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Effects of Labor Taxes on Hours of Market and Home Work: The Role of International Capital Mobility and Trade*

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Abstract

This paper evaluates the Prescott (2004) hypothesis that permanently higher payroll taxes fully explain the decline in number of market hours worked in Europe (relative to America) over three decades. The Prescott model made assumptions that, in steady state, left out any incentive for either international capital mobility or international exchange of goods. We study a one-good model where the imposition of higher payroll taxes in one region leads to higher domestic real interest rate in that region. As a result, there are incentives for international capital outflows into the high payroll tax region with the consequence that number of market hours worked in the low payroll tax region also decline. With identical tastes and rate of time discount across the two regions, we find that the number of hours worked in the market, home work, and leisure are equalized across the two regions. In the multi-good model, when factor price equalization holds so free trade acts as a substitute for factor mobility, we show that there is also equalization of market work, home work, and leisure across the two regions.

JEL classification: E13, E22, E24, F11, F16, F21, H20

Keywords: Payroll taxes, wealth decumulation, capital mobility

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1. Introduction

In an important paper, 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. (While Europeans worked more hours for market pay than Americans in the 1970s, they now work only about three-quarters as many hours as Americans.) That a rise in labor taxes discourages labor supply in the short run is not controversial. Given wealth, a reduction in the reward to work causes a substitution away from market work. However, as the reduced take-home pay causes individual savings to also fall, we would expect that over time the decline in wealth would act to counteract the substitution away from market work. Moreover, in the long term, the decline in wealth in the region or country with the higher marginal tax rates on labor could cause changes in the prices of domestic factors and goods, which would prompt international flows of goods and capital. The Prescott argument that higher labor taxes in one region (Europe) causes permanently fewer market hours there, however, is made in a model with two essentially *isolated* economies. In the Prescott model, there are neither incentives for international capital mobility nor international exchange of goods and services in the long run.

In this paper, we study the effects of labor taxes on market and home work in a two-region world in which there *are* incentives for international lending and borrowing and incentives for the international exchange of goods and services. We first study a one-good model in which there is an incentive for cross-border capital flows when one of the regions imposes a payroll tax.[1] We find that, in a two-region world with identical discount rates and preferences, the increase in labor taxes in one region (with tax revenue being used to finance government purchases) leads to a higher autarkic interest rate as residents in that region decumulate wealth by more than their aggregate hours fall. As a result, there is an incentive for capital

[1]The model is set up in such a way that, in the absence of asymmetric payroll tax rates, both regions are *ex ante* identical. As opposed to a model that ties down the real interest rate to the value of the time discount parameter in steady state as in the Prescott model, we adopt an overlapping generations model where the real interest rate can differ from the time discount parameter in the long run. Consequently, when there is an asymmetry in the payroll tax rates across the two regions, incentives are created for international capital flows despite identical time discount rates and preferences.

outflow from the other region until there is an equalization of the national interest rates. With the other region accumulating wealth, we find that, in the long run, there is an equalization of the market and home work across the two regions.

We study a second model with two goods, a Solow good and a pure consumption good.[2] We find that, with wealth decumulation, the country that imposes a tax on labor ends up with a lower autarkic long-run capital-labor ratio. Under free trade, it ends up importing the relatively capital-intensive good. With unhindered international exchange of goods and services, there is an equalization of goods prices and real interest rates as well as of hours of market and home work across the two regions. Thus we find that once there are incentives for international capital mobility or international exchange of goods and services, higher marginal taxes on labor in one region do not have unequalizing effects on market and home work across regions given identical preferences and rates of time discount. This finding of equalization of market and home work across the two regions in the long run despite higher marginal taxes on labor in one region holds even when we let the Solow good in the second model be produced by assembling a continuum of differentiated intermediate products and adopt the Krugman-Helpman set-up of monopolisitc competition in that sector.

Suppose, on the other hand, that there is complete specialization in production under free trade in goods. Then, factor prices would be unequal across the two regions. Would it then follow that a permanently higher payroll tax rate in one region leads it to a permanently lower aggregate level of employment as argued by Prescott (2004)? We show that such an outcome of unequal factor prices cannot be an equilibrium if we allow free international capital mobility. Prescott's quantitative model assumed zero international capital mobility, and had the property that there was no incentive for international lending and borrowing in steady state, 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 region that raises its payroll tax rate does indeed contract employment initially. However, a reduced take-home pay rate also has negative effects on savings and thus on wealth next year and beyond. In the long run, wealth would tend to decrease in the same proportion

[2]As in the one-good model, the Solow good can alternatively be used for consumption or investment.

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 regions in the long run if preferences and time discount rates are identical.

While our paper is motivated by the desire to evaluate the generality of the hypothesis that differences in payroll tax rates across regions fully explain permanent differences in home and market work, it is also related to the trade literature that endogenizes the determinants of comparative advantage. The classic paper of Findlay (1970) takes the national savings rate and population growth rate as primitive determinants of long run comparative advantage. Matsuyama (1988) retains the Findlay (1970) structure but makes the national savings rate endogenous with intertemporal utility maximization for given preferences. Baxter (1992) also adopts intertemporal utility maximization in a two-good model exhibiting Ricardian Equivalence but with fixed aggregate labor supply. In our paper, we abstract from population growth as a determinant of effective labor supply and instead focus on the length of the workweek (which is endogenous) as a basis for comparative advantage alongside the endogenous supply of wealth in a model exhibiting non-Ricardian Equivalence. More specifically, we develop here an overlapping generations two-region model in which physical capital accumulation, the length of the workweek, and the trade pattern are all endogenously determined in response to the asymmetric imposition of payroll taxes.[3]

The rest of the paper is organized as follows. In section 2, we set up the household side of the model at both the individual and aggregate levels. Section 3 studies the one-good model while section 4 studies the multi-good model. Section 5 examines the role of social wealth in influencing the adjustment of private wealth to the imposition of payroll taxes and thus the influence on the number of hours spent in market work. Section 6 concludes.

2. Individual Behavior and Aggregation

Demographics are as described in Blanchard (1985). At any instant, a new cohort, composed of many agents, is born, with its size normalized to θ. Because of the large number

[3]Hoon (forthcoming) incorporates a non-traded good sector in the analysis of the effects of payroll taxation.

of agents born in each cohort, each facing an instantaneous probability of death θ that is constant throughout life, the size of a cohort born at time s as of time t is $\theta \exp^{-\theta(t-s)}$ and the total population size at any time t is $\int_{-\infty}^{t} \theta \exp^{-\theta(t-s)} ds = 1$.

We first focus on an individual's choice of his time spent in market work, non-market housework, and time for leisure.[4] 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), we suppose that the period individual 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 $\hat{c} \equiv c_m^{\mu} c_n^{1-\mu}$, $0 < \mu < 1$. Here, $\bar{L}$ is time endowment, 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 produced 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 types of mental stimulation at the work place that one does not get by devoting all of one's time to leisure and home work. 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.

