KEYNESIAN MULTIPLIERS AND THE COST OF PUBLIC FUNDS UNDER MONOPOLISTIC COMPETITION

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1 Introduction

General equilibrium models with imperfect competition can display Keynesian features even if all goods and labour markets clear instantaneously - see Hart (1982), Ng (1982), Solow (1986), Dixon (1987), Blanchard and Kiyotaki (1987), Mankiw (1988), Startz (1989), Bénassy (1991) and others. Boosting aggregate demand raises national income and thus boosts profit income. Firms are eager to sell additional output, since price exceeds marginal cost under imperfect competition. This profit margin creates the potential for another round of the multiplier process; as extra output is sold, national income, private consumption, aggregate demand and eventually profit income rise even more. The multiplier process is dampened by labour supply dropping off as people become wealthier. Under constant returns to scale and perfect competition there is no profit margin and thus no multiplier process. The Keynesian multiplier relies on strategic complementarity, that is the gap between social and private returns on expanding output - see Cooper and John (1988). All firms together have an incentive to hire more workers and expand aggregate demand, but no individual firm has such an incentive as new workers will spend most of their income on the products of rival firms. Hence, the government must step in to resolve this macroeconomic coordination failure.

However, apart from coordinating macroeconomic outcomes, the government must step in to provide an adequate level of public goods. The main objective of this paper is to investigate the interactions between macroeconomic stabilisation and the optimal provision of public goods, hitherto a relatively neglected area of research. A rise in public spending is useful to the government for two reasons. First, it provides direct utility to the citizens. Second, it sets in motion a multiplier process which boosts the private component of social welfare. These two benefits must be balanced against the reduction in private welfare arising from the rise in taxes necessary to finance the public goods. This line of reasoning leads to the condition that the sum of the marginal rates of substitution between public and private goods should equal the marginal cost of public funds. The cost of funds is less than unity, because a rise in taxes accompanied by a rise in public spending raises private welfare on account of the multiplier process.

The second objective of this paper is to correct a disturbing convention in previous work on models of imperfect competition with Keynesian features. Economists have got into the habit of normalising the utility of the bundle of differentiated consumption products in such a way that a rise in the number of product varieties neither affects marginal utility of private consumption nor the consumer price index. Hence, in sharp contrast to the classic work of Dixit and Stiglitz (1977), the new macroeconomics literature assumes that an increase in the number of product varieties does not affect welfare through this channel. Although this assumption started as a convenient analytical simplification, it crucially affects the long-run multipliers under free entry and exit. If the effect of the number of product varieties on the consumer price index is switched

off, the long-run multiplier is eliminated. Indeed, the combination of free entry and exit with fixed costs reduces social marginal product just enough to counteract the adverse effect of monopolistic competition - see Startz (1989). However, if one allows for the effect of the expansion in the number of product varieties on the consumer price index, the long-run multiplier exceeds the short-run multiplier! Effectively, an expansion of aggregate demand induces entry of new firms and thus raises the number of product varieties in the long run. This lowers prices for consumers which further boosts private demand for goods. Hence, the diversity effect ensures that Keynesian multiplier effects do not vanish in the long run. By switching off the diversity effect, the new macroeconomics literature assumes a constant real wage.[1] This assumption seems somewhat out of place in attempts to derive Keynesian results for economies in which all goods and labour markets clear instantaneously. The diversity effect is crucial for having a pro-cyclical real wage. This quintessential Keynesian feature arises in the long run when the expansion of the number of product varieties depresses the consumer price index and pushes up the real consumer wage while at the same time boosting employment. Furthermore, the diversity effect is important for a proper understanding of the welfare effects of a rise in public spending.

The third objective of this paper is to extend the basic analysis by investigating the implications of subsistence levels for private consumption. The fourth objective is to briefly indicate how the analysis can be extended to allow for heterogeneous labour and imperfect competition in the labour market. The final objective of this paper is to give the integration of the public finance and stabilisation approaches to public policy more substance by analysing the effects of finance by distortionary taxes. This is why we allow for a non-zero uncompensated wage elasticity of labour supply. If this elasticity is positive, fiscal consolidation (i.e. trimming the size of the public sector and cutting the tax rate on labour) boosts employment and aggregate demand. Hence, the Keynesian multipliers vanish.

Section 2 presents a simple macroeconomic model of imperfect competition in which the diversity effect is not switched off. We also assume a non-unitary elasticity of substitution between consumption and leisure. Section 3 derives the output, profit and employment multipliers for a rise in public spending financed by lump-sum taxes and discusses the extent to which private consumption is crowded out under restricted entry and exit of firms. Section 3 also shows that the marginal cost of public funds is constant and below unity, and discusses how this affects the optimal provision of public goods. Section 4 shows that the real national income and employment multipliers are larger under free than under restricted entry and exit, and investigates how this

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[1] Solow (1986) similarly criticises Weitzman (1982) for assuming a rigid real wage in his explanation of involuntary unemployment based on a spatial model of imperfect competition and returns to scale.

affects the marginal cost of public funds and the provision of public goods. Section 5 briefly analyses the effects of non-homothetic preferences and shows that the presence of subsistence levels of private consumption depresses the national income multipliers. Section 5 also shows that imperfect competition in the labour market accentuates the Keynesian multiplier effects. Section 6 extends the analysis by investigating the implications of a rise in public spending financed by a distortionary tax on labour income or private consumption. Section 7 concludes with a summary of results.

