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Primary inputs supply, government size and welfare in the presence of monopolistic competition

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Abstract

The paper considers the impact of exogenous changes in the supply of primary inputs on government size and welfare in the presence of monopolistic competition. By making use of a simple general equilibrium model, this paper shows that an increase in the supply of labor increases (decreases) the relative size of government if the share of capital in the final good sector is larger (smaller) than the share of capital in the public good sector. An increase in the supply of capital decreases the relative size of government only if the share of capital in the final good sector is equal to (or larger) than the share of capital in the public good sector. An increase in the overall size of the country decreases the relative government size. In addition, an increase in the supply of both capital and labor increases welfare.

JEL classification: F20, H19, H41
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1. Introduction

Government sector accounts for a significant proportion of a country's national income. At present, the share of government spending in national income of most developed countries is well above 20 percent (Government Finance Statistics Yearbook [2003]). The size of government has been a concern in most industrialized economies due to significant budget deficits. The recent Asian financial crisis has also resulted in a push for reduction in the size of government in affected economies.

Some existing studies have considered the determinants of government size while others have considered its impact on economic growth.[1] It is well known that the size of government is also affected by changes in the supply of inputs such as capital and labor. Globalization and an increase in the push for free trade and factor

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[1] These studies include Ram [1986], Karras [1996], Barro [1990], Karras [1996], Rodrik [1998], Persson and Tabellini [1994, 2002]. For an interesting discussion of related issues, see Inman [1987], Alesina and Wacziarg [1998] and Annett [2001, 2002].

mobility are likely to result in further adjustments to the supply of inputs within a country. This paper aims to focus on the impact of changes in the supply of capital and labor on the size of government and welfare. Availability of high quality social services in developed countries, such as health care and education, attracts migrants seeking a better standard of living. Inflow of labor has implications for the size of government. It is well known that the inflow of capital also affects the size of government.[2] Most existing studies, for example Anwar and Zheng [2004], that explicitly include a government sector assume that perfect competition prevails in all sectors of the economy. In fact, in all real economies at least a few sectors are subject to imperfect competition. This paper examines the relationship between the size of government and the supply of inputs in the presence of monopolistic competition.

Specifically, this paper utilizes a simple model of an economy that produces one final good and one public good. The final good is produced by means of labor and a large number of varieties of an intermediate good. The intermediate good and the public goods are produced by labor and capital. Because there are constant returns to scale in the production of the public good and the final good (at least at the firm level), both are produced under conditions of perfect competition. On the other hand, due to internal economies of scale, monopolistic competition prevails in the intermediate good industry. The presence of internal economies in the intermediate good sector gives rise to a specialization-based externality to the final good sector. It is shown that, in a symmetric equilibrium, exogenous changes in the supply of labor and capital can influence the size of government and welfare. The paper also considers the relationship between the size of the country and the size of the government.

The rest of the paper is organized as follows. A simple general equilibrium model is developed in section two. The impact of changes in the supply of inputs on the size of government and welfare is examined in section three. The last section offers some concluding remarks.

2. A simple model

Consider an economy that produces one final good (Y) by means of labor and the output of industry (X). The X industry is characterized by Chamberlinian monopolistic competition. There are many firms in X industry, each a little monopolist producing a distinct product with a technology that exhibits internal economies of scale. Examples of intermediate goods include the so-called professional services (consulting, auditing, engineering, architectural, etc.) available to the producers. Each variety of the intermediate good is produced by means of labor and capital.

[2] For instance, the entry of multinationals in the domestic market can increase competition, leading to an increase in the level of stress and industrial pollution (Hill [2003]). Rising unemployment due to competition can also lead to increase in government spending on social services. Capital inflow can also result in increased government spending on infrastructure provision and/or maintenance.

The economy also produces a public good (G) by means of labor and capital. The production functions for Y and G are as follows:[3]

$$Y = K_y^{\beta(1-\alpha)} L_y^{(1-\alpha)(1-\beta)} \left(\sum_{i=1}^{n} x_i^{\delta} \right)^{\frac{\alpha}{\delta}}$$

$$G = L_g^{1-\theta} K_g^{\theta}$$

where α, β, θ and δ are parameters in the range [0,1]; x_i is the output of the *i*th variety produced by industry *X*; *n* is the number of varieties produced; L_y and L_g are labor used in the production of *Y* and *G* respectively and K_y and K_g respectively are capital used in the production of Y and G.

