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

Hian Teck Hoon†
Singapore Management University

September 2006

1. Introduction

The theoretical proposition 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 empirically (Bianchi, Gudmundsson and Zoega (2001)). But would a permanent cut in tax rates on labor encourage more work permanently—with no diminution of effectiveness? Conversely, does a permanent increase in tax rates on labor cause a

*I am grateful to Ned Phelps for the lessons I have learnt from our long collaboration upon which this paper builds. I also thank Pentti Kouri for his comments on the first version of this paper.

†Correspondence Address: School of Economics and Social Sciences, Singapore Management University, 90 Stamford Road, Singapore 178903, Republic of Singapore; e-mail: hthoon@smu.edu.sg; tel: (65)-6828-0248; fax: (65)-6828-0833.

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.) Using a neoclassical model of labor supply, he argued that the divergence in relative hours worked between Americans and Europeans over the three decades or so could be quantitatively accounted for entirely by the difference of marginal tax rates on labor without appealing to differences in preference for leisure or subjective rate of time discount. His quantitative model, however, assumed zero international capital mobility, an assumption that might be questioned given the lowering of barriers to international capital flows between Europe and America since the late 1960s (Obstfeld and Taylor, 2004). A central result we obtain in this paper is that in a world of perfect international capital mobility, the country that raises its payroll tax rate does indeed contract employment initially. However, a reduced take-home pay rate also has negative effects 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. As it is the after-tax wage *relative* to non-wage income from wealth ratio that determines the optimal number of hours supplied to the market (Hoon and Phelps (1996) first derived this relationship), and that ratio is pinned down by the common world interest rate, the number of hours worked is equalized across countries in the long run if preferences are identical.[1] Therefore, payroll taxes alone cannot explain

[1]Hoon and Phelps (1996) explored the consequences of substituting payroll taxes for VAT and showed long-run neutrality in a small open economy but non-neutrality in a large open economy. They explored the fiscal consequences in two types of labor market: a neoclassical one as well as one with an endogenous natural rate of unemployment derived from labor turnover.

cross-country differences in employment over the long run.

We must proceed cautiously, however. If the payroll tax increase were used to finance government transfers—social assistance and social insurance, which constitute social wealth—instead of government purchases, 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.

Faggio and Nickell (2006) have also questioned the adequacy of an explanation about the American-European work difference based on labor tax differences 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 only about 10 percent below that in the Anglo-Saxon countries. From the perspective of our theory, the long-term differences in hours worked among Continental Europe, the Scandinavian countries, and America must be due to differences in time and leisure preferences or the relative importance of social wealth in these countries.

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 neg-

ative 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 here, 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

Following Prescott (2004), our focus will be on an individual's choice of his time spent in market work, without substantive interest in the choice

between non-market housework and time for leisure. However, in working with a model with overlapping generations as described in Blanchard (1985), we face the possibility of some individuals who live forever having a rising consumption profile over their lifetimes even when the economy is in a steady state.[2] Such individuals who live forever and become very rich in this model may want to retire from the workforce thus making it difficult to aggregate across generations. To preserve the tractability of the Blanchardian model despite endogenizing the work-leisure choice, we therefore want to obtain an economy where every individual alive has an incentive to spend a positive (though variable) number of hours in the market sector.[3] This explains our modelling choice described in the next paragraph.

We explicitly model the choice of time spent in three activities: the market sector, non-market housework, and leisure. Building upon Benhabib, Rogerson and Wright (1991), suppose that the utility function is given by

$$\begin{aligned} U &= \log \hat{C} + A \log[\bar{L} - l_m - l_n] + B, \quad \text{if } l_m > 0 \\ &= \log \hat{C} + A \log[\bar{L} - l_m - l_n], \qquad \text{if } l_m = 0, \end{aligned}$$

where $A,\ B > 0$ and $\hat{C} \equiv [C_m^e + C_n^e]^{1/e}$, $e \leq 1$. Here, l_m is time spent working in the market sector, l_n is time spent in non-market housework, C_m is consumption of the market good, and C_n is consumption of the home pro-