2 A macroeconomic model of imperfect competition

The challenge is to obtain Keynesian multipliers in a macroeconomic model in which all markets clear instantaneously. Following previous work, we allow for monopolistic competition and increasing returns to scale as it is the wedge between price and marginal cost and the consequent opportunity to raise profits that generates Keynesian multiplier effects. In contrast to previous work, we allow for the effect of product variety on consumer prices, output and welfare. This extension is important, because previous work obtained misleading results for the long-run output multipliers for a rise in public spending. To make our long-run results more interesting, we allow for a non-unitary elasticity of substitution between consumption and leisure. To focus on the welfare effects of a rise in public spending, we only allow for lump-sum taxes and postpone the treatment of distortionary taxes on labour income or private consumption to section 6. We do not investigate the use of production subsidies to tackle the distortions arising from monopolistic competition head-on, hence our analysis is concerned with second-best issues.

2.1 Consumer demand and labour supply

Households derive utility from consuming a composite differentiated product (C) and leisure (1-L), as well as from a composite public good (G). We assume that preferences are separable in private goods and the public good and that the sub-utility function for private consumption and leisure has a constant elasticity of substitution (σ):

$$U \equiv \left[\alpha C^{\frac{\sigma-1}{\sigma}} + (1-\alpha)(1-L)^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}} + \eta\Gamma(G), \quad \sigma,\eta,\Gamma' > 0,\ 0 < \alpha < 1. \tag{1}$$

The composite good is a CES-aggregation of the consumption of each variety (C_j, $j=1,..,N$):

$$C \equiv \left[\sum_{j=1}^{N} C_j^{\frac{\theta-1}{\theta}}\right]^{\frac{\theta}{\theta-1}}, \quad \theta>1 \tag{2}$$

where θ is the elasticity of substitution between the different varieties of consumer products. The ideal price indices for private utility (P_V) and the composite consumption good (P_C) are given by:

$$P_V = \left[\alpha^{\sigma} P_C^{1-\sigma} + (1-\alpha)^{\sigma}\right]^{\frac{1}{1-\sigma}}, \quad P_C \equiv \left[\sum_{j=1}^{N} P_j^{1-\theta}\right]^{\frac{1}{1-\theta}} \tag{3}$$

where P_j denotes the price of product variety j. Note that the price of labour, i.e. the wage, is chosen as the numéraire. The household budget is $P_C C = L + \Pi - T$, where Π stands for aggregate profit income and T denotes lump-sum taxes. Two-stage budgeting yields private consumption, labour supply and indirect utility:

$$P_C C = c(1+\Pi-T), \quad C_j = \left[\frac{P_C}{P_j}\right]^{\theta} C, \; j=1,..,N \tag{4a}$$

$$L = 1 - (1-c)(1+\Pi-T) \tag{4b}$$

$$U = V + \eta\Gamma(G), \quad V \equiv (1+\Pi-T)/P_V \tag{4c}$$

where the marginal propensity to consume out of full-employment income is

$$c \equiv \frac{P_C C}{P_V V} = \frac{L+\Pi-T}{1+\Pi-T} = \alpha^{\sigma}\left[\frac{P_V}{P_C}\right]^{\sigma-1}. \tag{4d}$$

If the substitution effect dominates the income effect (i.e. $\sigma>1$), labour supply expands when the price index of indirect utility (P_V) falls, or the wage rate rises.

2.2 Production under imperfect competition

Labour is mobile between firms, so that a common wage is paid by all firms. Labour is the only factor of production. Firm j requires $L_j = kQ_j + F$ units of labour, where Q_j, F and k stand for the output of firm j, the fixed (internal) cost in terms of units of labour, and the (constant) marginal labour requirement. Firm j maximises its profits, $\Pi_j \equiv P_j Q_j - (kQ_j + F)$, subject to the elasticity of demand it faces for its product (i.e. θ) and under the Cournot assumption that other firms do not change their output level. Hence, marginal revenue (i.e. $(1-\theta^{-1})P_j$) should equal

marginal cost (k). Alternatively, we have the pricing rule $P_j=\mu k$, where $\mu \equiv \theta/(\theta-1)>1$. The price mark-up on variable labour costs (μ) and thus the degree of monopoly power are larger if substitution between the different varieties of consumption products is difficult (θ small). The short run is characterised by restricted entry and exit, so that N is fixed. The long run is characterised by free entry and exit, so that profits are driven to zero (i.e. $\Pi_j=0$, $j=1,..,N$).

2.3 Government and market equilibrium

The government budget is $P_C G=HT$, where H stands for the number of households. If the public good (G) is a similar composite of product varieties as the private good (C)[2], see (2), and the government minimises the nominal spending level $P_C G$ for a given provision of public goods (G), the demand by the government for each product variety is given by $G_j=(P_C/P_j)^{\theta}G$, $j=1,..,N$.

Equilibrium on the labour market requires that labour demand ($L_1+..+L_N$) equals total labour supply (HL). Goods market equilibrium implies that, in the absence of storage, production equals demand by households and government (i.e. $Q_j=HC_j+G_j$, $j=1,..,N$). Since private and public demand curves have the same price elasticities, the composition of aggregate demand does not affect the price elasticity of aggregate demand and the gross mark-up (μ) is constant and the same for each firm. In symmetric equilibrium all firms set the same price and have the same output level (i.e. $P_j \equiv P$ and $Q_j \equiv Q$, $j=1,..,N$). Nominal national income (Y) equals aggregate demand or, alternatively, total wage plus profit income, i.e. $Y \equiv NPQ=P_C Z=H(L+\Pi)$, where $Z \equiv HC+G$ stands for real national income. Upon substitution of (4a) or (4b), we obtain aggregate demand as an increasing function of profit income:

$$Y = P_C(HC+G) = cH(1+\Pi-T) + P_C G. \qquad (5)$$

Profits accruing to households can (with the aid of the pricing rule) be written as an increasing function of nominal national income:

$$H\Pi = \Pi_1 + \ldots + \Pi_N = \theta^{-1} Y - NF. \qquad (6)$$

3 Public policy under restricted entry and exit

Since the price mark-up is constant, producer prices are fixed. Under restricted entry and exit, the number of firms is fixed also. It follows from expression (3) that the consumer price index and the price index of indirect utility are fixed. Hence, expression (4d) indicates that the

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[2] If the public composite good is different from the private composite good, then the government can influence the price mark-up as well. See Solow (1986).

marginal propensity to consume out of full-employment income is constant in the short run. In addition, with lump-sum taxes, the marginal utility of private consumption (i.e. $U_C=P_C/P_V$) is constant under restricted entry and exit.

