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Fiscal Policy in a Small Open Economy with Endogenous Labor Supply*

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Utilizing a two-sector general equilibrium model with endogenous labor supply, we are going to show how fiscal spending can affect the labor supply and the price of nontraded good in a small open economy. Other than the marginal propensity to consume final goods, this study will show that empirical research to determine (a) the marginal propensity to supply labor, (b) the substitutability between the consumption of leisure and nontraded good, (c) the elasticity of supply with respect to wage rate, is also essential if we want to evaluate the positive impacts of fiscal policy in an economy with endogenous labor supply.

I. Introduction

Fiscal policy has been a popular macroeconomic policy in both developing and developed countries. Its economic effects have received attention by economists because of their importance. Some studies, e.g., Helpman (1976, 1977), Chao and Yu (1990, 1993), have shown that the implications of fiscal policy in a multi-sector economy are significantly different from a standard one good macroeconomy. Utilizing a two-sector (tradable and nontradable) general equilibrium model, we are going to study the effects of fiscal spending in a small open economy with endogenous labor supply.

There are two reasons for us to study the policy implications in the presence of endogenous labor supply. First, it is shown in the labor literature, e.g., Johnson and Layard (1986), that variable labor supply is a more reasonable assumption to describe the intermediate or long run phenomena. Hence, our analysis can provide the long run policy implications with endogenous labor supply which has been neglected in the literature.[1] Second, Mayer (1991) shows that the presence of endogenous labor supply may generate some "perverse" responses which can occur in a stable general equilibrium.[2]

Using a model similar to Mayer (1991), the policy effects on the relative price of nontraded good will also be studied. According to Stolper-Samuelson result, the change of this relative price affects the factor rewards and then the income distribution which has been shown to be

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1. Barry (1987) and Devereux (1987) study the long run implications of fiscal policy in a two- sector model. However, they only endogenize the capital supply but not the labor supply.
2. Neary (1978), Yu, Ingene (1986) and Fung (1994) also reach similar results in different economic environments with variable labor supply.

important in the literature of endogenous policy, see Magee, Brock and Young (1989). On the other hand, this relative price is also interpreted as the real exchange rate which has important policy implications in developing countries, see Edwards (1989).

The paper is organized as follows. Section II sets up a two-sector general equilibrium model with endogenous labor supply. Section III examines the implications of an increase in the government spending (on either the nontradable or the tradable). Its effects on the equilibrium labor supply and the relative price of nontradable are derived and discussed. Section IV provides some concluding remarks.

II. Basic Model

Consider a small open economy in which two types of commodities are produced: one nontraded good (X) and a composite of traded goods (Y). We assume quotas, taxes, subsidies, or tariffs are not levied on traded goods. Since the small open economy (SOE) has no market power in the world markets for traded goods, the price of the composite of traded goods is not affected by the SOE's economic conditions and thus it is normalized to be one. We use p to denote the price of nontraded good relative to the composite of traded goods in the SOE. Both X and Y are produced by utilizing labor and capital, which production functions are assumed to be linearly homogeneous. Markets are perfectly competitive and factors are fully mobile between sectors. The total value of the economy's output (NI) in terms of the composite of traded goods is:

$$NI = pX+Y = R(p, L, \overline{K}), \tag{1}$$

where $R(p, L, \overline{K})$ is the revenue function,[3] L the labor supply, and $\overline{K}$ the capital endowment of the economy.[4] Since there is no distortion in the SOE, the following properties of the revenue function can be derived: $R_p = X$, $R_{pp} = \partial X / \partial p$, $R_L = w$ (the wage rate), $R_K = r$ (the rental rate of capital), $R_{LL} = 0$, $R_{pL} = \partial X / \partial L = \partial w / \partial p$.

There is a representative private agent in the SOE, who lives for one period and is endowed with $\overline{K}$ units of capital and $\overline{L}$ units of labor effort.[5] We define the agent's utility on the consumption of two private goods (C_X and C_Y) and the consumption of leisure (H). All of the nontraded good, the composite of traded goods and the consumption of leisure are assumed to be normal goods. The expenditure function for the representative consumer is given by:

$$E(p,U,L) = \min\{C_X+pC_{YP} \mid U=U(C_X, C_Y, \overline{L}-L)\}, \tag{2}$$

where U is the utility level of the representative private agent. Assuming all usual properties

3. See Dixit and Norman (1980) for properties of revenue function with endogenous labor supply.
4. Capital and labor are assumed to be sectorally mobile. The allocation is determined by the first order conditions of firms's optimization problem and the full employment conditions. When either one of the primary factors is immobile, the model becomes a specific factor model which is discussed in Jones (1971).
5. Also see Dixit and Norman (1980) for properties of expenditure function with endogenous labor supply.

of the utility function are satisfied, the following properties of the expenditure function [6] can be derived: $Ep=C_X$, $E_L>0$, $E_U>0$, $E_{pp}<0$, $E_{LL}>0$, $E_{UU}<0$, $E_{pU}>0$, and $E_{LU}>0$.