To ensure that every living person in the economy spends a positive amount of time working in the market in order to facilitate aggregation, we make the assumption that the direct utility value from spending a positive amount of time in the market (B') is sufficiently large.

Assumption 1: $B' > \mu^{-1}(A' + 1 - \mu)[\log \bar{L} - \log(\bar{L} - 0^{+})]$.

Under Assumption 1, 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

[4]Freeman and Schettkat (2005) and Rogerson (2008) emphasize the role of non-market work in explaining the differences in market work between Europe and America.

working in the market ($l_m = 0^+ > 0$) given the positive utility value of market work compared to housework in our model.

The agent maximizes

$$\int_t^\infty \{\log[(c_m(s,\kappa))^\mu (c_n(s,\kappa))^{1-\mu}] + A' \log[\bar{L} - l_n(s,\kappa) - l_m(s,\kappa)] + B'\} \exp^{-(\theta+\rho)(\kappa-t)} \, d\kappa$$

subject to

$$\begin{aligned} c_n(s,t) &= s_n l_n(s,t), \\ \frac{dw(s,t)}{dt} &= [r(t)+\theta]w(s,t) + v^h(t) l_m(s,t) - c_m(s,t), \end{aligned}$$

and a transversality condition that prevents agents from going indefinitely into debt. As in Blanchard (1985), agents save or dissave by buying or selling actuarial bonds, that is, bonds that are cancelled by death. Here, ρ is the subjective rate of time discount, θ is the constant instantaneous probability of death so θ^{-1} is the expected remaining life, $w(s,t)$ is non-human wealth at time t of an agent born at time s, and $v^h(t)$ is after-tax wage rate.[5] The rate of interest on actuarial bonds is $r(t) + \theta$.

From the optimal choice of c_m, l_m, and l_n, we obtain, after some manipulation, the following two relationships:

$$\frac{\mu v^h}{c_m} = \frac{A'}{\bar{L} - l_n - l_m}, \tag{1}$$

$$\frac{(1-\mu)s_n}{c_n} = \frac{A'}{\bar{L} - l_n - l_m}. \tag{2}$$

Uisng (1) and (2) to get $c_n/c_m = (1-\mu)s_n(\bar{L} - l_m)[(A' + (1-\mu))c_m]^{-1}$, and using $c_n = s_n l_n$ in (2) to obtain $l_n = (1-\mu)(A')^{-1}[\bar{L} - l_n - l_m]$, we can eliminate l_n and c_n and write the individual's intertemporal optimization problem simply as

$$\text{Maximize} \quad \int_t^\infty \{\log c_m(s,\kappa) + A \log[\bar{L} - l_m(s,\kappa)] + B\} \exp^{-(\theta+\rho)(\kappa-t)} \, d\kappa$$

subject to

$$\frac{dw(s,t)}{dt} = [r(t)+\theta]w(s,t) + v^h(t) l_m(s,t) - c_m(s,t), \tag{3}$$

[5] We assume that the take-home wage per hour worked in the market is independent of the age of the agent.

where

$$\begin{aligned} A &\equiv \mu^{-1}[A' + (1-\mu)], \\ B &\equiv \mu^{-1}(1-\mu)\log\left[\frac{(1-\mu)s_n}{A' + (1-\mu)}\right] + \mu^{-1}A'\log\left[\frac{A'}{A' + (1-\mu)}\right]. \end{aligned}$$

The solution to the agent's modified problem immediately above, having solved out l_n and c_n, is given by

$$c_m(s,t) = (\theta+\rho)[h(s,t) + w(s,t)], \tag{4}$$

$$\frac{\bar{L} - l_m(s,t)}{c_m(s,t)} = \frac{A}{v^h(t)}, \tag{5}$$

where human wealth is given by

$$h(s,t) = \int_t^{\infty} [l_m(s,\kappa)v^h(\kappa)] \exp^{-\int_t^{\kappa}[r(\nu)+\theta]d\nu} d\kappa. \tag{6}$$

Aggregate consumption is obtained by aggregating (3), (4) and (6) over all agents alive at time t. Denoting aggregate variables by upper case letters, we obtain

$$C_m(t) = (\theta+\rho)[H(t) + W(t)], \tag{7}$$

$$\dot{H}(t) = (r+\theta)H(t) - v^h(t)L_m(t), \tag{8}$$

$$\dot{W}(t) = r(t)W(t) + v^h(t)L_m(t) - C_m(t), \tag{9}$$

where a dot over a variable denotes its time derivative and the aggregate variable $X(t)$ is defined as $X(t) \equiv \int_{-\infty}^{t} x(s,t)\theta \exp^{-\theta(t-s)} ds$. Aggregating (5) over all agents alive at time t, we obtain

$$\frac{AC_m(t)}{\bar{L} - L_m(t)} = v^h(t). \tag{10}$$

Moreover, using $c_n = s_n l_n$ in (2), and aggregating over all agents alive at time t, we obtain

$$L_n(t) = \left[\frac{1-\mu}{A + (1-\mu)}\right][\bar{L} - L_m(t)], \tag{11}$$

$$\bar{L} - L_n(t) - L_m(t) = \left[\frac{A}{A + (1-\mu)}\right][\bar{L} - L_m(t)]. \tag{12}$$

Once we have solved for the aggregate number of hours spent in market work, $L_m(t)$, (11) and (12) give us, respectively, the aggregate number of hours spent in home work and leisure.

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. 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.[6] Such individuals who live forever and become very rich in this model will still spend a positive (though vanishingly small) amount of time in market work given Assumption 1. This facilitates aggregation and preserves the tractability of the Blanchardian model despite endogenizing the work-leisure choice.

Taking the time derivative of (7), and using (8) and (9), we obtain

$$\dot{C}_m = (\theta + \rho)[rW + (r + \theta)H - C_m]. \tag{13}$$

Using (7) in (13), we obtain, after re-arrangement of terms,

$$\frac{\dot{C}_m}{C_m} = (r - \rho) - \frac{\theta(\theta + \rho)W}{C_m}. \tag{14}$$

3. The One-Good Model

There is a production technology for the output of the Solow good (Y) that is constant returns to scale in labor (L_m) and capital (K) satisfying the Inada conditions: $Y = L_m f(k)$, where $k \equiv K/L_m$ is the capital-labor ratio, with $\lim_{k\to\infty} f'(k) = 0$; $\lim_{k\to 0} f'(k) = \infty$; $f(0) = 0$; $f'(k) > 0$; $f''(k) < 0$. Under perfect competition, the optimal choice of capital and labor by price-taking firms gives

$$r \;=\; f'(k), \tag{15}$$

[6]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.

$$v^f = f(k) - kf'(k), \tag{16}$$

where r is the real interest rate and v^f is the demand wage paid by the firm. The latter is related to the take-home wage, v^h, by $v^h \equiv v^f/(1+\tau)$, τ being the payroll tax rate. The total tax revenue collected is $\tau v^h L_m$, which we assume is used to finance government purchases (G) so $\tau v^h L_m = G$. To understand the workings of the model, it is helpful to first consider a small open economy that takes the world interest rate, r^*, as parametrically given.

