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Payroll Taxes, Wealth and Employment in Neoclassical Theory: Neutrality or Non-neutrality?

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1. Introduction

The classroom exercise that temporarily below-normal tax rates on labor this year, when merged with the prospect of reversion to normal rates next year, will encourage households to squeeze more work into this year and to work less in future years is well-founded. This proposition was recently tested anew on Icelandic data and performed well (Bianchi, Gudmundsson and Zoega (2001)). But would a permanent cut in tax rates on labor encourage more work permanently—with no diminution of effectiveness? Con-

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versely, does a permanent increase in tax rates on labor cause a permanent decline in hours worked?

Recently, Prescott (2004) argued that the substantial decline in labor supply of French, Germans and Italians in the past three decades could be fully explained by the increase in their effective marginal tax rates on labor. Americans today work 50 percent more than their counterparts in the Big Three Continental countries although Europeans worked more than Americans in the early 1970s. However, Faggio and Nickell (2006) question the adequacy of this explanation by pointing out a puzzle. Although the Scandinavian countries (Denmark, Finland and Sweden) have increased their marginal tax rates on labor every bit as much as the Big Three Continental countries, their labor input has not declined by as much over the past three decades and is now about 10 percent below that in the Anglo-Saxon countries.

In this paper, we study the role played by wealth adjustment in response to changes in tax rates on labor in the context of the neoclassical model widely adopted by supply-siders. We show that what matters for the amount of labor supplied is the after-tax wage rate relative to income from wealth (see Hoon and Phelps (1996)). If tax rates were increased permanently this year, there is initially a strongly negative effect on labor supplied. But there would also be a negative effect on saving and thus on wealth next year and beyond. In the long run, wealth could tend to decrease in the same proportion as after-tax wages. The effect on work would vanish and thus labor taxes would be neutral for employment in the long run.

Wealth adjustment acts to offset the negative effect of labor taxes so labor supply increases as workers feel poorer despite leisure becoming relatively cheaper. We show that wealth adjustment fails to fully offset the negative effect of labor taxes in the long run if the country in question is large in the international capital market that its reduced saving pulls up the world interest rate. The after-tax wage to income from wealth ratio is permanently

reduced by the higher interest rate. In a small open economy that takes the external rate of interest as given, however, wealth adjustment fully offsets the negative effect of a payroll tax increase used to finance government purchases so there is neutrality in the long run.

We must proceed cautiously, however. If the payroll tax increase were used instead to finance government transfers—social assistance and social insurance, which constitute social wealth—the gradual decrease in private wealth is unable to fully offset the increase in social wealth even if the external rate of interest is exogenously given. Then the after-tax wage to income from *both* private and social wealth suffers a permanent decline so the reduction in labor input has a permanent component. The issue is an empirical one.

The rest of the paper is organized as follows. As a pedagogic device, section 2 develops the textbook model of the effects of labor taxes on leisure and hours worked. Section 3 then develops the general-equilibrium dynamic model of the small open economy. Section 4 studies a large open economy that has an influence on the external rate of interest. Concluding remarks are in section 5.

2. The Textbook Model

To understand the role played by wealth adjustment in offsetting the negative effect of labor taxes on labor supply, it is helpful to review the textbook model. In this model, the representative household maximizes $U(C, \bar{L} - L)$ subject to $C + v^h(\bar{L} - L) = v^h\bar{L} + y^w$, where C is consumption, $\bar{L}$ is the fixed time endowment, L is the number of hours worked (so $\bar{L} - L$ is leisure), v^h is hourly after-tax wage and y^w is unearned income, that is, income from private wealth. Note that $v^h\bar{L}$ is the potential wage earning if all the time endowment is devoted to paid work in the market and is called the full wage income.

In the standard exercise, an increase in the payroll tax reduces v^h, holding

other things constant, including the unearned income y^w. The fall in v^h produces the standard income and substitution effects. If the latter effect dominates, which we take to be the case, the increase in marginal tax rate on labor income discourages labor supply. In terms of Figure 1, the household moves from the initial equilibrium point E_1 to E_2. This, however, is only the initial impact of higher payroll taxes. As the household's take-home pay is reduced, personal savings fall and wealth decumulates. As unearned income, y^w, gradually falls, the budget line (with a gentler slope reflecting the reduced hourly after-tax wage) shifts toward the origin. Could the unearned income fall so as to fully restore the number of hours worked, that is, to move the household to point E_3? To answer this question, we need a general-equilibrium model that endogenizes the process of wealth accumulation. We set out to do this in the next two sections, handling first the case of a small open economy that takes the external rate of interest as given and then the case of a large open economy whose asset accumulation has an influence on the external rate of interest.