We assume that the government expenditure (G) is financed by taxes collected from the private agent such that the government budget is balanced:

$$G = pG_X + G_Y = T, \tag{3}$$

where T is the direct taxes imposed on the private agent, and $G_X(G_Y)$ is the government demand for the nontraded good (the composite of traded goods).

Following Helpman (1976, 1977) and Chao and Yu (1990), the government spending, G, is a pure government consumption which does not include the provision of public goods or public inputs. Since we do not intend to model the government behavior in this simple model, G_X and G_Y are taken as exogenous policy variables.

The SOE's general equilibrium is characterized by the following three equations:

$$E(p,U,L) = R(p,L,\overline{K}) - pG_X - G_Y, \tag{4}$$

$$E_p(p,U,L) + G_X = R(p,L,\overline{K}), \tag{5}$$

$$E_L(p,U,L) = R_L(p,L,\overline{K}), \tag{6}$$

(4) implies that the consumer's expenditure equals his/her disposable income. (5) implies that the equilibrium is reached in the market for the nontraded good, in which the consumer's demand (C_X) plus the government demand (G_X) equals the production (X) in the SOE. (6) implies that the reservation wage of the private agent (E_L) equals the wage offered by firms (R_L). The system consists of equations ((4) - (6)) containing three endogenous variable: p, L, and U and two exogenous policy variables: G_X and G_Y. According to the assumed properties of the revenue function and the expenditure function plus equations (4) - (6), the total differentiation of the system yields the following equations:

$$E_U dU = -(pdG_X + dG_Y), \tag{7}$$

$$(R_{pp} - E_{pp})dp = dG_X + (E_{Lp} - R_{Lp})dL + E_{pU}dU, \tag{8}$$

$$E_{LL}dL = (R_{Lp} - E_{Lp})dp - E_{LU}dU. \tag{9}$$

One immediate result from (7) is that *an increase in the government spending on either the nontraded good or the composite of traded goods will reduce the private agent's welfare since the fiscal expansion is financed by the agent*. Equation (8) describe the determinants of

6. Income distribution is not discussed in this model and then there is only one representative agent who is both capitalist and laborer. On the other hand, the model is a one-period model; however, the framework and basic properties of a two-period model are presented in the Appendix.

the nontraded good's price in the general equilibrium. There are several forces acting on the equilibrium price of nontraded good when the government demand for final goods is increased. The first term, dG_X, on the right hand side of (8) represents the direct demand effect on the price which is positive for an increase in the government demand for nontraded good. The second term, $E_{Lp}dL$, represents a substitution effect on the price. An increase in the SOE's labor supply (and hence a reduction in the consumption of leisure) has a positive (negative) substitution effect if the consumption of leisure and nontraded good are substitutes (complements), i.e., $E_{Lp} > (<) 0$. Opposite results can be derived if there is a reduction in the SOE's labor supply. Beside these, there is a "Rybczynski" effect, which is represented by $-(R_{Lp}dL)$, on the price if the SOE's labor supply is endogenized. A rise in the labor supply has a positive (negative) effect on the supply of the nontraded good and then a negative (positive) effect on the good's price if the good is labor (capital) intensive, i.e., $R_{Lp} > (<) 0$. Again, opposite results can be derived if there is a reduction in the SOE's labor supply. The last term, $E_{pU}dU$, represents the negative income effect of the increase in the government spending on the good's price since the spending is financed by the direct taxes imposed on the agent. The net change in the equilibrium price of nontraded good depends on the interaction of the above mentioned forces.

Several forces, as shown in (9), act on the SOE's equilibrium labor supply when the government demand for final goods is increased. The first term, $R_{Lp}dp$, represents the wage effect since the wage rate is the price of consuming leisure. The wage effect on labor supply is positive (negative) if there is a rise (reduction) in the wage rate induced by a rise (fall) in the nontraded good's price provided that the good is labor intensive. Opposite results can be derived when the good is capital intensive. The second effect is denoted as the substitution effect, as represented by $-(E_{Lp}dp)$, which has a positive (negative) effect on the SOE's labor supply of an increase in the nontraded good's price if the consumption of leisure and nontraded good are complements (substitutes). The last term, represented by $-(E_{LU}dU)$, is denoted as the taxation effect. Upon the assumption that leisure is a normal good, the income effect on labor supply is positive when the agent's disposable income is decreased by the rise in taxes induced by the increase in the government spending. The net effect on labor supply depends on the resultant of these different forces.