3.1 Keynesian multipliers

Solving (5) and (6) along the lines of the familiar Keynesian cross diagram, we obtain the national income and profit multipliers:

$$\left[\frac{dZ}{dG}\right]_T^{SR} = \left[\frac{\theta H d\Pi}{P_C dG}\right]_T^{SR} = (1-c)\left[1+\sum_{i=1}^{\infty}(c/\theta)^i\right] = \frac{1-c}{1-c/\theta} > 1-c. \qquad (7)$$

From $P_CHC=Y-P_CG$ and $HL=Y-H\Pi$, we get the private consumption and employment multipliers:

$$-c < H\left[\frac{dC}{dG}\right]_T^{SR} = -\left[\frac{\theta-1}{\theta-c}\right]c < 0, \quad 0 < \frac{H}{P_C}\left[\frac{dL}{dG}\right]_T^{SR} = \left[\frac{\theta-1}{\theta-c}\right](1-c) < 1-c. \qquad (8)$$

A rise in government spending boosts aggregate demand on impact. The rise in aggregate demand is attenuated by the rise in taxes, which depresses private consumption.[3] Since there is no entry of new firms, profit income expands. This induces a second round of demand and profit increases. Given that price exceeds marginal cost, firms are eager to sell the additional output. This multiplier process is dampened by the negative effect of profit income on labour supply. The net effect of the rise in public spending is to raise labour supply and employment, i.e. the negative effect of higher profits dominates the positive effect of higher taxes on labour supply. A bigger degree of monopoly power (i.e. a smaller elasticity of demand for the varieties of the differentiated product, θ) boosts the national income and profit multipliers but (as the higher profit income makes people lazier) depresses the labour supply multiplier. Private consumption falls, but crowding out is less severe if goods are more differentiated and firms have consequently more monopoly power.

3.2 The cost of public funds and the provision of public goods

The marginal adverse effect of a rise in lump-sum taxes on the private component of social welfare, expressed in resource units, is the marginal cost of public funds (MCPF):

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[3] If the rise in public spending is financed by firing civil servants, there is no accompanying rise in taxes. Hence, the output multiplier for a "bond-financed" rise in public spending is not attenuated, i.e. $dY/P_CdG=1/(1-c/\theta)$ - see Mankiw (1988) for the case $\sigma=1$ and $c=\alpha$.

$$0 < \text{MCPF} \equiv -\left[\frac{H dV}{U_C dG}\right]_T^{SR} = \left[\frac{\theta-1}{\theta-c}\right] < 1. \qquad (9)$$

The MCPF is below unity. This means that the social cost of a public project is less than its market cost. The reason is that a rise in taxes, associated with a rise in public spending, boosts national income and the private component of utility. Effectively, the rise in public spending helps to offset the distortion in the goods market (i.e. too low levels of output) caused by monopolistic competition. The MCPF is lower if the substitution elasticity between the different product varieties (θ) and the marginal propensity to consume (c) are small. Note that under perfect competition, i.e. perfect substitution between the product varieties, the MCPF is unity. Since the marginal propensity to consume is constant in the short run, the MCPF is constant also. Hence, (9) corresponds to a flat cost curve - see Figure 1(a).

The optimal provision of public goods follows from the modified Samuelson rule:

$$\frac{H\eta\Gamma'(G)}{U_C} = \text{MCPF}. \qquad (10)$$

This rule states that the sum of the marginal rates of substitution between public goods and private goods should equal the MCPF. Since U_C is constant in the short run, we can write the demand for public goods as a negative function of the cost of public funds:

$$\frac{dG}{G} = \frac{1}{\epsilon}\left[\frac{d\eta}{\eta} - \frac{d\text{MCPF}}{\text{MCPF}}\right], \quad \epsilon \equiv -\frac{G\Gamma''}{\Gamma'} > 0. \qquad (10')$$

The demand curve (10) and the cost curve (9) can be solved for the level of public goods provision and the MCPF in a similar manner as has been done for the competitive case by Atkinson and Stern (1974) - see Figure 1(a). Under restricted entry and exit, a rise in the priority given to public goods boosts the provision of public goods but leaves the MCPF unaffected.