3.1 *Wealth adjustment in the small open economy*

With the domestic interest rate being pinned down by the world interest rate, r^*, we also pin down the optimal capital-labor ratio, k^*, from (15). The demand wage is accordingly pinned down from (16): $v^{f*} = f(k^*) - k^* f'(k^*)$. We note from (10) that, defining $\tilde{C}_m \equiv C_m/v^h$, we can write $\tilde{C}_m = \psi(L_m)$; $\psi'(L_m) < 0$. Noting that $\dot{\tilde{C}}_m = \psi'(L_m)\dot{L}_m$, $v^h \equiv v^f/(1+\tau)$, and using (14), we obtain a dynamic equation showing the evolution of L_m:

$$\psi'(L_m)\dot{L}_m = (r^* - \rho)\psi(L_m) - \frac{\theta(\theta+\rho)(1+\tau)W}{v^{f*}}. \tag{17}$$

From (9), we obtain the following dynamic equation giving the evolution of wealth, $W \equiv K + F$, where F is the holding of net foreign assets:

$$\dot{W} = r^* W + \left(\frac{v^{f*}}{1+\tau}\right)[L_m - \psi(L_m)]. \tag{18}$$

Under the assumption obtained in Blanchard (1985) giving saddle-path stability in the case of the small open economy, which we call Assumption 2, we obtain a system represented by (17) and (18) that is also saddle-path stable in the two variables, L_m and W, the latter being a state variable:

Assumption 2: $r^* < \theta + \rho$

Figure 1 shows the dynamic properties of the system represented by (17) and (18) given an initial W_0. Suppose that the payroll tax rate, τ, is initially equal to zero and the economy is in a steady state. We wish to study how the economy's total hours supplied to the market and wealth will evolve in response to a sudden unanticipated permanent increase in τ. We observe that, by setting $\dot{L}_m$ and $\dot{W}$, respectively, equal to zero, we obtain

$$(r^* - \rho)\psi(L_m) = \theta(\theta + \rho)\left[\frac{(1+\tau)W}{v^{f*}}\right], \tag{19}$$

$$\frac{r^*(1+\tau)W}{v^{f*}} = \psi(L_m) - L_m. \tag{20}$$

Inspecting (19) and (20), we see that an increase in τ leads to an equiproportionate decline in wealth that leaves $(1+\tau)W$ and L_m invariant. In Figure 2, we show the dynamic adjustment path taken in response to the sudden permanent increase in τ. At the initial wealth level, L_m drops the most in response to the higher payroll tax rate. (We note from (11) and (12) that the reduction in market work is compensated by proportionate increases in home work and leisure.) Gradually, however, as savings become negative and wealth declines, the total number of hours spent in market work increases (and home work and leisure decrease proportionately). Finally, when wealth has fully adjusted, total hours allocated to market work, home work and leisure are all restored to their original levels despite the higher payroll tax rate. We obtain the following proposition:

Proposition 1: In the small open economy taking the world interest rate as parametrically given, the payroll tax is neutral for market work, home work, and leisure in the long run.

3.2 *The Prescott long-run result*

It is useful to contrast the long-run result of neutrality of payroll taxes in the small open economy with Prescott's result of long-run non-neutrality in the closed economy. In the Prescott model, the long-run rate of interest is pinned down by the rate of time discount, ρ, so via (15), we have $\rho = f'(k_{ss})$, where the optimal capital-labor ratio, k_{ss}, is pinned down by ρ. From (16), we also pin down the real demand wage with $v^f_{ss} = f(k_{ss}) - k_{ss}f'(k_{ss})$. From the wealth accumulation equation expressed in steady state so $\dot{W} = 0$, and $W \equiv K$, we now have

$$\frac{\rho(1+\tau)K}{v^f_{ss}} = \psi(L_m) - L_m,$$

which we can re-express as

$$\frac{\rho(1+\tau)k_{ss}}{f(k_{ss}) - k_{ss}f'(k_{ss})} = \frac{\psi(L_m) - L_m}{L_m}. \tag{21}$$

From (21), we obtain the following derivative, which says that an increase in the payroll tax rate, τ, decreases market work, L_m:

$$\frac{dL_m}{d\tau} = -\left[\frac{\rho k_{ss}}{f(k_{ss}) - k_{ss}f'(k_{ss})}\right]\left[\frac{L_m^2}{\psi(L_m) - L_m^2\psi'(L_m)}\right] < 0.$$

Why do we obtain long-run neutrality with the imposition of the payroll tax in the small open economy but not in the closed economy of Prescott (2004) despite the fact that, in both cases, the optimal capital-labor ratio is uniquely pinned down by the exogenously given world real interest rate and the rate of time discount, respectively? To get the answer, we note that, since $L_m = \phi(C/v^h)$; $\phi'(C/v^h) < 0$ from (10) so market work depends inversely on the consumption to take-home pay ratio, the consumption falls in proportion to the decline in take-home pay due to the imposition of the payroll tax in the small open economy but falls by less than proportionately in the closed economy. More precisely, in the case of the small open economy, noting (7) and (8) in the steady state, we can write

$$L_m = \phi\left(\frac{(\theta + \rho)\left[\frac{v^{f*}L_m}{r^* + \theta} + (1+\tau)(k^* L_m + F)\right]}{v^{f*}}\right), \tag{22}$$

where $W \equiv K + F$, F being net foreign assets, $r^* = f'(k^*)$ and $v^{f*} = f(k^*) - k^* f'(k^*)$. As we saw from our analysis in subsection 3.1, in the long run, wealth adjusts fully to offset the decline in take-home pay, v^h. More explicitly, since we can write $W \equiv K + F = k^* L_m + F$, the wealth adjustment in response to the payroll tax comes from a decline in net foreign assets, F. What (22) tells us is that the proportionate decline in consumption in response to the payroll tax is achieved via a decline in net foreign assets at the given world real interest rate. If, for simplicity, the small open economy was initially neither a net creditor nor debtor, the imposition of a payroll tax turns it into a net debtor. Feeling poorer, individuals in this economy work more to exactly compensate the disincentive to work due to the higher payroll tax.

In Prescott's closed economy model, we have, in place of (22),

$$L_m = \phi\left(\frac{v_{ss}^f L_m + \rho(1+\tau)k_{ss}L_m}{v_{ss}^f}\right), \tag{23}$$

where $W \equiv K$, $\rho = f'(k_{ss})$ and $v_{ss}^f = f(k_{ss}) - k_{ss}f'(k_{ss})$. What (23) tells us is that when the payroll tax rate increases, and wealth (made up entirely of K) decumulates, the need to maintain the optimal capital labor ratio (k_{ss}) pinned down by the rate of time discount (ρ) means that L_m must decline in proportion to the decline in wealth. This, however, leaves consumption *higher* relative to the new lower take-home pay, v^h.