The positive implications on the nontraded good's price and the equilibrium labor supply can be obtained by substituting (7) into (8) and (9):

$$(E_{pp} - R_{pp})dp + (E_{Lp} - R_{Lp})dL = -[(1 - m_X)dG_X - (m_x/p)dG_Y], \tag{10}$$

$$(E_{Lp} - R_{Lp})dp + E_{LL}dL = -(E_{LL}/w)m_L(pdG_X + dG_Y), \tag{11}$$

where $0 < m_X \equiv p\partial C_X / \partial E = pE_{pU}/E_U < 1$ is the marginal propensity to consume nontraded good and $-1 < m_L \equiv w\partial L / \partial E = -(wE_{LU})/(E_{LL}E_U) < 0$ is the marginal propensity to supply labor. Given our assumptions on the expenditure function and the revenue function, the stability of the system is ensured.

III. Fiscal Spending, Labor Supply, and Real Exchange Rate

We are going to investigate how the resource allocation will be affected if there is a change in either G_X or G_Y. First, we study how the policy change will affect the SOE's equilibrium labor supply. Based on (10) and (11), the following results can be derived:

$$\frac{dL}{dG_X} = -\frac{w}{p\gamma\eta_{Lw}}\left\{\left(\frac{pX}{wL}\right)am_L+(1-m_X)(\eta_{Lp}+\eta_{Lw}\psi_{wp})\right\}, \tag{12}$$

$$\frac{dL}{dG_Y} = -\frac{w}{p^2\gamma\eta_{Lw}}\left\{\left(\frac{pX}{wL}\right)am_L-m_X(\eta_{Lp}+\eta_{Lw}\psi_{wp})\right\}, \tag{13}$$

where $\gamma=E_{LL}(E_{pp}-R_{pp})-(E_{Lp}-R_{Lp})^2<0$, $\eta_{Lp}=(p/L)(\partial L/\partial p)=-pE_{Lp}/(LE_{LL})$ is the compensated elasticity of labor supply with respect to the nontraded good's which is positive (negative) if the consumption of leisure and nontraded good are complements (substitutes), $\eta_{Lw}=(w/L)(\partial L/\partial w)=w/(LE_{LL})>0$ is the compensated elasticity of labor supply with respect to wage rate, $a=(C_X/X)\eta_{Xp}-\Psi_{Xp}$, $\eta_{Xp}=(p/C_X)(\partial C_X/\partial p)=pE_{pp}/E_p<0$ is the compensated elasticity of the demand for nontraded good with respect to its own price, $\Psi_{Xp}=(p/X)(\partial X/\partial p)=pR_{pp}/R_p>0$ is the own price elasticity of the supply of nontraded good, and $\Psi_{wp}=(p/w)(\partial w/\partial p)=pR_{Lp}/R_L>0$ is the elasticity of wage with respect to the nontraded good's price which is positive (negative) if the production of nontraded good is labor (capital) intensive. Based on (12) and (13), the following proposition can be derived:

Proposition 1: An increase in the government demand for the nontraded good (the composite of traded goods) will lead to an increase in the equilibrium labor supply if the nontraded good is labor (capital) intensive and a complement (substitute) for leisure in consumption. Otherwise, the effect is indeterminate.

The intuition behind the proposition is explained as follows. The increase in the government for either the composite of traded goods or nontraded good will be financed by an increase in the direct taxes imposed on the private agent. According to (11), the policy change, holding the nontraded good's price constant, has a positive income effect on the SOE's labor supply. On the other hand, an increase in the government demand for nontraded good (the composite of traded goods), according to (10), has a direct positive (negative) effect on the nontraded good's price in the economy if the total labor supply remains unchanged. This initial rise (reduction) in the nontraded good's price has a positive substitution effect on labor supply if the consumption of leisure is a complement (substitute) for the consumption of nontraded good. Additionally, the rise (reduction) in the nontraded good's price will increase the wage rate if the production of nontraded good is labor (capital) intensive. The induced increase in wage rate also has a positive wage effect on labor supply. In this case, the income effect, substitution effect and wage effect are working in the same direction to increase the economy's labor supply. If the mentioned conditions are not satisfied, these effects may work in different directions on labor

supply, giving an ambiguous net effect.