Each variety of the intermediate good is produced by means of both capital and labor. The total cost of production consists of fixed and variable cost as follows:

$$c(w, r, x_i) = r\mu + w(\lambda x_i) \tag{1}$$

r and *w* respectively are the price of capital and the wage rate. μ and λx_i respectively are the amount of capital and labor used in the production of each variety. In other words, the fixed cost consists of capital whereas the variable cost consists of labor only. Because of the presence of fixed cost, the production of each variety of the intermediate good x_i is subject to internal economies of scale. Due to identical production functions and an equalization of factor prices between sectors, all varieties produced are equally priced. Additionally, no two firms produce the same variety. Free entry and exit of firms derives the profit of firms down to zero. Thus, in the symmetric equilibrium, $X = nx$ is the aggregate production of the intermediate good. Accordingly, the production function for the final good can be written as:

$$Y = L_y^{1-\alpha-\beta+\alpha\beta} K_y^{\beta(1-\alpha)} X^{\alpha} n^{\frac{\alpha(1-\delta)}{\delta}}$$

From the point of view of each firm in *Y* industry, the number of varieties supplied is given. Accordingly, as indicated by the above production function, there are constant returns at the firm level but, for the industry as a whole, there are economies of scale because $\alpha(1-\delta)/\delta$ is positive.[4] In other words, the presence of internal economies of scale in *X* industry leads to external economies of scale in *Y* industry. There is a large number of firms in *Y* industry each taking external effects,

[3] Except for the inclusion of a public good, the above model is identical to Rivera-Batiz and Rivera-Batiz [1991]. This model also resembles the so-called 'new economic geography' models such as Rodrik [1996], Venables [1996] and Markusen and Venables [1999]. See Puga and Ottaviano [1998] for an excellent survey of the relevant literature.

generated by the number of varieties available, on their production level as given. The external economies of scale in Y industry are compatible with perfect competition. Within the intermediate good industry (X), a large number of differentiated goods is produced; the price elasticity of demand for each differentiated good is $1/(1-\delta)$.[5] Y and G are produced under conditions of perfect competition whereas differentiated goods are produced under conditions of monopolistic competition. The final good Y is the numéraire.

The following condition determines the profit-maximizing output of the final good industry where p is the price of x and Ψ is a positive constant.

$$1 = \Psi\left[\frac{w}{r}\right]^{-\beta(1-\alpha)}\left[\frac{w}{p}\right]^{-\alpha} wn^{\frac{-\alpha(1-\delta)}{\delta}} \tag{2}$$

The right-hand side of equation (2) is the unit cost of production whereas the left-hand side is the unit price, which has been set equal to unity. The productivity of the final good sector is linked to the number of varieties of the intermediate good available. An increase in the number of varieties available decreases the unit cost of production in the final good sector.

The presence of economies of scale in the intermediate good sector implies that a single firm under monopolistic competition will produce each variety. If the intermediate good sector is active in equilibrium, then the following first order condition must hold:

$$\delta p = \lambda w \tag{3}$$

Equation (3) is the usual profit-maximization condition which shows that marginal revenue equals marginal cost. Because of free entry and exit, the price of each variety of the intermediate good in the long-run equilibrium will just cover average cost as follows:

$$p = \frac{r\mu}{(1-\delta)x} \tag{4}$$

The market-clearing condition for labor, which is assumed to be in fixed supply, is as follows:

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[4] $\alpha(1-\delta)/\delta$ is assumed to be less than unity to avoid being in the land of Cockaigne. See Wong [1995: 203].

[5] This and similar assumptions are widely used in the existing literature. See for example Wong [1995], Rodrik [1996] and Markusen and Venables [1999].

$$\left[\frac{\theta}{1-\theta}\right]^{-\theta}\left[\frac{w}{r}\right]^{-\theta} G+n(\lambda x)+\Psi(1-\alpha)(1-\beta)\left[\frac{w}{r}\right]^{\beta(1-\alpha)}\left[\frac{w}{p}\right]^{-\alpha} n^{\frac{-\alpha(1-\delta)}{\delta}} Y=L \quad (5)$$

The left-hand side of equation (5) is the demand for labor whereas the right-hand side is the supply of labor. The market-clearing condition for capital, which is assumed to be in fixed supply, is as follows:

$$\left[\frac{\theta}{1-\theta}\right]^{1-\theta}\left[\frac{w}{r}\right]^{1-\theta} G+n(\mu)+\Psi\beta(1-\alpha)(1-\alpha)\left[\frac{w}{r}\right]^{1-\beta(1-\alpha)}\left[\frac{w}{p}\right]^{-\alpha} n^{\frac{-\alpha(1-\delta)}{\delta}} Y=K \quad (6)$$

The left-hand side of equation (6) is the demand for capital whereas the right-hand side is the supply of capital. The market clearing condition for the intermediate good is as follows:

$$\alpha\Psi\left[\frac{w}{r}\right]^{-\beta(1-\alpha)}\left[\frac{w}{p}\right]^{1-\alpha} n^{\frac{-\alpha(-\delta)}{\delta}} Y=nx \quad (7)$$

The left-hand side of the above equation is the demand for the intermediate good in Y industry whereas the right-hand side is the supply.