3. The Small Open Economy

The production structure of the economy is described as follows. There are two goods: one traded and the other a non-traded good. The traded good, following Obstfeld (1989), is a Solow good that can be used either for consumption or for addition to the capital stock. The non-traded good is a pure consumption good. We choose the traded good as numeraire.

Demographics are described as in Blanchard (1985). Agents derive utility from consumption and leisure, have finite lives and face an instantaneous probability of death θ that is constant throughout life. Let $c(s,t)$ denote consumption at time t of an agent born at time s, $l(s,t)$ the number of hours worked, $w(s,t)$ non-human wealth, and $h(s,t)$ human wealth. Note that $c(s,t) \equiv c^T(s,t) + pc^N(s,t)$, where $c^T(s,t)$ is consumption of the traded

good, $c^N(s,t)$ is consumption of the non-traded good and p is the relative price of the non-traded good. Also let $y^g(s,t)$ be entitlement received and $v^h(s,t)$ be the after-tax real hourly wage (both measured in units of the traded good), where v^h is related to the hourly labor cost to the firm, v^f, by $v^f \equiv (1+\tau)v^h$, τ being the payroll tax rate. We make the assumption that workers of all age cohorts have the same productivity, face the same tax rate and receive the same entitlement so $v^h(s,t) = v^h(t)$ and $y^g(s,t) = y^g(t)$ for all s. We let $r(t)$ denote the real instantaneous short-term interest rate and $\rho(>0)$ the pure rate of time preference.

The agent maximizes

$$\int_t^\infty \{\log[(c^T(s,\kappa))^\gamma (c^N(s,\kappa))^{1-\gamma}] + B\log(\bar{L} - l(s,\kappa))\} \exp^{-(\theta+\rho)(\kappa-t)}\, d\kappa,$$

subject to

$$\frac{dw(s,t)}{dt} = [r(t)+\theta]w(s,t) + v^h(t)l(s,t) + y^g(t) - c(s,t)$$

and a transversality condition that prevents agents from going indefinitely into debt. Here, $B \equiv$ parameter > 0 measures the value of leisure relative to consumption. The solution to the agent's problem is given by

$$\begin{aligned} c(s,t) &= (\theta+\rho)[h(s,t) + w(s,t)], \\ \frac{\bar{L} - l(s,t)}{c(s,t)} &= \frac{B}{v^h(t)}, \end{aligned}$$

where human wealth is given by

$$h(s,t) = \int_t^\infty [l(s,\kappa)v^h(\kappa) + y^g(\kappa)] \exp^{-\int_t^\kappa [r(\nu)+\theta]d\nu}\, d\kappa.$$

Aggregating across all individuals, dropping the time index t and denoting per capita aggregate variables by capital letters, we obtain

$$C = (\theta+\rho)[H+W], \tag{1}$$

$$\frac{BC}{\bar{L}-L} = v^h, \tag{2}$$

$$\dot{H} = (r+\theta)H - (Lv^h + y^g), \tag{3}$$

$$\dot{W} = rW + Lv^h + y^g - C, \tag{4}$$

where a dot over a variable denotes its time derivative. We note that although every worker faces the same hourly pay, the fact that the members of the labor force are of different ages means that their wealth levels are different, and consequently, the number of hours worked will be different across the different age cohorts.

The government is assumed to run a balanced-budget policy and, for simplicity, we set government debt to zero. The government budget constraint can be expressed as

$$\tau L v^h = y^g + G, \tag{5}$$

where $G \equiv G^T + pG^N$ is the per capita level of government purchases, and tax revenue collected is from payroll taxation. Assuming that domestic residents own all the capital stock, K, and assuming free international lending and borrowing, $W \equiv K + F$, where F is the holding of net foreign assets. (Residents can always borrow from abroad to achieve this portfolio allocation.) Taking the time derivative of (1), and using (3) and (4), we obtain

$$\dot{C} = (\theta+\rho)[rW + (r+\theta)H - C]. \tag{6}$$

Using (1) in (6), we obtain, after re-arrangement of terms,

$$\frac{\dot{C}}{C} = (r-\rho) - \frac{\theta(\theta+\rho)[K+F]}{C}. \tag{7}$$

Let us now lay out the conditions satisfied by the production side of the economy. We assume that the non-traded good is the relatively labor-intensive good.[1] For simplicity, we suppose that producing a unit of the non-