Second, we turn to study the effect on the price of nontraded good in the economy. Based on (10) and (11), the following results can be derived:

$$\frac{dp}{dG_X} = -\frac{E_{LL}}{\gamma \eta_{Lw}} \{ (1-mx)\eta_{Lw} + m_L(\eta_{Lp} + \eta_{Lw} + \Psi_{wp}) \}, \tag{14}$$

$$\frac{dp}{dG_Y} = \frac{E_{LL}}{p\gamma \eta_{Lw}} \{ mx\eta_{Lw} - m_L(\eta_{Lp} + \eta_{Lw} + \Psi_{wp}) \}. \tag{15}$$

Based on (14) and (15), the following proposition can be derived:

Proposition 2: An increase in the government demand for the composite of traded goods (the nontraded good) will decrease (increase) the price of nontraded good if the nontraded good is labor (capital) intensive and a complement (substitute) for leisure in consumption. Otherwise, the effect is indeterminate.

The intuition behind the proposition is explained as follows. According to (10), an increase in the government demand for the nontraded good (the composite of traded goods), holding labor supply constant, has a primary positive effect on the nontraded good's price since the combination of the income and direct demand effects are positive. As discussed in Proposition 1, there is also a change in the equilibrium labor supply which has a "Rybczynski" effect on the supply of nontraded good. If nontraded good is labor (capital) intensive and a substitute (complement) for leisure consumption, labor supply will be increased according to Proposition 1. Consequently, the "Rybczynski" effect, opposite to the primary effect, has a negative (positive) impact on the equilibrium price of nontraded good. Proposition 2 provides the condition under which the net effect will be going to the same direction as the primary effect on the nontraded good's price. Accordingly, the wage rate is decreased (is increased) while the rental rate of capital is increased (decreased). When the mentioned conditions are not satisfied, the implications on the nontraded good's price and then the factor prices will be ambiguous.

IV. Concluding Remarks

We have studied how the increase in the government spending on final good (traded or nontraded goods) affects the resource allocation in a small open economy with endogenous labor supply. We have shown how the equilibrium labor supply and the relative price of nontraded good are affected. Other than the marginal propensity to consume final goods, we suggest that empirical research to determine (a) the marginal propensity to supply labor, (b) the substitutability between the consumption of leisure and nontraded good, (c) the elasticity of labor supply with respect to wage rate, is also essential if we want to evaluate the impacts of fiscal policy in a small open economy.

Appendix: A Two-Period Model

This appendix extends the one-period model to a two-period model. Now the representative consumer maximizes a two-period utility function defined over consumption and leisure in each period. The expenditure function for the representative consumer is

$$E(p^1, \delta p^2, L^1, L^2, U) = \min \sum_{i=1}^{2} \delta^{i-1}(p^i C_X^i + C_Y^i) \mid U(\cdot) \geq U \ , \tag{16}$$

where $U(\cdot) = U(C_X^1, C_X^2, C_Y^1, C_Y^2, \overline{L} - L^1, \overline{L} - L^2)$ is the welfare function and the superscript i (i=1, 2) refers to period i and $\delta = \frac{1}{1+r}$, where r is the (constant) interest rate. The revenue function for period i is

$$R^i(p^i, L^i, \overline{K}) = p^i X^i + Y^i, \ i = 1, 2. \tag{17}$$

The government budget constraint is

$$\sum_{i=1}^{2} \delta^{i-1}(p^i G_X^i + G_Y^i) = \sum_{i=1}^{2} \delta^{i-1} T^i. \tag{18}$$

The equilibrium conditions are

$$E(p^1, \delta p^2, L^1, L^2, U) = \sum_{i=1}^{2} \delta^{i-1}[R^i(p^i, L^i, \overline{K}) - (p^i G^X + G_Y^i)], \tag{19}$$

$$E_i(p^1, \delta p^2, L^1, L^2, U) + G_X^i = R_1^i(p^i, L^i, \overline{K}), \ i = 1, 2, \tag{20}$$

$$E_{(i+2)}(p^1, \delta p^2, L^1, L^2, U) = R_2^i(p^i, L^i, \overline{K}), \ i = 1, 2. \tag{21}$$