4 Public policy under free entry and exit

4.1 Do Keynesian multipliers really disappear under free entry of firms?

Under free entry and exit of firms, profits are driven to zero (so $Y=\theta NF$). Producer prices and the scale of production for individual firms are constant. An increase in the number of product varieties thus raises national income, employment, aggregate output and real national income, and (see (3)) lowers the consumer price index:

$$\frac{dN}{N} = \frac{dY}{Y} = \frac{dL}{L} = \frac{dNQ}{NQ} = \left[\frac{\theta-1}{\theta}\right] \frac{dZ}{Z} = -(\theta-1)\frac{dP_C}{P_C}. \tag{11}$$

The marginal propensity to consume out of full-employment income (4d) then rises if the substitution effect in labour supply dominates the income effect so that the boost to the real wage raises labour supply (i.e. $\sigma > 1$):

$$\frac{dc}{c} = \left[\frac{\sigma-1}{\theta-1}\right](1-c)\frac{dY}{Y}. \tag{12}$$

Of course, under perfect competition, the consumer price index and the marginal propensity to consume are constant. Using (11) and the government budget, we see that a rise in the number of product varieties lowers the consumer price index and thus less taxes are required to finance a given real increase in public spending:

$$HdT = P_C dG - \left[\frac{1}{\theta-1}\right]\left[\frac{P_C G}{Y}\right] dY. \tag{13}$$

With imperfect competition, the rise in the number of product varieties and national income reduces the extent of crowding out of private consumption caused by the tax-financed rise in public spending. Upon substitution of the consumption function (4a) into the national income identity (5), we find the relative change in nominal national income under free entry of firms:

$$\frac{dY}{Y} = \omega \frac{dc}{c} + (1-c)\,(1-\omega)\,\frac{dT}{T}, \tag{14}$$

where $\omega \equiv HC/Z$ denotes the share of private consumption in aggregate demand. Upon substitution of (12) into (14), we can solve for the nominal national income and employment multipliers:

$$\left[\frac{dY}{dP_C G}\right]_T^{LR} = \left[\frac{HdL}{dP_C G}\right]_T^{LR} = \frac{1-c}{1-\omega(1-c)(\sigma-1)/(\theta-1)}. \tag{15}$$

Startz (1989) assumes that the elasticity of substitution between private consumption and leisure (σ) is unity, so that the long-run multiplier (15) simply amounts to the impact effect of a rise in public spending financed by taxes (i.e. 1-c). Hence, as in Startz (1989), if $\sigma = 1$, the long-run nominal income multiplier does not feature any propagation effects and is therefore less than the corresponding short-run multiplier. However, if the substitution effect dominates the income effect in labour supply (i.e. $\sigma > 1$), the long-run nominal income multiplier exceeds the impact multiplier (1-c). The reason is that the reduction in the consumer price index boosts the real consumption

wage and encourages households to work harder and produce more goods. If the income effect dominates the substitution effect in labour supply (i.e. $\sigma<1$), the dominating effect is that the boost to real income induces households to work less. Hence, the long-run nominal income multiplier is less than the corresponding short-run multiplier. Finally, under perfect competition the long-run nominal income multiplier reduces to the short-run multiplier (regardless of the value of σ).

For the welfare analysis it is more relevant to study the long-run real national income and employment multipliers. These may be found from (11) and (15):[4]

$$\left[\frac{dZ}{dG}\right]_T^{LR} = \left[\frac{\theta}{\theta-1}\right]\left[\frac{HdL}{P_C dG}\right]_T^{LR} = \frac{1-c}{1-c/\theta-\sigma\omega(1-c)/\theta} > \left[\frac{dZ}{dG}\right]_T^{SR} = \frac{1-c}{1-c/\theta}. \qquad (7')$$

The long-run effects of a tax-financed increase in the real value of public spending on real aggregate demand and employment consist of three components. The first one is the *impact* effect (i.e. 1-c). The second component is the *propagation* effect discussed in section 3.1. The final component is the *substitution* effect caused by the fall in the consumer price index and the consequent boost to the real consumer wage. Effectively, there is no income effect in labour supply and private consumption as (7′) is a real multiplier. Hence, households are encouraged to consume less leisure, thereby pushing up employment and real spending. This substitution effect explains why the long-run real national income multiplier exceeds the corresponding short-run multiplier, particularly if substitution between private consumption and leisure is easy. This contrasts with the result derived by Startz (1989). The pro-cyclical behaviour of the real consumer wage captures an important feature of Keynesian macroeconomics.

4.2 Welfare analysis and optimal provision of public goods

Since the multiplier under free entry and exit consists of substitution as well as propagation and impact effects, the adverse effect of a rise in public spending and taxation on the private component of social welfare is less than under restricted entry and exit. Indeed, we see that the long-run MCPF is less than the short-run MCPF:

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[4] A perverse multiplier is obtained if the denominator in the long-run multiplier (7′) is negative. However, we rule this counter-intuitive result out by appealing to the correspondence principle. A plausible, albeit ad hoc, adjustment mechanism amounts to new firms entering the economy if there is a profit to be made, that is $dN/dt=\gamma\Pi$ with $\gamma>0$. This adjustment process is stable if and only if $\theta>c+\sigma\omega(1-c)$.

$$MCPF \equiv -\left[\frac{HP_V dV}{P_C dG}\right]_T^{LR} = \frac{\theta - 1 - \sigma\omega(1-c)}{\theta - c - \sigma\omega(1-c)} < \frac{\theta - 1}{\theta - c} < 1. \qquad (9')$$

Since the cost of public funds is lower with free entry of firms, a bigger provision of public goods seems likely in the long than in the short run. The long-run cost curve (9′) typically slopes upwards, as (for $\sigma=1$ and constant c) we have

$$\frac{dMCPF}{(1-MCPF)^2} = -d\omega = \frac{(1-\omega)^2(\theta-1)c}{\theta-c(1-\omega)-\omega}\,\frac{dG}{G}, \qquad (9'')$$

and approaches the short-run cost curve as the real value of public spending increases - see Figure 1(b). The demand curve slopes downwards provided that ϵ is large enough:

$$\frac{dG}{G} = \frac{\frac{d\eta}{\eta} - \frac{dMCPF}{MCPF}}{\epsilon - \frac{(1-c)^2\,(1-\omega)}{\theta - c - \sigma\omega(1-c)}}. \qquad (16)$$

The elasticity of the demand for public goods with respect to the MCPF is bigger in the long than in the short run. The reason is that a given increase in the real value of public spending lowers not only the marginal utility of public goods, but also depresses the consumer price index and thus the marginal utility of private consumption. Hence, the reduction in the cost of public funds, that society is willing to pay for a given increase in the real provision of public goods, is smaller for the long than for the short run.