If we place two such economies or regions together that are initially in steady state, one with a higher payroll tax rate than the other, and allow free international capital mobility, there will in fact be no incentive for international lending or borrowing as the domestic real interest rate will be equal. (Without loss of generality, we will suppose that the payroll tax rate, τ, is zero in one region (Region A) and positive in the other (Region B).) In the next sub-section, we will study two initially isolated economies with the overlapping generations structure introduced in section 2.

3.3 *The two-region global economy*

We consider first a single closed economy with the demographic structure described in section 2. Following Prescott (2004), we let the production function be Cobb-Douglas so $y = k^{\alpha}$; $0 < \alpha < 1$. Competitive behavior by firms leads to $r = \alpha k^{-(1-\alpha)}$ so $k = (\alpha/r)^{1/(1-\alpha)}$ and $v^f = (1-\alpha)k^{\alpha} = (1-\alpha)(\alpha/r)^{\alpha/(1-\alpha)}$. The condition that $\dot{L}_m = 0$ gives

$$r = \rho + \frac{\theta(\theta+\rho)(1+\tau)}{1-\alpha}\left(\frac{\alpha}{r}\right)\frac{L_m}{\psi(L_m)}, \tag{24}$$

while the condition that $\dot{W} = 0$, where $W \equiv K$ gives

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{1}{1+\tau}\right]\left[\frac{\psi(L_m)}{L_m} - 1\right]. \tag{25}$$

Substituting out for $\psi(L_m)/L_m$ in (24) using (25), we obtain

$$r = \rho + \frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{r}\right)\left[\frac{\alpha}{1-\alpha} + \frac{1}{1+\tau}\right]^{-1}. \tag{26}$$

We now consider two regions in the global economy, Region A and Region B, which are initially isolated from each other. Without loss of generality, we suppose that in Region A, $\tau^A = 0$, while in Region B, $\tau^B = \tau > 0$. From (25) and (26), we find that in Region B (the high marginal labor tax rate region) the number of hours of market work (L_m) is fewer and the domestic interest rate (r) is higher compared to Region A, that is, $(L_m^B)_{autarky} < (L_m^A)_{autarky}$

and $(r^B)_{autarky} > (r^A)_{autarky}$. In contrast to the Prescott (2004) model, there is now an incentive for international capital mobility with capital flowing from Region A to Region B.

Allowing for perfectly free international capital mobility, we have interest rate (r) equalization and equalization of the demand wage (v^f) across regions. By setting $\dot{L}_m^i$ and $\dot{W}^i$, $i =$ Region A, B, respectively, equal to zero, we obtain

$$(r-\rho)\psi(L_m^i) = \theta(\theta+\rho)\left[\frac{(1+\tau^i)W^i}{v^f}\right], \tag{27}$$

$$\frac{r(1+\tau^i)W^i}{v^f} = \psi(L_m^i) - L_m^i, \tag{28}$$

where $\tau^A = 0$ and $\tau^B = \tau > 0$. Using (28) to substitute out for $(1+\tau^i)W^i/v^f$ in (27), we obtain

$$(r-\rho)r = \theta(\theta+\rho)\left[1 - \frac{L_m^i}{\psi(L_m^i)}\right]. \tag{29}$$

Since the righthand side of (29) is monotone decreasing in L_m^i, the equalization of the real interest rate under perfect international capital mobility implies the international equalization of hours worked, that is, $L_m^A = L_m^B$ even though the payroll tax rate is higher in Region B.

Since $(L_m^B)_{autarky} < (L_m^A)_{autarky}$ in autarky, we can have a better understanding of the mechanism leading to the equalization of market work across the two regions under perfect international capital mobility, $(L_m^B)_{capital\ mobility} = (L_m^A)_{capital\ mobility}$, by examining the net foreign asset position of each region. The regions start off in autarky with Region B facing a higher real interest rate as a result of the higher payroll tax. Residents in region A are then attracted by the higher return to invest in Region B until the real interest rate is equalized across the regions, that is, $r = \alpha(k^A)^{-(1-\alpha)} = \alpha(k^B)^{-(1-\alpha)}$, where $k^A \equiv K^A/L_m^A$ and $k^B \equiv K^B/L_m^B$. However, as $L_m^A = L_m^B$ under perfect international capital mobility, we must have $(K^A)_{capital\ mobility} = (K^B)_{capital\ mobility} = K_{capital\ mobility}$. Defining $F > 0$ as the size of net foreign assets of Region A (equivalently, net foreign liabilities of Region B), the non-human wealth of residents in Region B is given by $W^B \equiv K^B - F$ while the non-human wealth of residents in Region A is given by $W^A \equiv K^A + F$.

How do we calculate the size of F? We note from (27) that since $L_m^A = L_m^B$ and both regions face the same real interest rate (r) and demand wage (v^f), we have $(1+\tau^B)W^B = (1+\tau^A)W^A$. With $\tau^A = 0$ and $\tau^B = \tau > 0$, without loss of generality, and $K^A = K^B = K$ under perfect international capital mobility, we must have $(1+\tau)(K-F) = K+F$. Solving, we find that

$$F = \frac{\tau K}{2+\tau}. \tag{30}$$

Thus we prove that Region B (with the higher marginal payroll tax rate) ends up as a net debtor and Region A becomes a net creditor. Using (30) and the definitions of W^A and W^B, we can show that

$$W^A = \left[\frac{2(1+\tau)}{2+\tau}\right] K, \tag{31}$$

$$W^B = \left[\frac{2}{2+\tau}\right] K, \tag{32}$$

so, clearly, $W^A > W^B$, that is, residents in Region A become wealthier than residents in Region B.

A question of interest is what happens to the number of hours of market work in Region A as a result of the net capital flows that occur in response to the payroll tax imposed in Region B? To get the answer, we note from setting $\tau = 0$ in (25) that, in autarky, the number of market hours worked in Region A is given by

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{\psi((L_m^A)_{autarky})}{(L_m^A)_{autarky}} - 1\right], \tag{33}$$

and setting $\tau = 0$ in (26) gives us the autarkic real interest rate:

$$(r^A)_{autarky} = \rho + \frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{(r^A)_{autarky}}\right)\left[\frac{\alpha}{1-\alpha}+1\right]^{-1}. \tag{34}$$

With perfect international capital mobility so that $r^A = r^B = r$, using (31) in (27) and (28), and making a substitution, gives us

$$r = \rho + \left[\frac{\theta(\theta+\rho)}{1-\alpha}\right]\left(\frac{\alpha}{r}\right)\left[\frac{\alpha}{1-\alpha} + \frac{2+\tau}{2(1+\tau)}\right]^{-1}, \tag{35}$$

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{2+\tau}{2(1+\tau)}\right]\left[\frac{\psi((L_m^A)_{capital\ mobility})}{(L_m^A)_{capital\ mobility}} - 1\right]. \tag{36}$$

Comparing (33) to (36) we find that, with $(2+\tau)/[2(1+\tau)] < 1$, we have $(L_m^A)_{capital\ mobility} < (L_m^A)_{autarky}$, that is, wealth accumulation through the generation of current account surpluses in Region A in response to the higher real interest rate (caused, in turn, by the higher payroll tax rate) offered by region B leads to a decline in the number of hours of market work in Region A compared to autarky.