[1]Obstfeld (1989) notes that empirical evidence gives support to the assumption that non-tradables, taken as an aggregate, are relatively labor-intensive compared to tradables and cites Kravis and Lipsey (1983).

traded good requires Λ_N^{-1} units of labor. The traded good constant-returns-to-scale production function is given by $F(K, L_T)$, where L_T is employment in the traded-good sector. Profit maximization gives

$$v^f = p\Lambda_N = f(k_T) - k_T f'(k_T), \tag{8}$$

$$r = f'(k_T), \tag{9}$$

where $k_T \equiv K/L_T,\ f'(k_T) > 0;\ f''(k_T) < 0$.

From (8), we see that k_T is positively related to p and in conjunction with (9), $p = \phi(r);\ \phi'(r) < 0$. For the small open economy, $r = r^*$(exogenously given) > 0. Consequently, the relative price of the non-traded good is pinned down by the external rate of interest. To determine the domestic stock of capital, we use the market-clearing condition for the non-traded good sector:

$$\frac{(1-\gamma)C}{p} + G^N = \Lambda_N[L - \frac{K}{k_T}]. \tag{10}$$

The pure case of government purchases with no transfers

To understand the long-run effects of labor taxes, it is convenient to first focus on the steady state before turning to the dynamics. In a steady state with no government transfers, aggregate human wealth, H, equals $v^h L/(r + \theta)$. Non-human private wealth is given by $K + F$ so nonwage income (or unearned) income from private wealth is given by $y^w = (r+\theta)(K+F)$, which takes the form of annuity income, $\theta(K + F)$ being the component called the actuarial dividend. Using these relations and (1) in (2), and rearranging, we obtain the steady-state labor-supply relation in manhours:

$$\frac{L}{\bar{L}} = \frac{1 - B\left[\frac{\theta+\rho}{r+\theta}\right]\left(\frac{v^h \bar{L}}{y^w}\right)^{-1}}{1 + B\left[\frac{\theta+\rho}{r+\theta}\right]}. \tag{11}$$

We also note that in a steady state, (7) can be expressed as

$$r = \rho + \theta \left[\frac{1}{1 + \left(\frac{v^h \bar{L}}{y^w}\right)\left(\frac{L}{\bar{L}}\right)} \right]. \tag{12}$$

Suppose that the government now finances increased purchases (ΔG) by raising payroll taxes. The key result from (11) and (12) is that with the interest rate pinned down by the exogenously given external rate, $r = r^*$, $(v^h \bar{L}/y^w)$ and $L/\bar{L}$ are determined independently of the payroll tax rate, τ. Since the external interest rate pins down the demand wage offered by the firm, v^f, the after-tax wage $v^h \equiv v^f/(1+\tau)$ is reduced by the increase of labor taxes. In the long run, however, unearned income from private wealth, y^w, falls by the same proportion so as to leave the wage to nonwage income ratio unchanged. Hence labor taxes raised to finance government purchases are neutral for employment in the long run. In effect, government purchases end up crowding out private consumption one for one.

To understand the dynamics, it is useful to note from (2) that labor supply is uniquely pinned down by $\tilde{C} \equiv C/v^h$. We write $L = \mu(\tilde{C}); \mu'(\tilde{C}) < 0$. Using (7), we can write in terms of $\tilde{C}$,

$$\frac{\dot{\tilde{C}}}{\tilde{C}} = (r - \rho) - \frac{\theta(\theta + \rho)[K + F]}{\tilde{C} v^h}. \tag{13}$$

The evolution of private wealth is dictated by

$$\dot{K} + \dot{F} = r(K + F) + (\mu(\tilde{C}) - \tilde{C})v^h. \tag{14}$$

Noting that $r = r^*$, and that v^h is pinned down by r^* and the value of τ, (13) and (14) give us a pair of dynamic equations in $\tilde{C}$ and $K + F$, with the latter being a state variable. We assume that $r^* > \rho$ so that, in steady state, the representative household owns a positive level of wealth. The phase diagram in Figure 2 shows that we obtain saddle-path stability. Figure 3 shows the dynamic response of the economy to a sudden permanent increase

in the payroll tax rate, τ, which reduces v^h, used to finance government purchases. Recalling that labor supply is inversely related to $\tilde{C}$, we see that the maximum contraction in employment occurs initially. However, as private wealth gradually declines, employment recovers until in the new steady state, employment is exactly back to where it was before the policy.