Figure 1(b) shows that a bigger priority for public goods raises both the cost of public funds and the provision of public goods. As a result, the consumer price index falls while both nominal and real national income rise and employment expands. Private consumption is crowded out, albeit by less than under restricted entry of firms.

5. Extensions

5.1 Necessities

So far, we only considered homothetic preferences. To allow private consumption goods to be necessities or luxuries, we consider non-homothetic preferences. In particular, we follow Startz (1989) and assume a Stone-Geary utility function:

$$U = \alpha\log(C-C_M) + (1-\alpha)\log(1-L) + \eta\log(G) \qquad (1')$$

where $C_M>0$ stands for the subsistence level of private consumption. Since the short-run

multipliers and cost of public funds are unaffected by a positive subsistence level of private consumption[5], we focus attention on the long run.

The long-run nominal national income multiplier is lower than the impact multiplier and *a fortiori* lower than the short-run national income multiplier:

$$\left[\frac{dY}{dP_C G}\right]_T^{LR} = \left[\frac{H dL}{dP_C G}\right]_T^{LR} = \frac{1-\alpha}{1+(1-\alpha)\omega_M/(\theta-1)} < 1-\alpha < \frac{1-\alpha}{1-\alpha/\theta} \qquad (15')$$

where $\omega_M \equiv HC_M/Z > 0$ denotes the national income share of the subsistence level of private consumption. Since private consumption goods are necessities, private demand tapers off as the economy expands. Hence, the long-run nominal income and employment multipliers for a rise in the nominal value of public spending are lower if the subsistence level of private consumption is higher. The long-run real income multiplier is also lower if private consumption goods are necessities:

$$\left[\frac{dZ}{dG}\right]_T^{LR} = \frac{1-\alpha}{1-\alpha/\theta-(\omega-\omega_M)(1-\alpha)/\theta} < \frac{1-\alpha}{1-\alpha/\theta-\omega(1-\alpha)/\theta}. \qquad (7'')$$

It follows that a positive subsistence level for private consumption pushes up the long-run MCPF:

$$MCPF = \frac{\theta-1-(\omega-\omega_M)(1-\alpha)}{\theta-\alpha-(\omega-\omega_M)(1-\alpha)} > \frac{\theta-1-\omega(1-\alpha)}{\theta-\alpha-\omega(1-\alpha)}. \qquad (9''')$$

5.2 Labour market imperfection

Up to this point the only source of market imperfection has been due to monopolistic competition in the goods market. As a final extension we now consider the consequences of imperfect competition on the labour market. Suppose that utility is Cobb-Douglas in consumption and leisure:

$$U_i = \alpha \log C_i + (1-\alpha)\log(1-L_i) + \eta \log(G) \qquad (1'')$$

for each household $i=1,..,H$. C_i is the usual CES aggregate of all varieties $j=1,..,N$ consumed by household i, and L_i is the labour supply of household i. Following Hart (1982) and Blanchard and Kiyotaki (1987), labour from the different households are imperfect substitutes in production, with substitution elasticity ξ:

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[5] Expressions (7)-(9) are unaltered, except that c is replaced by α.

$$Q_j + F = \left[\sum_{i=1}^{H} L_{ij}^{\frac{\xi-1}{\xi}}\right]^{\frac{\xi}{\xi-1}}, \qquad \xi > 1, \tag{17}$$

where F is fixed cost measured in terms of lost output, and L_{ij} is labour of type i purchased by firm j. Since firms purchase all types of labour and $\xi > 1$, each household has some monopoly power in the market for its own type of labour. Consequently, if there are only lump-sum taxes (i.e. t=0), the demands for goods and leisure become:

$$P_C C = \alpha^*(W_i + \Pi_i - T_i) \tag{4a'}$$

$$W_i(1 - L_i) = (1 - \alpha^*)(W_i + \Pi_i - T_i) \tag{4b'}$$

where the marginal propensity to consume is given by $\alpha^* \equiv \alpha/[\alpha+(1-\alpha)\mu_U]$ and the "union" mark-up is defined as μ_U ($\equiv \xi/(\xi-1) > 1$). Monopolistic competition in the labour market drives a wedge between the private and social marginal utility of leisure and reduces the marginal propensity to consume. In symmetric equilibrium each type of labour sells for the same price and employment and composite consumption of each household is the same (i.e. $W_i=W$, $L_i=L$, and $C_i=C$ for $i=1,..,H$). As before, firms set price equal to a mark-up times marginal cost, which yields $P_j=\mu_F W_P$, where the firms' mark-up is $\mu_F \equiv \theta/(\theta-1) > 1$ and W_P is a the unit cost function associated with (17):

$$W_P = \left[\sum_{i=1}^{H} W_i^{1-\xi}\right]^{\frac{1}{1-\xi}} \text{ where } \sum_{i=1}^{H} W_i L_{ij} = W_P(Q_j + F). \tag{18}$$

Firms are also in symmetric equilibrium with $Q_j=Q$ and $P_j=P$ ($j=1,..,N$), so that $H\Pi=\theta^{-1}Y-FH^{1/(1-\eta)}WN$ and $P_C=\mu_F N^{1/(1-\theta)}H^{1/(1-\eta)}W$, $HT=P_C G$, and $Y=P_C(HC+G)=P_C Z$. As before, the price of labour can be chosen as the numéraire, so that $W=1$.