Using (32) in (27) and (28), and making a substitution, gives us, with perfect international capital mobility so $r^A = r^B = r$, (35) and

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{2+\tau}{2(1+\tau)}\right]\left[\frac{\psi((L_m^B)_{capital\ mobility})}{(L_m^B)_{capital\ mobility}} - 1\right]. \tag{37}$$

Comparing (25) (applied to Region B in autarky with payroll tax rate $\tau^B = \tau > 0$) to (37), and noting that $[(2+\tau)/(2(1+\tau))] > (1+\tau)^{-1}$, we infer that $(L_m^B)_{autarky}$ with the imposition of payroll taxation is less than $(L_m^B)_{capital\ mobility}$. Thus the possibility of capital inflows increases the foreign indebtedness of residents in Region B, which acts as a spur to the supply of market work. Although the imposition of higher payroll taxes in Region B leads to a decline in market work in Region B in autarky, the possibility of running account deficits leads to a decline in wealth that partly acts to boost the supply of market work until the number of hours of market work is equalized across the two regions. We can summarize the results in this sub-section as follows:

Proposition 2: In a two-region world with both regions initially in autarky, the imposition of higher payroll taxes in one region leads that region to have fewer hours of market work and higher autarkic real interest rate in steady state. However, with the possibility of international capital mobility, the region with the higher payroll taxes ends up as a net debtor as it attracts capital inflows and the low payroll tax region ends up as a net creditor. Market work, home work, and leisure end up being equalized across the two regions in the long run with free international capital mobility.

4. The Multi-Good Model

4.1 *Free trade with factor price equalization*

We introduce two goods, Good 1 being a Solow good and Good 2 a pure consumption good. We choose Good 1 as the numeraire and define p as the relative price of Good 2. Production functions are Cobb-Douglas with $Y_1 = L_{m1}k_1^{\alpha}$; $Y_2 = L_{m2}k_2^{\beta}$; $1 > \beta > \alpha > 0$, where $k_1 \equiv K_1/L_{m1}$ and $k_2 \equiv K_2/L_{m2}$, with Good 2 being the relatively capital-intensive good.[7] Profit maximization by price-taking firms gives us

$$v^f = (1-\alpha)k_1^\alpha = p(1-\beta)k_2^\beta, \tag{38}$$

$$r = \alpha k_1^{-(1-\alpha)} = p\beta k_2^{-(1-\beta)}. \tag{39}$$

Sectoral labor allocation is given by $L_{m1} + L_{m2} = L_m$ and sectoral capital allocation is given by $K_1 + K_2 = K$. Denoting the wage-rental ratio as $\omega \equiv v^f/r$, manipulation of (38) and (39) gives

$$\omega = \Phi^{1/(\beta-\alpha)} p^{-1/(\beta-\alpha)}, \tag{40}$$

$$\frac{k_1^\alpha}{k_2^\beta} = \left[\frac{1-\beta}{1-\alpha}\right] p, \tag{41}$$

where $\Phi \equiv \alpha^\alpha (1-\alpha)^{1-\alpha}[\beta^\beta(1-\beta)^{1-\beta}]^{-1}$.

With utility being derived from the demand for two market goods, the individual dynamic optimization problem is now amended to

$$\text{Maximize} \quad \int_t^\infty \{\log[(c_{m1}(s,\kappa))^\eta (c_{m2}(s,\kappa))^{1-\eta}] + A\log[\bar{L} - l_m(s,\kappa)] + B\} \exp^{-(\theta+\rho)(\kappa-t)} d\kappa$$

subject to

$$\frac{dw(s,t)}{dt} = [r(t) + \theta]w(s,t) + v^h(t) l_m(s,t) - c_m(s,t),$$

where $c_m(s,t) \equiv c_{m1}(s,t) + pc_{m2}(s,t)$. We define total government purchases of the market goods as $G_m \equiv G_{m1} + pG_{m2}$ with $G_{m1}/G_m = \eta$, $pG_{m2}/G_m = 1-\eta$ and $\tau v^h L_m = G_m$. Equations (7) to (14) continue to hold with the additional condition giving the relative consumption demand of Goods 1 and 2:

$$\frac{C_{m1}}{C_{m2}} = \left[\frac{\eta}{1-\eta}\right] p. \tag{42}$$

If we place two regions together that initially have zero payroll taxes and government purchases and focus on the steady state, there would neither be incentives for international capital mobility nor international exchange of goods. We then suppose that Region B imposes a permanent positive payroll tax while allowing for the possibility of free trade. The question we wish to answer is: Does the high payroll tax Region B end up with fewer market hours in the long run compared to the low payroll tax Region A in the presence of unhindered

[7] The main proposition of this sub-section is robust to a change in the assumption of relative factor intensity.

international exchange of goods? (Without loss of generality, we suppose that the payroll tax rate in Region A, τ^A, is zero while the payroll tax rate in Region B is positive, $\tau^B = \tau > 0$.)

Using (14) in the steady state, and noting that $W^A \equiv K^A$, $W^B \equiv K^B$, $C_m^B = (1+\tau)^{-1}v^f L_m^B + rK^B$ and $C_m^A = v^f L_m^A + rK^A$, we find that with free trade leading to international factor price equalization, the following must hold:[8]

$$r = \rho + \frac{\theta(\theta+\rho)}{\frac{v^f}{(1+\tau)\left(\frac{K^B}{L_m^B}\right)} + r} = \rho + \frac{\theta(\theta+\rho)}{\frac{v^f}{\left(\frac{K^A}{L_m^A}\right)} + r}. \tag{43}$$

From (43), we infer that

$$(1+\tau)\left(\frac{K^B}{L_m^B}\right) = \left(\frac{K^A}{L_m^A}\right). \tag{44}$$

Noting from (10) that $L_m = \phi(C_m/v^h)$; $\phi'(C_m/v^h) < 0$, $C_m^B = (1+\tau)^{-1}v^f L_m^B + rK^B$ and $C_m^A = v^f L_m^A + rK^A$, we obtain

$$L_m^A = \phi\left(L_m^A\left[1 + \left(\frac{1}{\omega}\right)\left(\frac{K^A}{L_m^A}\right)\right]\right), \tag{45}$$

$$L_m^B = \phi\left(L_m^B\left[1 + \left(\frac{1}{\omega}\right)(1+\tau)\left(\frac{K^B}{L_m^B}\right)\right]\right). \tag{46}$$

With free trade so that both regions face the same relative goods price, (40) tells us that the wage-rental ratio, ω, is identical in both countries. Thus, using (44) in (45) and (46), we infer that the number of market hours worked is equalized across the two regions ($L_m^A = L_m^B$) despite the fact that Region B has the higher payroll tax rate. With free trade, the imposition of higher payroll taxes in Region B is to cause wealth decumulation and to turn the region into the relatively capital-scarce region. Under trade, Region B ends up as the net-importer of the relatively capital-intensive good but the residents there supply the same number of market hours as residents in the low payroll tax region.