Increase in payroll taxes to finance government transfers

In a steady state, aggregate human wealth, H, now equals $(v^h L + y^g)/(r + \theta)$. Non-human private wealth is given by $K + F$ so nonwage income (or unearned) income from private wealth is given by $y^w = (r + \theta)(K + F)$. Using these relations and (1) in (2), and rearranging, we obtain the steady-state labor-supply relation in manhours:

$$\frac{L}{\bar{L}} = \frac{1 - B\left[\frac{\theta+\rho}{r+\theta}\right]\left(\frac{v^h \bar{L}}{y^w + y^g}\right)^{-1}}{1 + B\left[\frac{\theta+\rho}{r+\theta}\right]}. \tag{15}$$

We also note that in a steady state, (7) is now expressed as

$$r = \rho + \theta\left(\frac{y^w}{y^w + y^g}\right)\left[\frac{1}{1 + \left(\frac{v^h \bar{L}}{y^w + y^g}\right)\left(\frac{L}{\bar{L}}\right)}\right]. \tag{16}$$

Suppose that initially y^g and τ are both zero. Figure 4 illustrates the effect of raising payroll taxes to finance a positive level of government transfers. Given $r = r^*$, we note from (15) that $L/\bar{L}$ is positively related to $v^h \bar{L}/(y^w + y^g)$ so we obtain the positively-sloped line in Figure 4. On the other hand, given $r = r^*$, (16) gives us a hyperbola. The increase in payroll taxes used to finance y^g has the effect of shifting inward the hyperbola along an unshifted labor supply curve. The result is that there is a permanent decline in $v^h \bar{L}/(y^w + y^g)$. In this case, the decline in income from private wealth in response to reduced take-home wage fails to offset the increase in income from social wealth (y^g) so the reduction in employment has a permanent component.

4. The Large Open Economy

If payroll taxes raised to finance government purchases and transfers lead to a tightening of private savings, and the increased borrowing in the international capital market leads to an increase in the world interest rate, will the after-tax wage to unearned income ratio be permanently reduced? Taking the pure case of government purchases with no transfers, we suppose that as the large economy increases the stock of private wealth $(K + F)$, it acts to lower the real rate of interest, that is, $r = R(K + F)$; $R'(K + F) < 0$ with an interest elasticity (defined with a positive sign) that we assume is less than one. We first determine what happens to the long-run rate of interest in response to the increase in labor taxes.

Setting $\dot{\tilde{C}} = 0$ in (13) gives

$$\tilde{C} = \frac{\theta(\theta + \rho)(K + F)}{v^h[R(K + F) - \rho]} \tag{17}$$

and setting $\dot{K} + \dot{F} = 0$ in (14) gives

$$\tilde{C} - \mu(\tilde{C}) = \frac{(K + F)R(K + F)}{v^h}. \tag{18}$$

Substitution of $(K + F)/v^h$ in (18) using (17) gives us

$$\left[\frac{\tilde{C} - \mu(\tilde{C})}{\tilde{C}}\right] = \frac{R(K + F)[R(K + F) - \rho]}{\theta(\theta + \rho)}, \tag{19}$$

where we note that the lefthand side of (19) is increasing in $\tilde{C}$ and the righthand side is decreasing in $K + F$. We plot this relationship as the downward-sloping schedule in Figure 5. [2] Note from (17) that we have a positively-sloped schedule that we plot in Figure 5. The intersection gives the initial equilibrium $\tilde{C}$ and $K+F$, and hence the initial steady-state rate of

[2]Notice that in the case of a small open economy taking the external rate of interest as given, this line is horizontal.

interest. At given $K+F$, we see from (17) that an increase in the payroll tax rate lowers v^h and so shifts up the positively-sloped schedule. Consequently, an increase in the payroll tax rate raises the real rate of interest in the long run, increases $\tilde{C}$, and thus decreases employment.

Studying the dynamics of the system is now straightforward. Setting $r = R(K+F)$ in (13) and (14) and using the factor-price frontier relationship making v^f a decreasing function of r, we can study the economy's response to an increase in payroll taxes used to finance government purchases. The adjustment path in response to a sudden permanent increase in τ is shown in Figure 6. The impact of the labor taxes on employment is greatest initially.