In the short run the number of firms is fixed, and the real output multiplier is given by:

$$\left[\frac{dZ}{dG}\right]_T^{SR} = \frac{1-\alpha^*}{1-\alpha^*/\theta} \tag{19}$$

The mark-up demanded by the monopolistic households implies that $\alpha^* < \alpha$, so that the multiplier exceeds the one that obtains if only the goods market is imperfectly competitive (equation (7)). The union mark-up lowers the marginal propensity to consume, but also increases the effect of after-tax profits on labour supply. A given rise in government spending has a larger impact effect on national income (i.e. $1-\alpha^*$) and leads to a smaller fall in private consumption on account of the

higher taxes that are required.

In the long run firms enter the economy until all opportunities for making a profit are wiped out. It follows that the long-run real output multiplier is given by:

$$\left[\frac{dZ}{dG}\right]_T^{LR} = \frac{1-\alpha^*}{1-\alpha^*/\theta-\omega(1-\alpha^*)/\theta} > \frac{1-\alpha^*}{1-\alpha^*/\theta} = \left[\frac{dZ}{dG}\right]_T^{SR} \qquad (20)$$

As before, the long-run multiplier exceeds the short-run multiplier. In addition, we also see that imperfect competition in the labour market raises the long-run multiplier.

6 Does fiscal consolidation work?

So far, we have showed that a rise in public spending financed by lump-sum taxes generates Keynesian multiplier effects under imperfect competition. In practice, we see that many countries are engaged in fiscal consolidation in order to improve labour market participation and give private initiative a better chance. Hence, it may be more realistic to consider finance by distortionary taxes. Consider what happens if public spending is financed by a tax on labour income (i.e. $tWHL=P_CG$ and $T=0$, where t denotes the labour tax rate)[6] and assume unit income elasticities in demand for private consumption goods ($C_M=0$). Private consumption, labour supply and indirect utility are now given by:

$$P_CC=c(1-t+\Pi), \quad L=1-(1-c)(1-t+\Pi)/(1-t), \quad V=(1-t+\Pi)/P_V \qquad (4'')$$

where the marginal propensity to consume equals $c=\alpha^\sigma(P_V/P_C)^{\sigma-1}$ and the price index of indirect utility is given by

$$P_V = \left[\alpha^\sigma P_C^{1-\sigma} + (1-\alpha)^\sigma(1-t)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}. \qquad (3')$$

6.1 Restricted entry of firms

In the short run the consumer price index is constant. Differentiating labour supply (around an equilibrium with zero profits) and substituting the result into the government budget, we obtain:

$$P_CdG = HLdt + tHdL = HL\Delta dt - \left[\frac{t}{1-t}\right]\left[\frac{1-c}{\theta}\right]dY \qquad (21)$$

where $\Delta \equiv [1-(t/(1-t))(\sigma-1)(1-c)]^{-1}>0$. In the short run, labour supply falls if profit income

[6] This is equivalent to a consumption tax if there is no profit income.

expands. This reduces public revenues, especially if the tax rate on labour income is large. A higher tax rate on labour income lowers the consumer wage and induces households to substitute leisure for consumption. It also lowers real income and thus boosts labour supply. Labour supply thus falls if the substitution effect dominates the income effect, i.e. $\sigma > 1$. A higher tax rate on labour income directly raises public revenues, especially if the base of the labour tax (HL) is large. If the substitution effect dominates the income effect in labour supply ($\sigma > 1$), a higher tax rate on labour erodes the labour tax base and thus decreases public revenues, especially if the tax rate is large. We assume that the erosion of the tax base is small enough to ensure that a higher tax rate indeed raises public revenues, i.e. we assume that $\Delta > 0$. This requires that the tax rate and the elasticity of substitution between private consumption and leisure are not too large. Figure 2 portrays the government budget constraint (GBC), i.e. expression (21), on the assumption that the economy is on the upward-sloping part of the Laffer curve. Since we assume that a lower level of profit income or of national income (as $dY = \theta H d\Pi$) necessitates a bigger tax rate in order to finance a given level of public revenues, the GBC-locus slopes upwards.[7]

Combining the national income identity and the profit relationship (6), using (4′), and linearising, we obtain:

$$dY = \left[\frac{\theta}{\theta - c}\right] \left[P_c dG - cH\,dt - c(\sigma - 1)(1 - c)\left[H + \frac{NF}{1 - t}\right] dt\right] . \qquad (22)$$

This multiplier relationship (MULT) is portrayed in Figure 2 as well. A higher tax rate depresses disposable income and thus reduces private consumption and aggregate demand, so that the MULT-locus slopes downwards. If the substitution effect is strong relative to the income effect in labour supply, a higher tax rate depresses labour supply and thus erodes the tax base. This makes the MULT-locus steeper.

