theta}\left(\frac{P_j}{P}\right)^{-\theta}, \quad j = 1, \ldots, N, \tag{13.16}$$

where the similarity to (13.7) should be apparent to all and sundry. Since C and G feature the same functional form, the price index for the public good is given by P in (13.9).

Total demand facing each firm j equals $Y_j \equiv C_j + G_j$, which in view of (13.7) and (13.16) shows that the demand elasticity facing firm j equals $\epsilon_j = \theta$ so that the markup is constant and equal to $\mu_j = \mu = \theta/(\theta - 1)$. In this simplest case, the composition of demand does not matter. The model is completely symmetric: all firms face the same production costs and use the same pricing rule and thus set the same price, i.e. $P_j = \bar{P} = \mu W^N k$. As a result they all produce the same amount, i.e. $Y_j = \bar{Y}$, for $j = 1, \ldots, N$. A useful quantity index for real aggregate output can then

Table 13.1. A simple macro model with monopolistic competition

$Y = C + G$	(T1.1)
$PC = \alpha I_F,\ I_F \equiv \left[W^N + \Pi - T\right]$	(T1.2)
$\Pi \equiv \sum_{j=1}^{N} \Pi_j = \theta^{-1} PY - W^N NF$	(T1.3)
$T = PG + W^N L_G$	(T1.4)
$P = N^{1-\eta}\bar{P} = N^{1-\eta}\mu W^N k$	(T1.5)
$W^N(1-L) = (1-\alpha) I_F$	(T1.6)
$P_V = \left(\frac{P}{\alpha}\right)^{\alpha}\left(\frac{W^N}{1-\alpha}\right)^{1-\alpha},\ V = \frac{I_F}{P_V}$	(T1.7)

be defined as:

$$Y \equiv \frac{\sum_{j=1}^{N} P_j Y_j}{P}, \tag{13.17}$$

so that the aggregate goods market equilibrium condition can be written as in (T1.1) in Table 13.1.

For convenience, we summarize the model in aggregate terms in Table 13.1. Equation (T1.1) is the aggregate goods market clearing condition and (T1.2) is household demand for the composite consumption good (see (13.6)). Equation (T1.3) relates aggregate profit income (Π) to aggregate spending (PY) and firms' outlays on overhead labour ($W^N NF$). This expression is obtained by using the symmetric pricing rule, $P_j = \bar{P} = \mu W^N k$, in the definition of firm profit in (13.11) and aggregating over all active firms. The government budget restriction (T1.4) says that government spending on goods (PG) plus wage payments to civil servants ($W^N L_G$) must equal the lump-sum tax (T). By using the symmetric pricing rule in the definition of the price index (13.9) expression (T1.5) is obtained. Labour supply is given by (T1.6). Finally, (T1.7) contains some welfare indicators to be used and explained below in section 1.4.

Equilibrium in the labour market implies that the supply of labour (L) must equal the number of civil servants employed by the government (L^G) plus the number of workers employed in the monopolistically competitive sector:

$$L = L_G + \sum_{j=1}^{N} L_j. \tag{13.18}$$

Walras' Law ensures that the labour market is in equilibrium, i.e. (T1.1)–(T1.6) together imply that (13.18) holds.

There is no money in the model so *nominal* prices and wages are indeterminate. It is convenient to use leisure as the numeraire, i.e. W^N is fixed and everything is measured in wage units. The model can be analysed for two polar cases. In the first case, the number of firms is constant and fluctuations in profits emerge. This version of the model is deemed to be relevant for the short run and gives rise to short-run multipliers (Mankiw, 1988). In the second case, the number of firms is variable and exit/entry of firms ensures that profits return to zero following a shock. Following Startz (1989) this can be seen as the long-run version of the model.

13.1.2 The short-run balanced-budget multiplier

In the (very) short run, Mankiw (1988) argued, the number of firms is fixed (say $N = N_0$) and the model in Table 13.1 exhibits a positive balanced-budget multiplier. This can be demonstrated as follows. By substituting (T1.3) and (T1.4) into (T1.2), the aggregate consumption function can be written in terms of aggregate output and constants:

$$C = c_0 + (\alpha/\theta)Y - \alpha G, \tag{13.19}$$

where $c_0 \equiv \alpha\,[1 - N_0 F - L_G]\,W$ and $W \equiv W^N/P$ is the real wage. It follows from (T1.5) that the real wage rate is constant in the short run.[3] The consumption function looks rather Keynesian and has a slope between zero and unity since $0 < \alpha < 1$ and $\theta > 1$. Additional output boosts real profit income to the household which spends a fraction of the extra income on consumption goods (and the rest on leisure). The consumption function has been drawn in Figure 13.1 for an initial level of government spending, G_0. By vertically adding G_0 to C, aggregate demand is obtained. The initial equilibrium is at point E_0 where aggregate demand equals production and equilibrium consumption and output are, respectively, C_0 and Y_0.

Now consider what happens if the government boosts its consumption, say from G_0 to G_1, and finances this additional spending by an increase in the lump-sum tax. Such a balanced-budget policy has two effects in the short run. First, it exerts a negative effect on the aggregate consumption function (see (13.19)) because households have to pay higher taxes, i.e. the consumption function shifts down by $\alpha\, dG$ in Figure 13.1. Second, the spending shock also boosts aggregate demand one-for-one because the government purchases additional goods. Since the marginal propensity to consume out of full income, α, is less than unity, this direct spending effect dominates the private consumption decline and aggregate demand increases (by $(1 - \alpha)\, dG$), as is illustrated in Figure 13.1. The equilibrium shifts from E_0 to E_1,

[3] The number of product varieties (N) is fixed as are (by assumption) the markup (μ) and the marginal labour requirement (k).