One result in the large open economy case is noteworthy. Suppose that the government purchases child-care services, which we regard as a non-traded good and thus relatively labor-intensive, and pays for it with higher payroll taxes. The model suggests that as savings decline and the economy ends up borrowing from the international capital market and pushes up the world interest rate, child-care services become relatively cheaper in terms of the traded good. The reason is that the higher interest rate means that wage costs (v^f)faced by the firm are lowered. As child-care services are relatively labor-intensive, their relative price declines.

5. Concluding Remarks

In this paper, we proved the proposition that a permanent increase in payroll taxes used to finance government purchases in a small open economy that takes the external rate of interest as given is neutral for employment in the long run. However, if the economy in question is large in the sense that an increase in its borrowing in the world capital market pushes up the interest rate, the neutrality breaks down. In the large open economy case, the higher world interest rate, in lowering the after-tax wage to unearned income ratio, reduces permanently the number of hours supplied. Does this provide

a resolution to the Faggio-Nickell puzzle that despite higher labor taxes in both the group of Scandinavian countries (Denmark, Finland and Sweden) and the Big Three Continental countries, labor inputs fell far more in the latter than in the former over the past three decades? Can one argue that the Scandinavian countries can be safely regarded as small open economies with little influence on the world interest rate whereas the Big Three Continental countries have market power in the world capital market so that payroll taxes are neutral in the former but non-neutral in the latter?

Unfortunately, the theoretical propositions we proved in this paper do not help to resolve the Naggio-Nickell puzzle. If the Scandinavian countries and the Big Three Continental countries all operate in an integrated international capital market, the resultant higher world interest rate brought about by reduced savings in the latter would have an effect on the former through the interest channel. The higher world interest rate lowers the after-tax wage to unearned income ratio and hence reduces labor supply in the Scandinavian countries through the capital-market linkage. Moreover, insofar as payroll taxes have been increased to finance government transfers (and not just government purchases) in the Scandinavian countries, labor taxes are non-neutral for employment at *given* interest rates. A hypothesis that has to be explored is whether the relatively high employment in the Scandinavian countries despite high labor taxes is due to superior "entrepreneurial" institutions and economic culture.

Wealth adjustment places important limits on the long-term effectiveness of implementing tax cuts on labor as a means of expanding employment. The effectiveness of such tax cuts would be largely, if not wholly, transitory—especially if the welfare state was spared. In two decades' time, employment would creep back to nearly where it was before the policy implementation as wealth increased. The false hopes raised by cutting taxes would have diverted policy makers away from fundamental reforms that are necessary if

the Continent is to achieve the dynamism on which high rates of innovation, abundant job creation, and world-class productivity depend.