A rise in public spending has two effects. First, it shifts out the GBC-locus as either a higher tax rate or a bigger labour supply (induced by a lower level of profit income) and tax base are required to generate the required extra public revenues. Second, the MULT-locus shifts out as the rise in public spending boosts aggregate demand. On balance there is a positive effect on the tax rate and an ambiguous effect on profits and national income. If the elasticity of substitution between private consumption and leisure is unity, the net effect on national income is zero - see Molana and Moutos (1991). However, if the substitution effect dominates the income effect in labour supply ($\sigma > 1$), employment, profits and national income fall. Conversely, if labour supply

[7] For the case of finance by lump-sum taxes, there is no erosion of the tax base so that the corresponding GBC-locus is vertical.

bends backwards ($\sigma<1$), employment, profits and national income expand after a rise in public spending financed by an increase in the labour tax rate. The short-run national income multiplier follows from solving (21) and (22):

$$\left[\frac{dZ}{dG}\right]_t^{SR} = \left[\frac{\theta H d\Pi}{P_C dG}\right]_t^{SR} = \left[\frac{\theta H dL}{(\theta-1)dG}\right]_t^{SR} = \frac{1-[c(1-\sigma)+\sigma]\Delta}{1-c/\theta+\left[\frac{t}{1-t}\right][c(1-\sigma)+\sigma]\Delta(1-c)/\theta}. \quad (23)$$

If $\sigma=1$, expression (23) vanishes as $\Delta=1$. Fiscal consolidation then has no effect on aggregate demand and employment. In general, if the substitution effect dominates the income effect in labour supply (i.e. $\sigma>1$), a higher tax rate also erodes the tax base and thus $\Delta>1$. If the initial tax rate on labour is zero (or $\sigma=1$), then $\Delta=1$ and (23) reduces to:

$$\left[\frac{dZ}{dG}\right]_t^{SR} = \frac{(1-\sigma)(1-c)}{1-c/\theta}. \quad (23')$$

Hence, if the income effect dominates the substitution effect in labour supply (i.e. $\sigma<1$), an increase in public spending boost employment and aggregate demand. Intuitively, a higher tax rate on labour boosts employment only if the labour supply curve bends backwards. If the uncompensated wage elasticity of labour supply is positive, fiscal consolidation boosts employment and aggregate demand. Hence, crowding out of public consumption is less than the rise in public spending. The boost to employment is magnified under imperfect competition.

The required change in the tax rate to finance a given increase in public spending follows from (21), and is given by:

$$\left[\frac{HLdt}{P_C dG}\right]^{SR} = \Delta\left[1+\left[\frac{t}{1-t}\right](1-c)\theta^{-1}\left[\frac{P_C dZ}{dG}\right]_t^{SR}\right] \quad (24)$$

The term Δ stands for the traditional effect of a change in the tax rate on labour supply and the corresponding tax base. If $\sigma>1$ and $t>0$, there is an erosion of the labour tax base and thus a more than proportional increase in the tax rate is required ($\Delta>1$). Hence, if $\sigma>1$ and $t>0$, the MCPF under perfect competition (i.e. Δ) exceeds unity. Since in that case the short-run national income multiplier is negative (see (23)), the rise in the tax rate needed to finance a given increase in government spending is smaller under monopolistic competition than under perfect competition. Intuitively, under monopolistic competition the negative profit effect has a positive effect on labour supply and thus dampens the erosion of the tax base.

In general, the adverse effects of a rise in public spending financed by a tax on labour on

the private component of welfare are strengthened (weakened) if the substitution effect dominates the income effect in labour supply. This may be seen from the following expression for the short-run cost of public funds:

$$\text{MCPF} \equiv -\left[\frac{HP_V dV}{P_C dG}\right]_t^{SR} = \left[1 + \frac{(\sigma-1)(1-c)}{\theta(1-t)-(c-t)}\right]\left[\frac{HLdt}{P_C dG}\right]^{SR}. \qquad (24)$$

The reason is thus that, if $\sigma > 1$, a rise in public spending financed by a tax on labour, on the one hand, erodes the tax base for labour and necessitates a higher tax rate and, on the other hand, depresses output. Both effects reduce private consumption and welfare and therefore push up the MCPF. Expression (21) indicates that the short-run MCPF (24) reduces to the term in square brackets if the initial tax rate on labour income is zero. In that case, the MCPF is unity if labour supply is inelastic (i.e. $\sigma=1$). More generally, the MCPF exceeds unity if the substitution effect dominates the income effect in labour supply (i.e. $\sigma > 1$). In that case, fiscal consolidation may make sense as long as there is imperfect competition in the goods market.

6.2 Free entry of firms

In the long run firms enter the market until profits are wiped out, so that L=c and (11) hold. Following the same procedure as before, we derive the long-run national income multiplier:

$$\left[\frac{dZ}{dG}\right]_t^{LR} = \frac{1-[c(1-\sigma)+\sigma]\Delta}{1-[c(1-\sigma)+\sigma](1-t)\left[\frac{2-t-\omega}{1-t+t(1-\sigma)(1-c)}\right]/\theta}. \qquad (25)$$

If $\sigma=1$, the substitution and income effects cancel out so that labour supply is inelastic. Consequently, the long-run multiplier is zero as well. If real aggregat demand expands through the arrival of new product varieties on the market, the consumer price index falls (see (11)). This implies that public goods are cheaper as well and hence that the tax rate on labour income needs to rise by less. Obviously, if the various products are homogeneous goods ($\theta\to\infty$), this effect disappears and thus the multiplier (25) reduces to the impact effect (i.e. the numerator). The impact effect is smaller if (for $\sigma > 1$) the tax rate on labour is higher, so that Δ is larger and (25) is smaller. It follows from (25) and (23′) that the long-run multiplier is bigger in absolute value than the short-run multiplier. Hence, fiscal consolidation yields an even bigger expansion of employment under free entry and exit.