In order to focus on the role of exogenous changes in the supply of capital and labor on government size, this paper considers a situation where the economy is not involved in international trade. This implies that $C_y = Y/N$ is the amount of final good consumed by the representative consumer where N is the population size. Each consumer is endowed with one unit of labor which is supplied inelastically so that $L = N$. The utility function of the representative consumer is as follows where ϕ is a constant in the range [0,1];

$$U = C_y^{\phi} G^{1-\phi} \quad (8)$$

The above utility function shows that the entire amount of the public good is available to each consumer (i.e., G is a pure public good). The optimal supply of the public good is determined by the following condition which resembles the usual Samuelson rule (i.e., $\Sigma MRS = MRT$[6]):

$$L\left[\frac{1-\phi}{\phi}\right]\left[\frac{C_y}{G}\right]=\left\{\left[\frac{\theta}{1-\theta}\right]^{-\theta}+\left[\frac{\theta}{1-\theta}\right]^{1-\theta}\right\}\left[\frac{w}{r}\right]^{-\theta} w \quad (9)$$

[6] MRS and MRT respectively are the marginal rate of substitution and the marginal rate of transformation.

Equation (9) is a zero profit condition where the right-hand side is the unit cost and the left-hand side is the unit price of the public good. This condition shows that the government finances the cost of public good by means of Lindahl pricing.

This completes the description of the model where equations (2) to (9) are eight equilibrium conditions in eight endogenous variables; Y, G, X, U, n, w, r and p. K and L are exogenous variables. Equations (2) and (9) can be combined in to a single equation as follows:

$$\left[\frac{1-\theta}{\theta}\right]\left[\frac{Y}{G}\right]=\left\{\left[\frac{\theta}{1-\theta}\right]^{-\theta}+\left[\frac{\theta}{1-\theta}\right]^{1-\theta}\right\}\left[\frac{w}{r}\right]^{-\theta+\beta(1-\alpha)}\left[\frac{w}{p}\right]^{\alpha}n^{\frac{\alpha(1-\delta)}{\delta}} \tag{10}$$

Equations (3) and (4) can be used to derive the following equations:

$$x=\left[\frac{\delta}{1-\delta}\right]\left[\frac{\mu}{\lambda}\right]\left[\frac{w}{r}\right]^{-1} \tag{11}$$

$$\frac{w}{p}=\left[\frac{\delta}{\lambda}\right] \tag{12}$$

Equations (11) and (12), can be used to eliminate w/p and x from equations (5) to (7) and (10). The resulting equations involve only four endogenous variables (i.e., Y, G, n and w/r). It is clear that the equilibrium values of each variable and hence the government size depends on the supply of labor and capital. The size of government in the present study is measured by G-Y ratio.

3. Exogenous changes in the supply of inputs

This section deals with the impact of exogenous changes in the supply of labor and capital. Changes in the supply of labor and capital in the present case can also be attributed to international factor mobility.[7] The impact of an exogenous increase in labor supply on production of the intermediate good, the number of varieties produced and relative size of government is as follows:

$$\left[\frac{\partial x}{\partial L}\right]\left[\frac{L}{x}\right]=-\left[\frac{\partial\left(\frac{w}{r}\right)}{\partial L}\right]\left[\frac{L}{\left(\frac{w}{r}\right)}\right]=\frac{1}{1-\beta(1-\alpha)}>0 \tag{13}$$

[7] There is no trade or factor mobility in the initial equilibrium.

$$\left(\frac{\partial n}{\partial L}\right)\left(\frac{L}{n}\right)=0 \tag{14}$$

$$\left[\frac{\partial\left(\frac{G}{Y}\right)}{\partial L}\right]\left[\frac{L}{\left(\frac{G}{Y}\right)}\right]=\frac{\beta(1-\alpha)-\theta}{1-\beta(1-\alpha)} \tag{15}$$

Equation (13) shows that there is a positive relationship between the production of each variety of the intermediate good and the supply of labor. An increase in the supply of labor decreases wage-rental ratio, which decreases the marginal cost of production and hence the production of each variety increases. Equation (14) shows that there is no relationship between the supply of labor and the number of varieties produced which is consistent with the results reported by Rivera-Batiz and River-Batiz [1991]. Equation (15) shows that an increase in the supply of labor increases (decreases) the relative size of government if the share capital in the final good sector is larger than the share of capital in the public good sector. It is interesting to note that in the present case, irrespective of relative factor intensity, there is a positive relationship between the supply of labor and production of the public and final good.