[2]The reason we do not use an infinitely-lived *representative* agent model as in Prescott (2004) is that applying such a model in a world economy with perfect international capital mobility leads to national wealth being degenerate. To obtain non-degenerate wealth in the open economy, we can either use the Blanchard-Yaari model where all individuals face a constant and identical probability of death or a model of overlapping and unconnected infinitely-lived families as in Weil (1989) and Obstfeld (1989). Our results in this paper carry through if we adopt the Weil-Obstfeld characterization of demographics instead of the Blanchardian characterization.

[3]Since Prescott (2004) focuses on the choice of market work at the intensive rather than the extensive margin, the representative agent always supplies a positive number of hours to the market sector.

duced non-market good. We assume that the non-market good is produced according to $C_n = s_n l_n;\ s_n > 0$. Notice that as in Benhabib, Rogerson and Wright (1991), we suppose that working in the market sector gives positive direct utility, presumably because one enjoys certain social interactions and mental stimulus at work that are especially valued. We assume that there is a fixed positive utility value from working in the market sector (given by B) that is independent of the actual number of hours worked. In contrast, the utility value derived from housework comes indirectly from consuming the home-produced good generated by the time input into the non-market sector. Making the further assumption that the direct utility value from spending a positive amount of time in the market is sufficiently large, in particular, that

$$(A+1)[\log \bar{L} - \log(\bar{L} - 0^+)] < B,$$

we ensure that every living person in the economy spends a positive amount of time working in the market.[4] Benhabib, Rogerson and Wright (1991) show that solving out for non-market housework, l_n, we end up, in the Cobb-Douglas case with $e = 0$, the following reduced-form utility function:

$$\log C_m + (A+1)\log(\bar{L} - l_m) + B.$$

The production structure of the economy is described as follows. There are two market goods: one internationally traded and the other a non-traded good. The internationally 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.

[4] A very wealthy individual who might have chosen to retire in a model without a positive utility value from market work spends a very small positive amount of time working in the market ($l_m = 0^+$) given the positive utility value of market work compared to housework in our model.

Demographics are described as in Blanchard (1985). Agents face an instantaneous probability of death θ that is constant throughout life. We now leave out the m subscript used earlier to index market good and market work, understanding that, using the reduced-form utility function (having solved out for l_n and C_n), we refer now only to market goods and time spent in market work. Let $c(s,t)$ denote consumption at time t of an agent born at time s, $l(s,t)$ the number of hours worked in the market, $w(s,t)$ 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

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

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. The solution to the agent's problem, after using two-stage budgeting, is given by

$$\begin{aligned} c(s,t) &= (\theta+\rho)[h(s,t)+w(s,t)], \\ \frac{\bar{L} - l(s,t)}{c(s,t)} &= \frac{A+1}{v^h(t)}, \end{aligned}$$

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

$$\begin{aligned} C &= (\theta+\rho)[H+W], && (1)\\ \frac{(A+1)C}{\bar{L}-L} &= v^h, && (2)\\ \dot{H} &= (r+\theta)H - (Lv^h + y^g), && (3)\\ \dot{W} &= rW + Lv^h + y^g - C, && (4) \end{aligned}$$

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.[5] For simplicity, we suppose that producing a unit of the non-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

[5]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).

actuarial dividend. Using these relations and (1) in (2), and rearranging, we obtain the steady-state labor-supply relation in manhours:

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

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

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

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. Hence, an increase in the payroll tax rate is *neutral* for employment in the long run.

The economic logic underlying the neutrality result is as follows: 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 one-for-one 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. A sudden permanent increase in payroll tax rates therefore produces a temporary contraction of employment with the negative effect of higher payroll tax rates diminishing to zero as wealth decumulates.