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Figure 1: Textbook Model

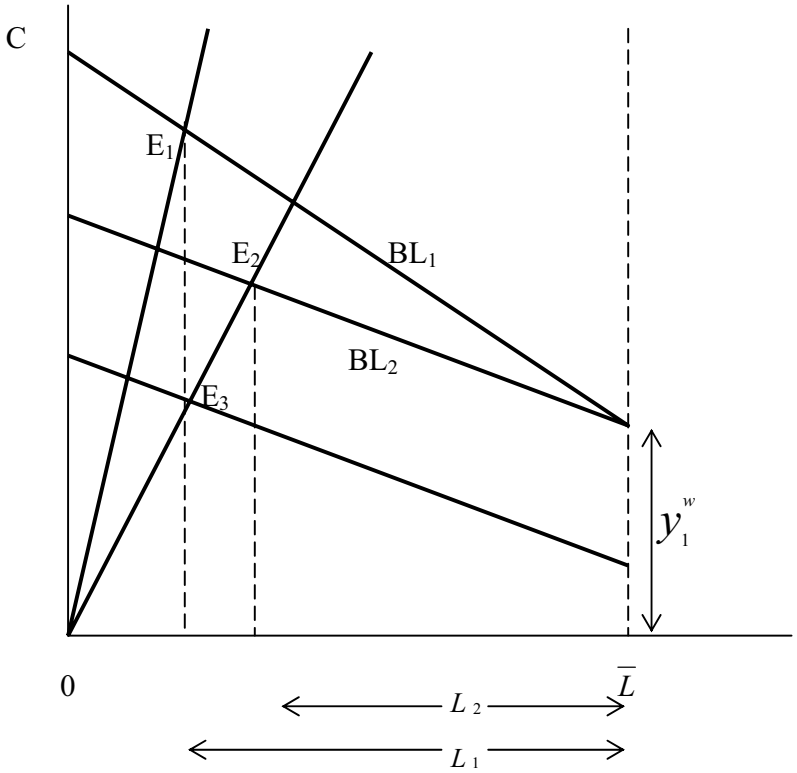

Figure 2: Phase Diagram

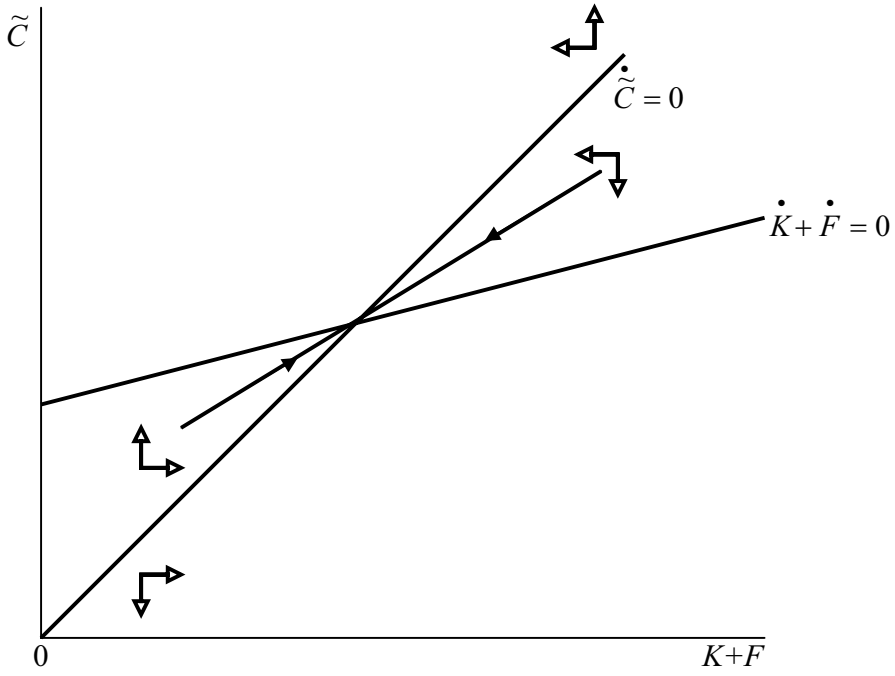

Figure 3: Dynamic Response

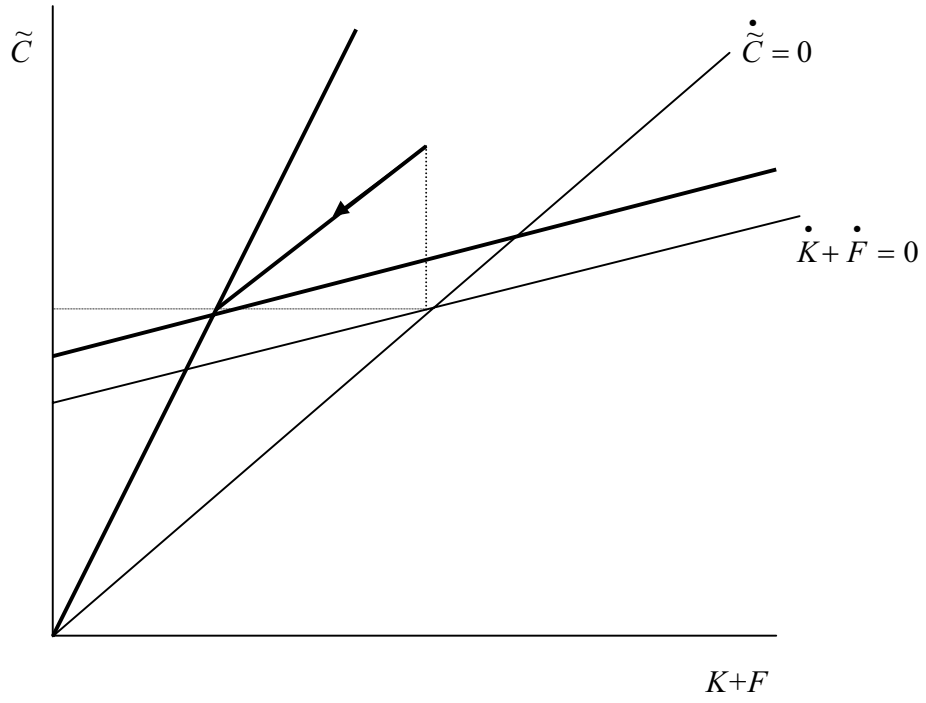