We next solve for the world market-clearing relative price, p. Using the global goods market clearing conditions, $\sum_{i=A,B}[C_{mj}^i + G_{mj}^i] = \sum_{i=A,B} Y_j^i$; $j = 1,2$, we can express, after some simplifying steps,

$$p = \left(\frac{1-\eta}{\eta}\right)\left[\frac{k_2 - (K^A/L_m^A) + k_2 - (K^B/L_m^B)}{(K^A/L_m^A) - k_1 + (K^B/L_m^B) - k_1}\right]\left[\frac{k_1^\alpha}{k_1^\beta}\right]. \tag{47}$$

[8] We later consider the case where international factor price equalization does not hold.

Noting that $k_1 = [\alpha/(1-\alpha)]\omega$ and $k_2 = [\beta/(1-\beta)]$, and using (41) and (44), we can re-express (47) as

$$1 = \left(\frac{1-\eta}{\eta}\right)\left(\frac{1-\beta}{1-\alpha}\right)\left[\frac{\left(\frac{\beta}{1-\beta}\right)\omega - \left(\frac{2+\tau}{2(1+\tau)}\right)\left(\frac{K^A}{L_m^A}\right)}{\left(\frac{2+\tau}{2(1+\tau)}\right)\left(\frac{K^A}{L_m^A}\right) - \left(\frac{\alpha}{1-\alpha}\right)\omega}\right]. \tag{48}$$

Noting that $r = \alpha^\alpha(1-\alpha)^{1-\alpha}\omega^{-(1-\alpha)}$ and $v^f = \alpha^\alpha(1-\alpha)^{1-\alpha}\omega^\alpha$, we have, from (43),

$$\alpha^\alpha(1-\alpha)^{1-\alpha}\omega^{-(1-\alpha)} = \rho + \frac{\theta(\theta+\rho)}{\frac{\alpha^\alpha(1-\alpha)^{1-\alpha}\omega^\alpha}{\left(\frac{K^A}{L_m^A}\right)} + \alpha^\alpha(1-\alpha)^{1-\alpha}\omega^{-(1-\alpha)}}. \tag{49}$$

Taking note of (40) that links the wage-rental ratio, ω, uniquely to the relative price, p, (48) and (49) give two equations that allow us to solve for K^A/L_m^A and p. The solution is illustrated in Figure 3 with the GG schedule representing (48) and the KK schedule representing (49).[9] With K^A/L_m^A determined under free trade, we can also determine $K^B/L_m^B = (1+\tau)^{-1}K^A/L_m^A$.

It is helpful to study Region A's autarkic equilibrium and compare it with its free trade equilibrium because this helps us understand the mechanism through which free international exchange of goods leads to the equalization of market hours worked despite Region B's higher payroll tax rates. The autarkic general equilibrium in Region A can be summarized by (49) and

$$1 = \left(\frac{1-\eta}{\eta}\right)\left(\frac{1-\beta}{1-\alpha}\right)\left[\frac{\left(\frac{\beta}{1-\beta}\right)\omega - \left(\frac{K^A}{L_m^A}\right)}{\left(\frac{K^A}{L_m^A}\right) - \left(\frac{\alpha}{1-\alpha}\right)\omega}\right]. \tag{50}$$

Comparing (50) with (48), noting that $(2+\tau)/(2(1+\tau)) < 1$ and using Figure 3, we can check that, under free trade, the GG schedule is moved to the right. Thus, in autarky, Region A faces a lower p and thus lower real interest rate and higher ω and lower K^A/L_m^A. Using (45), we infer that $(L_m^A)_{autarky} > (L_m^A)_{free\ trade}$. In the model economy, the imposition of a permanently higher payroll tax rate by one region of the world (Region B) leads to wealth decumulation and global capital shortage in the long run. As a result, the relative price of the relatively capital-intensive good is raised for the world economy and the real interest rate is increased (compared to a case of zero payroll taxes).

We summarize our results in this sub-section as follows:

[9] If we make the opposite assumption that Good 2 is relatively labor-intensive, the GG schedule becomes positively sloped while the KK schedule becomes negatively sloped.

Proposition 3: In a world of free international trade in goods with factor price equalization, the imposition of a permanently higher payroll tax rate in one region leads to wealth decumulation in that region with the result that it becomes a net-exporter of the relatively labor-intensive good. Market work, home work, and leisure end up being equalized across the two regions in the long run with free international exchange of goods.

Suppose that the size of the payroll tax rate imposed in Region B is sufficiently large that wealth decumulation, in the absence of international capital flows, leads Region B to end up being completely specialized in its production activity. In this case, international factor price equalization breaks down. Does this imply that higher payroll taxes in one region then have permanent unequalizing effects on the two regions' labor supplies? The answer is that, in this case, with the domestic real interest rates being unequal across the two regions, there will be an incentive for international capital flows. Applying (27), (28) and (29), we see that international capital flows would occur until $r^A = r^B = r$ so that $L_m^A = L_m^B$.

4.2 *Free trade with monopolistic competition*

It is of some interest to extend the analysis to intra-industry trade since this is empirically relevant in describing the trade flows between Europe and America. This sub-section sets out to study the effects of the imposition of higher payroll taxes in one region when both inter-industry as well as intra-industry trade takes place. In the model of sub-section 4.1, we now make the assumption that the Solow good, Good 1, is assembled from differentiated intermediate inputs according to a CES aggregate of a variety of differentiated intermediate products, $Y_1 = [\int_0^{n_x} x_j^{\theta} dj]^{\frac{1}{\theta}}$, with elasticity of substitution given by $(1-\theta)^{-1}$, $0 \leq \theta \leq 1$, where x_j denotes the input of intermediate good of variety j and n_x denotes the number of varieties. With perfect competition in the supply of the Solow good, the unit cost of production is equal to the price (being unity since we take the Solow good as numeraire), that is,

$$1 = \left[\int_0^{n_x} p_{xj}^{\frac{-\theta}{1-\theta}} dj\right]^{\frac{-(1-\theta)}{\theta}}.$$

Under symmetry, we obtain

$$p_x = n_x^{\frac{1-\theta}{\theta}}. \tag{51}$$

We assume that Good 2 is produced according to $Y_2 = L_{m2} k_2^{\beta}$ as before.