Increase in payroll taxes to finance government transfers

In a steady state, aggregate human wealth, H, now equals $(v^h L + y^g)/(r + \theta)$, which includes the component, $y^g/(r + \theta)$ (the present discounted value of the stream of government transfers), that can be thought of as social wealth. Non-human *private* wealth is given by $K + F$ so non-wage 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:

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

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

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

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

It might be argued that if we consider a simultaneous increase in the payroll tax rate in each of the Continental European economies, it might be more appropriate to think of a large open economy whose dissaving is likely to affect the world interest rate. In this section, we extend the analysis to a 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.[6] Note from (17) that we have a positively-sloped schedule that we also plot in Figure 5. The intersection gives the initial equilibrium $\tilde{C}$ and $K+F$, and hence the initial steady-state rate of 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.

To recapitulate, an increase in the payroll tax rate in a large open economy such as Continental Europe leads, in the long run, to a decline in European employment so the higher marginal tax rate does have a permanent negative effect on employment. The reason is that the dissaving that is brought about by reduced take-home pay *raises* the world interest rate, which prevents private wealth from falling enough to restore the after-tax wage to non-wage income ratio back to its original level. This does not imply, however, that another country, say America, with unchanged (lower) payroll tax rates will

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

have higher employment. In fact, if preferences, including the subjective rate of time preference, and mortality rate are identical and there is no hindrance to the cross-border mobility of capital so each country faces a common world interest rate, the fiscal shock in Europe acts also to contract American employment by the same amount in the long run. The economic mechanism producing this result is that wealth accumulation in America (which runs a current account surplus) that is stimulated by the higher world interest rate brought about by European dissaving leads to a decline in the wage to non-wage income ratio in America. In fact, with both America and Europe facing the common world interest rate, (11) and (12) shows that, given r, there is an equalization of the employment rates in the long run despite different payroll tax rates.

Studying the dynamics 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, and wealth decumlation once again leads to diminishing negative effects of higher payroll taxes although there is now a permanent negative component as world interest rate is pushed up.

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 world 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. This does not mean, however, that the other economies in the integrated world economy with lower payroll tax rates have higher employment. As these economies run current account surpluses, stimulated by the higher world interest rate, their wage to non-wage income ratios fall causing the number of hours worked in the low-payroll-tax economies also to decline. If preferences are identical across countries, there is an equalization of employment across countries despite differences in payroll tax rates. Different marginal tax rates on labor, therefore, cannot explain long-run differences in hours worked across countries if capital is internationally mobile.

Does our model 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 so payroll taxes are neutral whereas the Big Three Continental countries have market power in the world capital market so that payroll taxes are non-neutral in the long run?

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 international capital-market linkage.

From the point of view of the theory developed here, two routes are open to explain the Faggio-Nickell puzzle. If a higher proportion of payroll tax revenues is used to finance government transfers in Continental Europe compared to the Scandinavian countries, then total hours worked will be lower in the former than in the latter despite every country facing a common world interest rate. Another hypothesis that has to be explored is whether the relatively high employment in the Scandinavian countries despite high marginal labor taxes is due to superior "entrepreneurial" institutions and economic culture that are represented here by different values of preference parameters.

References

Benhabib, Jess, Richard Rogerson, and Randall Wright, "Homework in Macroeconomics: Household Production and Aggregate Fluctuations," *Journal of Political Economy,* Vol. 99, No. 6, pp. 1166-1187, December 1991.

Bianchi, Marco, Bjorn Gudmundsson and Gylfi Zoega, "An Icelandic Natural Experiment in Supply-side Economics," *American Economic Review*, Vol. 91, No. 5, pp. 1564-1579, December 2001.

Blanchard, Olivier J, "Debts, Deficits and Finite Horizons," *Journal of*

Political Economy, 93, pp. 223-247, April 1985.

Faggio, Guilia and Stephen Nickell, "Patterns of Work Across the OECD," Centre for Economic Performance, *CEP Discussion Paper*, No. 730, June 2006.