Figure 4: Government Transfers

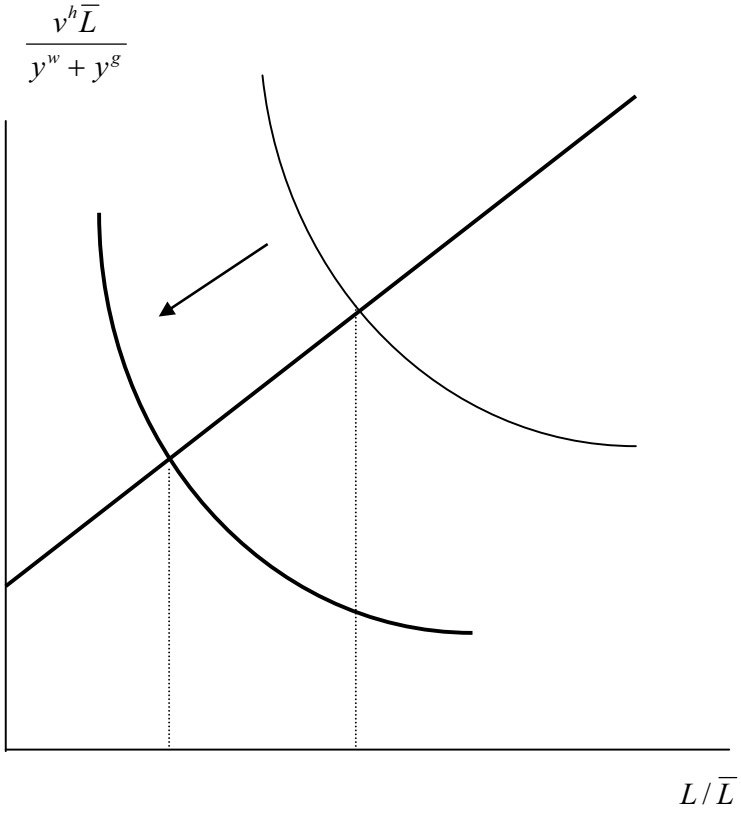

Figure 5 : Steady-State Effect in Large Open Economy

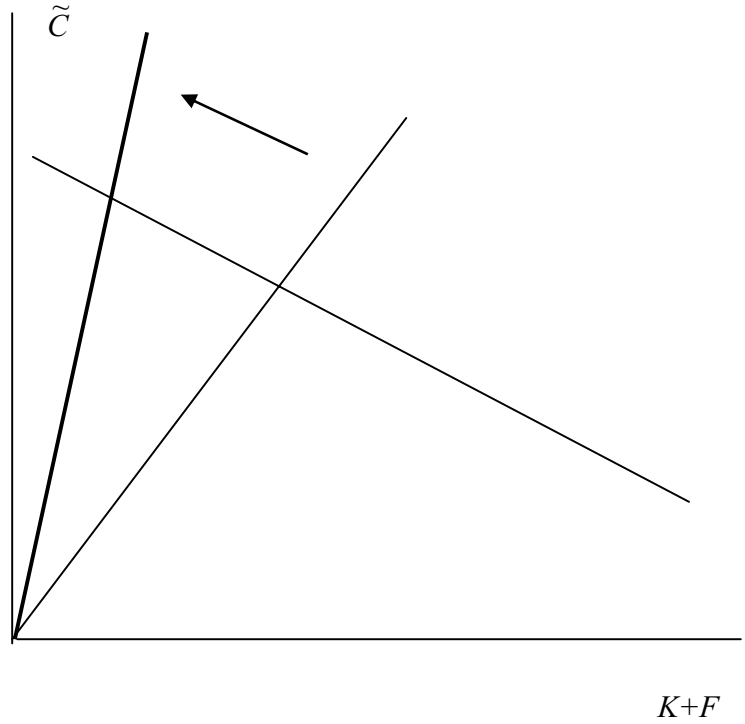

Figure 6: Dynamic Response in Large Open Economy