The impact of an exogenous change in the supply of capital on production of the intermediate good, the number of varieties produced and relative size of government is as follows:

$$\left[\frac{\partial x}{\partial K}\right]\left[\frac{K}{x}\right]=-\left[\frac{\partial\left(\frac{w}{r}\right)}{\partial K}\right]\left[\frac{K}{\left(\frac{w}{r}\right)}\right]=\frac{-1}{1-\beta(1-\alpha)}<0 \tag{16}$$

$$\left(\frac{\partial n}{\partial K}\right)\left(\frac{K}{n}\right)=\frac{-1}{1-\beta(1-\alpha)}>0 \tag{17}$$

$$\left[\frac{\partial\left(\frac{G}{Y}\right)}{\partial K}\right]\left[\frac{K}{\left(\frac{G}{Y}\right)}\right]=\left[\frac{\theta-\beta(1-\alpha)-\frac{\alpha(1-\delta)}{\delta}}{1-\beta(1-\alpha)}\right] \tag{18}$$

Equation (16) shows that the relationship between the supply of capital and the production of each variety of the intermediate good is positive. This follows from the fact that there is a positive relationship between the wage rate and supply of capital, which increases the marginal cost, and hence production of each variety decreases. The resulting impact on the price of the intermediate good leads to an increase in the number of varieties produced which is consistent with Rivera-Batiz and Rivera-Batiz [1991]. Equation (18) shows that an increase in the supply of capital decreases the size of government only if the share of capital in the final good sector is equal to (or larger than) the share of capital in the public good sector. It is clear that the size of specialization-based externality can influence the direction of the relationship between the supply of capital and the size of government. An increase in the supply of capital increases the size of government only if $\theta-\beta(1-\alpha)>\alpha(1-\delta)/\delta$, which is not possible unless the share of capital in the public good sector is larger than the final good sector.

Equations (15) and (18) can also be used to argue that there is a negative relationship between the size of the country and the size of government as follows:

$$\left[\frac{\partial\left(\dfrac{G}{Y}\right)}{\partial K}\right]\left[\frac{K}{\left(\dfrac{G}{Y}\right)}\right]_{\Delta K=\Delta L}=\frac{-\left[\dfrac{\alpha(1-\delta)}{\delta}\right]}{1-\beta(1-\alpha)}<0 \tag{19}$$

It is clear from equation (19) that the relationship between the size of government and the size of the country depends on the size of external economies to the final good producers. In other words, a larger country is likely to have a smaller government.

3.1. Welfare implications

The relationship between the supply of primary inputs and welfare in the presence of a public good and monopolistic competition is as follows:

$$\left[\frac{\partial U}{\partial L}\right]\left[\frac{L}{U}\right]=\frac{(1-\phi)(1-\theta)}{1-\beta(-\alpha)}>0 \tag{20}$$

$$\left[\frac{\partial U}{\partial K}\right]\left[\frac{K}{U}\right]=\frac{\phi\left[\beta(1-\alpha)+\dfrac{\alpha(1-\delta)}{\delta}\right]+\theta(1-\phi)}{1-\beta(1-\alpha)}>0 \tag{21}$$

Equations (20) and (21) indicate that there is a positive relationship between the supply of primary factors and welfare. In the absence of the specialization-based externality the impact of an increase in the supply of capital on welfare would be smaller. This result follows from the fact that an increase in the supply of labor does not change the number varieties of the intermediate good produced.

4. Concluding remarks

A number of existing studies have considered the size of government and its impact on economic growth. This paper focuses on the impact of exogenous changes in the supply of inputs, such as capital and labor, on the size of government and welfare in the presence of monopolistic competition. The paper utilizes a simple general equilibrium model of an economy that produces one final good and one public good. The final good is produced by means of capital, labor and a large number of varieties of an intermediate good. The intermediate good and the public goods are produced by means of capital and labor. The production of the intermediate good is subject to internal economies of sale, which gives rise to monopolistic competition and also results in a specialization-based externality to the producers of the final good. The size of government is measured by the ratio of the public and the final good produced.

It is shown that an increase in the supply of labor increases the relative size of government if the share of capital in the final good sector is larger than the share of capital in the public good sector. On the other hand, the impact of an increase in the supply of capital on relative size of government is influenced by the size of specialization-based externality. Specifically, an increase in the supply of capital can decrease the relative size of government even if the share of capital in the final good sector is equal to the share of capital in the public good sector. It is also shown that an increase in the overall size of the country decreases the size of government as long as the specialization-based externality is not zero. Finally, it is shown that in the presence of monopolistic competition and a public good, an increase in the supply of either primary input increases the welfare of the representative consumer.

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