Hoon, Hian Teck and Edmund S. Phelps, "Payroll Taxes and VAT in a Labor-Turnover Model of the 'Natural Rate'," *International Tax and Public Finance*, 3, pp. 369-383, 1996.

Kravis, Irving B. and Robert E. Lipsey, "Toward an Explanation of National Price Levels," *Princeton Studies in International Finance,* No. 52, November 1983.

Obstfeld, Maurice, "Fiscal Deficits and Relative Prices in a Growing World Economy," *Journal of Monetary Economics,* Vol. 23, No.3, pp. 461-484, May 1989.

Obstfeld, Maurice and Alan M. Taylor, *Global Capital Markets: Integration, Crisis, and Growth,* Cambridge: Cambridge University Press, 2004.

Prescott, Edward C., "Why Do Americans Work So Much More Than Europeans?" *Federal Reserve Bank of Minneapolis Quarterly Review,* 28(1), July, 2-13, July 2004.

Weil, Philippe, "Overlapping Families of Infinitely-Lived Agents," *Journal of Public Economics,* Vol. 38, pp. 183-198, 1989.

Figure 1: Textbook Model

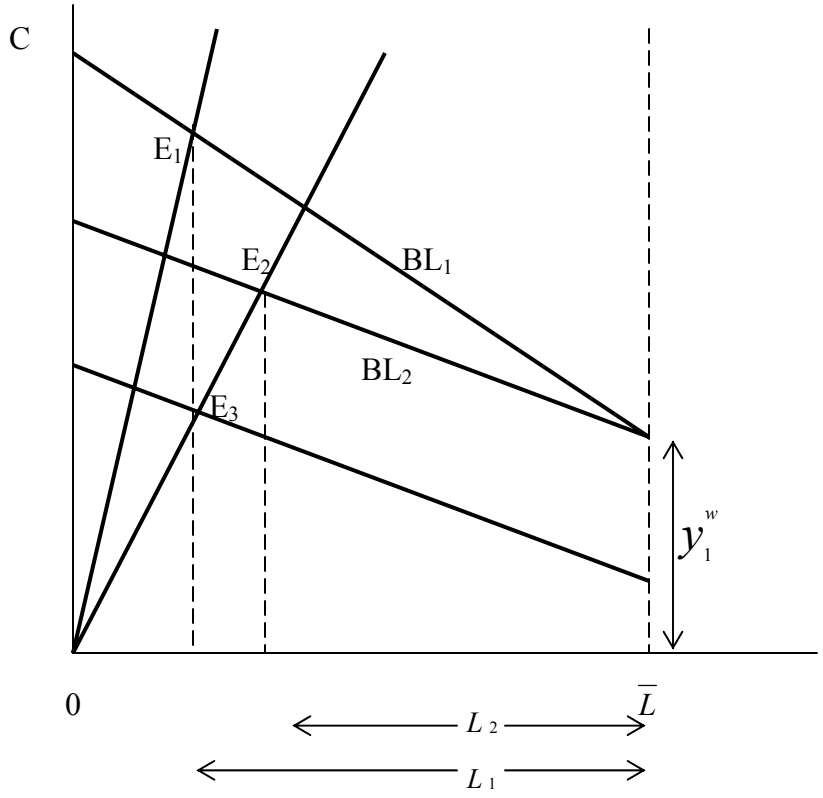

Figure 2: Phase Diagram

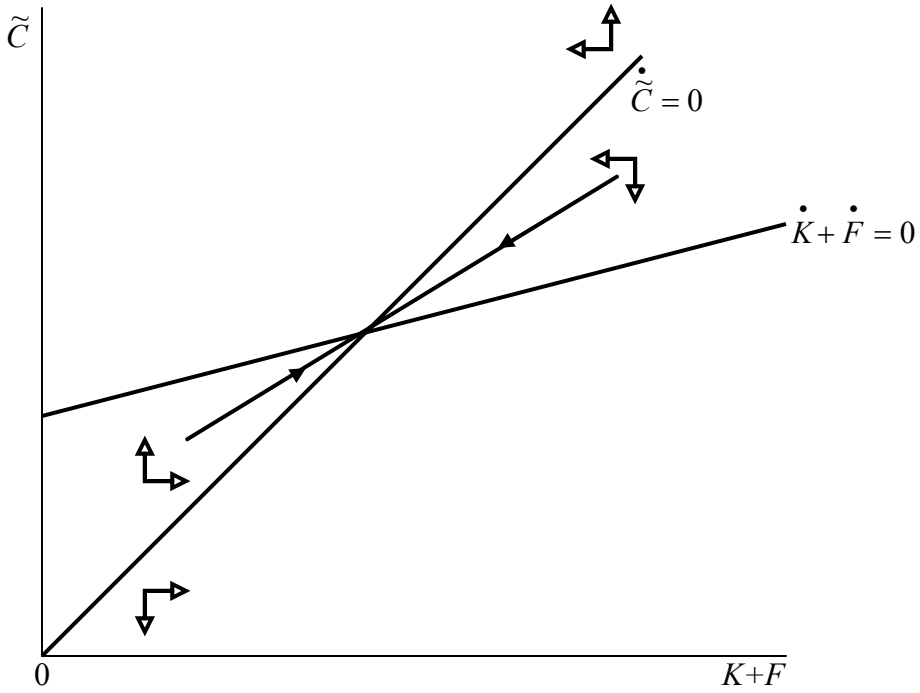

Figure 3: Dynamic Response

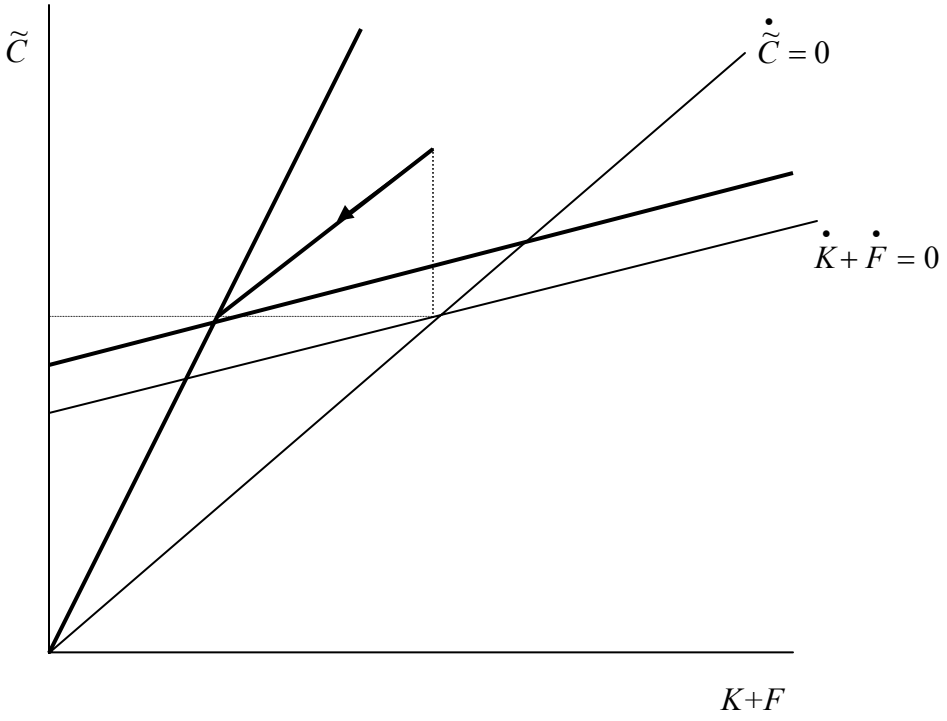

Figure 4: Government Transfers

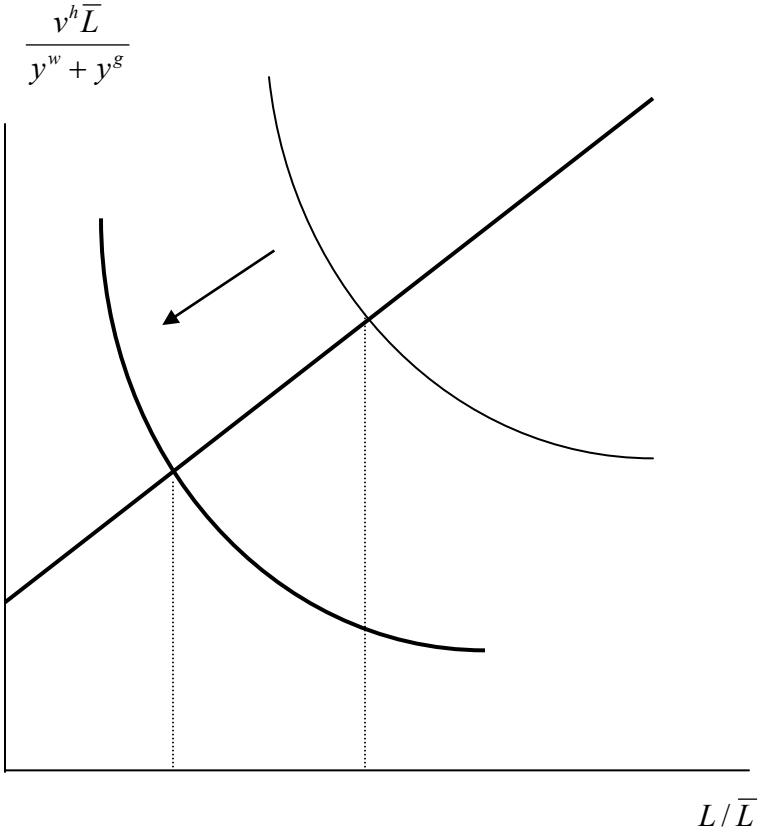

Figure 5 : Steady-State Effect in Large Open Economy

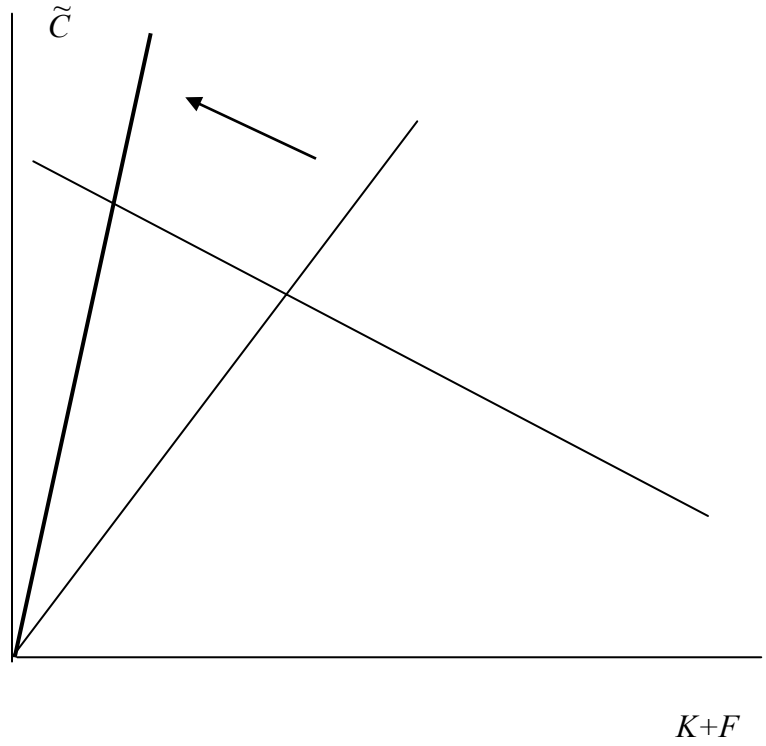

Figure 6: Dynamic Response in Large Open Economy