Equation (19) says that in equilibrium the consumer's income and expenditure must be equal. Equation (20) is the nontraded good market clearing condition. Equation (21) is the labor market clearing condition. To see the effects of fiscal policy, we totally differentiate equations (19)-(21). Then we have the following

$$E_5 dU = -\sum_{i=1}^{2} \delta^{i-1}(p^i dG_X^i + dG_Y^i), \tag{22}$$

$$(R_{11}^1 - E_{11})dp^1 = dG_X^1 + \delta E_{12} dp^2 + (E_{13} - R_{12}^1)dL^1 + E_{14} dL^2 + E_{15} dU, \tag{23}$$

$$(R_{11}^2 - \delta E_{22})dp^2 = dG_X^2 + E_{21} dp^1 + E_{23} dL^1 + (E_{23} - R_{12}^2)dL^2 + E_{25} dU, \tag{24}$$

$$(R^1_{22}-E_{33})dL^1=(E_{31}-R^1_{21})dp^1+\delta E_{32}dp^2+E_{34}dL^2+E_{35}dU, \tag{25}$$

$$(\delta R^2_{22}-E_{44})dL^2=E_{41}dp^1+\delta(E_{42}-R^2_{21})dp^2+E_{43}dL^1+E_{45}dU, \tag{26}$$

where E_i (E_{ij}) is partial the derivative of $E(\cdot)$ with respect to ith variable (jth variable) (i, j =1, 2, 3, 4, 5), and R_{ij} is the second-order derivative of $R(\cdot)$ with respect to ith and jth variables (i, j=1, 2). The above five equations, (22)-(26), can be used to solve the five unknowns: dp^1, dp^2, dL^1, dL^2 and dU.

Equation (22) is the counterpart of (7) in the one-period model. This equation implies a negative effect on the welfare of an increase in the government demand for the nontraded good or the composite of the traded goods in any period because, as in the one period model, the fiscal expansion is financed by the consumer. Therefore, the welfare effect of fiscal policy is the same as in the one-period model.

Equation (23) decomposes the effect on the first period's price of the nontraded good of an increase in the government demand for the final goods. Note that $(R^2_{11}-E_{11})>0$. The first term, dG^1_X, on the right hand side of (23) is the direct effect and the other terms are indirect effects. The direct effect is positive because an increase in the government demand for the nontraded good in the first period increases the price of the nontraded good in the first period. The second term, $\delta E_{12}dp^2$, is an indirect effect through the price of the nontraded good in the second period. E_{12} represents a substitution effect. If the nontraded goods in the first and second periods are substitutes ($E_{12}>0$), then an increase in the price of the nontraded good in the second period has a positive effect on the price in the first period. Otherwise, the increase in the second period's price has a negative effect on the first period's price. The third term, $(E_{13}-R^1_{12})dL^1$, is an indirect effect through the first period's labor supply. This effect includes two parts. The first part, $E_{13}dL^1$, is again a substitution effect. If the first period's nontraded good and leisure are substitutes (complements) ($E_{13}>(<)0$), then an increase in the first period's labor supply increases (decreases) the first period's price. The second part, $-R^1_{12}dL^1$, is a "Rybczynski" effect. If the nontraded good is labor (capital) intensive ($R^1_{12}>(<)0$), then an increase in the first period's labor supply decreases (increases) the first period's price. The fourth tern, $E_{14}dL^2$, is another substitution effect. If the first period's nontraded good and the second period's leisure are substitutes (complements) ($E_{14}>(<)0$), then an increase in the second period's labor supply raises (reduces) the first period's price. The last tern, $E_{15}dU$, is a negative income effect ($E_{15}>0$). Compared with its counterpart (8) in the one-period model, the equation involves more forces that affect the price of the nontraded good in the first period. In addition to the direct effect and income effect, there are more channels through which increases in the government demand for the final goods can affect the price of the nontraded good in the first period. More specifically, in the two-period model, the substitutability between two different period's goods also plays an important role.

Similarly, equations (24), (25) and (26) represent respectively the effect on the second period's price of the nontraded good, and the labor supply in the first and second period of increases in the government demand for the final goods through various channels. Again, they are much more complicated than their counterparts in the one-period model.

Therefore, other than the welfare effect, which is unambiguously negative as in the one-period model, the net effects of increases in government demand for the final goods on the price of the nontraded good and labor supply in each period are ambiguous because they depend on the interactions of various forces, which include not only the substitutability between different goods in the same period, as in the one-period model, but also the substitutability between different period's goods.

Notice that Ricardian Equivalence Theorem applies here. In this two-period model, the government spending in the first period can be financed by either taxes or bonds.[7] Tax financing and bond financing are equivalent.

7. We do not explicitly consider government bonds in the model. Government bonds can be easily introduced into the model.

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