In the monopolistically competitive sector which produces the horizontally differentiated intermediate good, we assume that capital is the fixed factor, and so the fixed cost of setting up a differentiated good firm is $r f_k$. To produce a differentiated product of the amount x requires a labor input of $a_x x$. The optimal choice of employment gives rise to

$$v^f = p(1-\beta)k_2^{\beta} = p_x \theta a_x^{-1}, \tag{52}$$

where p is the relative price of Good 2 and p_x is the price of intermediate input measured in terms of the Solow good. Free entry and exit imply $p_x x - [v^f x a_x] = r f_k$. Using (52), the zero-profit condition gives

$$x = a_x^{-1} \left[\frac{\theta}{1-\theta}\right] \left[\frac{r}{v^f}\right] f_k,$$

which, using $l_x = x a_x$, gives us the per differentiated good firm employment of

$$l_x = \left[\frac{\theta}{1-\theta}\right] \left[\frac{r}{v^f}\right] f_k. \tag{53}$$

Capital intensity in the monopolistically competitive sector is given by

$$k_x \equiv \frac{f_k}{l_x} = \left[\frac{1-\theta}{\theta}\right] \left[\frac{v^f}{r}\right]. \tag{54}$$

Using $r = p\beta k_2^{-(1-\beta)}$ along with (52), we also have

$$k_2 = \left[\frac{\beta}{1-\beta}\right] \left[\frac{v^f}{r}\right]. \tag{55}$$

In what follows, we assume that $(1-\theta) > \beta$ so the intermediate input is relatively more capital intensive. The adding up constraints are given by

$$L_m = n_x l_x + L_{m2}, \tag{56}$$

$$K = n_x f_k + K_2. \tag{57}$$

Noting (51) and (52), we obtain $v^f = n_x^{(1-\theta)/\theta} \theta a_x^{-1}$. With the two regions freely trading with each other, both regions use the same number of varieties and thus the real demand wages are equalized. With real wages being equalized and free trade ensuring that both regions face the same relative price (p), the capital intensity (k_2), wage-rental ratio (v^f/r), and the real interest rate (r) are also equalized across the two regions. Applying (43) to (46), we infer that the number of market hours worked is equalized across the two regions ($L_m^A = L_m^B$) despite the fact that Region B has the higher payroll tax rate. Once again, with free trade the imposition of higher payroll taxes in Region B is to cause wealth decumulation and to turn the region into the relatively capital-scarce region. Under trade, Region B ends up as the net-importer of the relatively capital-intensive good but there is also intra-industry trade in differentiated intermediate inputs. The residents in the high payroll tax region supply the same number of market hours as residents in the low payroll tax region.

Under the free trade equilibrium with factor price equalization, we have the following system of four equations to solve the four endogenous variables: n_x, $\omega \equiv v^f/r$, K^A/L_m^A, and L_m^A.

$$n_x = \frac{L_m^A\left[\left(\frac{K^A}{L_m^A}\right) - \left(\frac{\beta}{1-\beta}\right)\omega\right]}{\left[1 - \left(\frac{\theta}{1-\theta}\right)\left(\frac{\beta}{1-\beta}\right)\right] f_k}, \tag{58}$$

$$L_m^A = \phi\left(L_m^A\left[1 + \left(\frac{1}{\omega}\right)\left(\frac{K^A}{L_m^A}\right)\right]\right), \tag{59}$$

$$\frac{\theta n_x^{\frac{1-\theta}{\theta}}}{a_x\omega} = \rho + \frac{\theta(\theta+\rho)}{\frac{\theta n_x^{\frac{1-\theta}{\theta}}}{a_x\left(\frac{K^A}{L_m^A}\right)} + \frac{\theta n_x^{\frac{1-\theta}{\theta}}}{a_x\omega}}, \tag{60}$$

$$(1-\eta)\left[\frac{\theta n_x^{\frac{1-\theta}{\theta}}}{\beta a_x}\right]\left[\frac{2+\tau}{1+\tau}\right]\left[1 + \frac{\left(\frac{K^A}{L_m^A}\right)}{\omega}\right] = \left[\frac{\left(\frac{\beta}{1-\beta}\right)^\beta}{1 - \left(\frac{\theta}{1-\theta}\right)\left(\frac{\beta}{1-\beta}\right)}\right] \times \left[2\omega^\beta - \left(\frac{\theta}{1-\theta}\right)\left(\frac{2+\tau}{1+\tau}\right)\frac{\left(\frac{K^A}{L_m^A}\right)}{\omega^{1-\beta}}\right]. \tag{61}$$

5. The Role of Social Wealth in Influencing Adjustment of Private Wealth

Suppose that payroll taxes are used, not only to finance government purchases, but are also used to finance entitlements that are received by agents *independent* of the number of hours worked. We let y^g be the flow amount of entitlement received per agent at each instant. The dynamic budget constraint of an agent born at time s in period t is now given by

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

An agent's human wealth can now be thought of as consisting of two components:

$$h(s,t) = \int_t^{\infty} [l(s,\kappa)v^h(\kappa)] \exp^{-\int_t^{\kappa}[r(\nu)+\theta]d\nu} d\kappa + \int_t^{\infty} y^g(\kappa) \exp^{-\int_t^{\kappa}[r(\nu)+\theta]d\nu} d\kappa. \tag{62}$$

The first component on the righthand side of (62) is the present discounted value of the agent's current and future labor market earnings net of payroll taxes while the second component represents the present discounted value of government entitlements and can be thought of as social wealth. We will now show how, in the presence of social wealth, private wealth still adjusts in response to the sudden unanticipated permanent increase in payroll taxes to boost labor supply but does not now *fully* adjust.

In the small open economy facing the parametrically given world interest rate of r^*, the evolution of aggregate human wealth and non-human wealth are now given, respectively, by

$$\dot{H} = (r^* + \theta)H - v^h L_m - y^g, \tag{63}$$

$$\dot{W} = r^* W + v^h L_m + y^g - v^h \psi(L_m), \tag{64}$$

where $W \equiv K + F$ and $C_m/v^h = \psi(L_m)$. The government budget constraint is given by $\tau v^h L_m = G + y^g$. The dynamic evolution of market hours worked is represented by

$$\psi'(L_m)\dot{L}_m = (r^* - \rho)\psi(L_m) - \frac{\theta(\theta+\rho)(1+\tau)W}{v^{f*}}, \tag{65}$$

where v^{f*} is the real demand wage pinned down by the parametrically given world interest rate.