7 Concluding remarks

Macroeconomic models of imperfect competition with Keynesian features have been analysed. In contrast to previous work, we have allowed for non-unitary elasticities between leisure and private consumption, and for the effect of product variety on multipliers and welfare. We find that the real national income multiplier for a given rise in real public spending under free entry and exit is larger than under restricted entry and exit of firms, so that private consumption is crowded out more in the short than in the long run. The reason is that, as the economy expands and more product varieties come on the market, the consumer price index falls which boosts real income. This also gives rise to the Keynesian feature of a pro-cyclical real wage. We also show that with lump-sum taxes the marginal cost of public funds is below unity, more so in the long run than in the short run especially if substitution between consumption and leisure is easy. This leads to more provision of public goods in the long than in the short run. More priority for public goods raises the cost of public funds in the long run. If private consumption goods are necessities, the long-run multiplier is lower and consequently the marginal cost of public funds is larger than if these good are luxuries. If labour supplied by different households are imperfect substitutes, there is imperfect competition on the labour market also. This depresses the marginal propensity to consume and boosts the Keynesian multiplier. A rise in public spending financed by a distortionary tax on labour income yields no short-run multiplier effects. In fact, if the substitution effect dominates the income effect in labour supply, a rise in public spending depresses national income and thus the marginal cost of public funds exceeds unity. Hence, in that case fiscal consolidation, by trimming the size of the public sector and cutting the tax rate on labour, boosts employment and the size of the private sector. This highlights that recent results on Keynesian multipliers are not very robust and that more research is needed into the integration of the public finance and stabilisation approaches to public policy.

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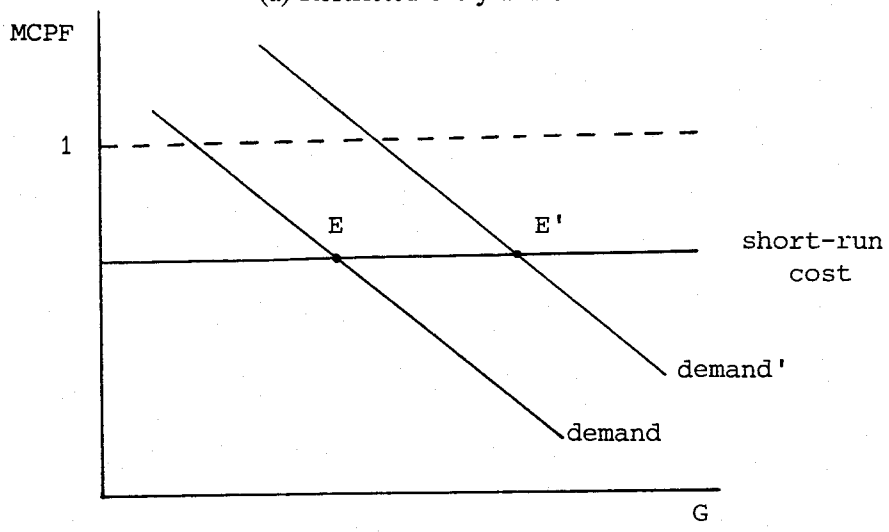
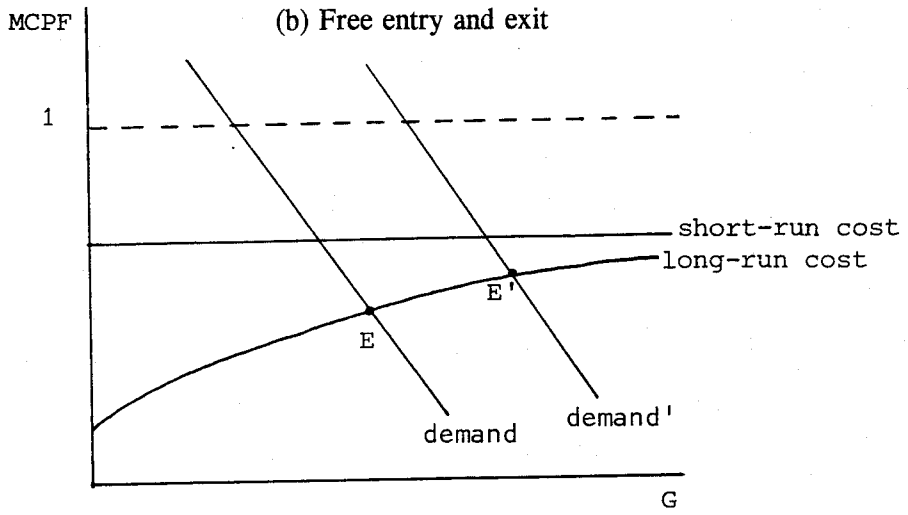
Figure 1: Optimal provision of public goods

(a) Restricted entry and exit

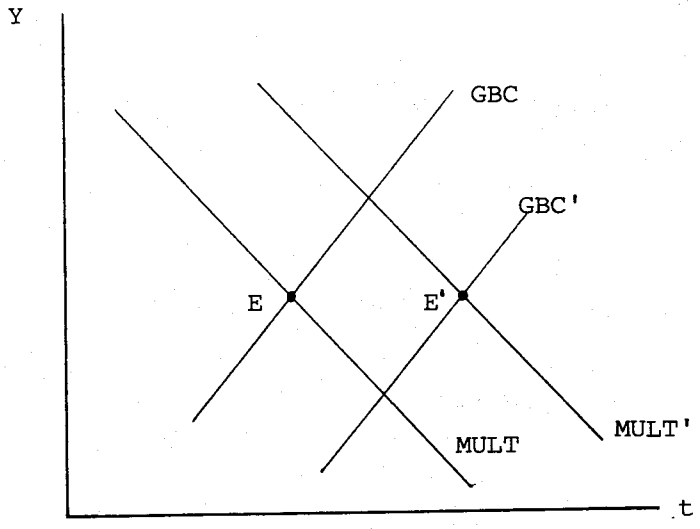


(b) Free entry and exit



Key: Higher η shifts E to E'.

Figure 2: Distortionary taxes and the determination of national income



Key: Higher G shifts E to E'.