We find now that, in the steady state, in place of (19) and (20), we have

$$r^* - \rho = \frac{\theta(\theta+\rho)(1+\tau)W}{\psi(L_m)v^{f*}}, \tag{66}$$

$$\frac{r^*(1+\tau)W}{\psi(L_m)v^{f*}} + \frac{(1+\tau)y^g}{\psi(L_m)v^{f*}} = 1 - \frac{L_m}{\psi(L_m)}. \tag{67}$$

Substituting out for $[(1+\tau)W]/[\psi(L_m)v^{f*}]$ in (67) using (66), we obtain

$$\frac{r^*(r^*-\rho)}{\theta(\theta+\rho)} + \frac{(1+\tau)y^g}{\psi(L_m)v^{f*}} = 1 - \frac{L_m}{\psi(L_m)}. \tag{68}$$

The righthand side of (68) is monotone decreasing in L_m. We observe from (68) that if there is no social wealth so $y^g = 0$, the steady state L_m is independent of τ. On the other hand, when $y^g > 0$, we check that the derivative obtained from (68) is negative:

$$\frac{dL_m}{d\tau} = \frac{-\left[\frac{y^g}{\psi(L_m)v^{f*}}\right]}{\frac{1}{\psi(L_m)} - \left[\frac{(1+\tau)y^g}{(\psi(L_m))^2 v^{f*}} + \frac{L_m}{(\psi(L_m))^2}\right]\psi'(L_m)} < 0. \tag{69}$$

What the phase diagram in Figure 4 representing (64) and (65) together with the derivative in (69) tells us is that the wealth decumulation that occurs in response to a permanent unanticipated increase in the payroll tax does restore the supply of market work but the restoration is not complete in the presence of social wealth.

6. Conclusions

This paper has been motivated by the desire to evaluate the Prescott (2004) hypothesis that permanently higher payroll taxes fully explain the decline in number of market hours worked in Europe (relative to America) over three decades. The Prescott model, however, made assumptions that, in steady state, left out any incentive for either international capital mobility or international exchange of goods. We proceed by first studying a one-good model where there are no incentives for the international exchange of goods but where the imposition of higher payroll taxes in one region leads to higher domestic real interest rate in that region. As a result, there are incentives for international capital outflows into the high payroll tax region with the consequence that number of market hours worked in the low payroll tax region also decline. With identical tastes and rate of time discount across the two regions as Prescott (2004) assumed, we find that the number of hours worked in the market, home work, and leisure are equalized across the two regions. In the multi-good model, when factor price equalization holds so free trade acts as a substitute for factor mobility, we show that higher payroll taxation in one region leads to wealth decumulation so that the high payroll tax region ends up being relatively capital scarce. As a result, it becomes a net-importer of the relatively capital-intensive good. The low payroll tax region ends up as the net exporter of the relatively capital intensive good, and relative to a position of autarky, finds that the international trade prompted by the imposition of a higher payroll tax in the other region leads it to decrease the number of hours worked in the market. Under free trade, there is equalization of market work, home work, and leisure across the two regions. The latter result of equalization of hours worked continues to hold when we introduce intra-industry trade.

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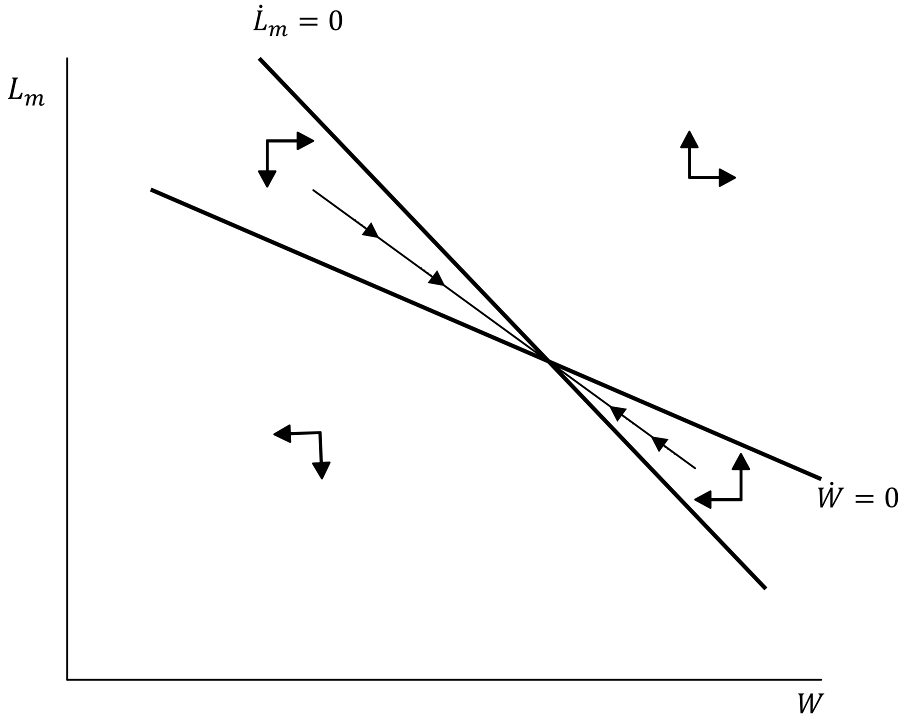

Figure 1. Saddle-path Stability

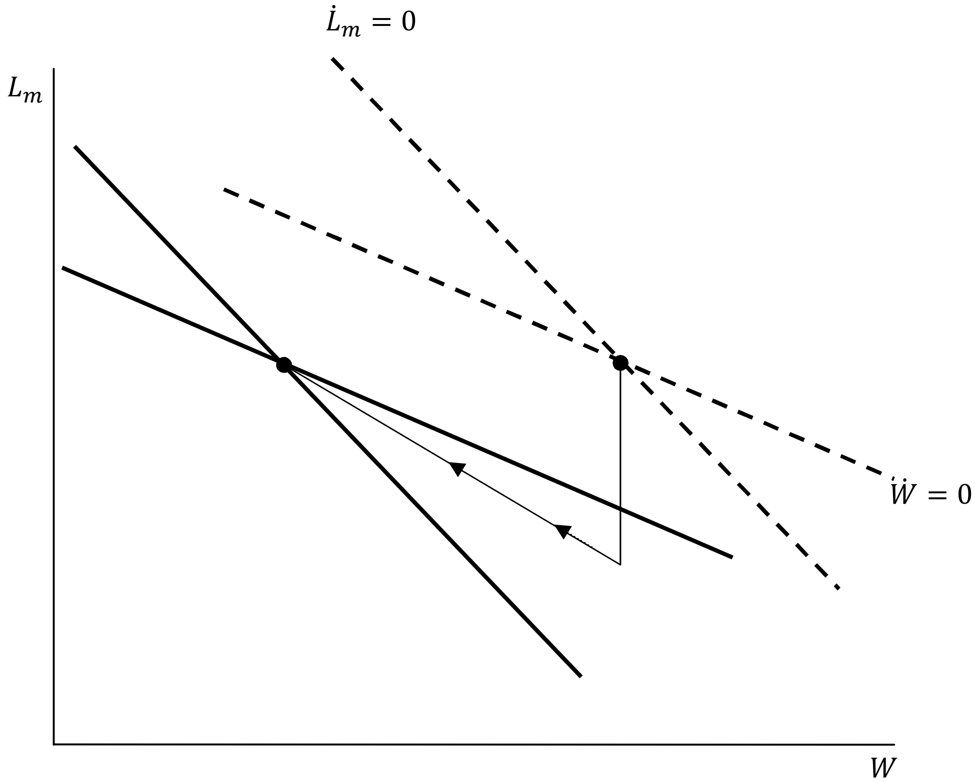

Figure 2. Private Wealth Decumulation in Response to Payroll Taxes

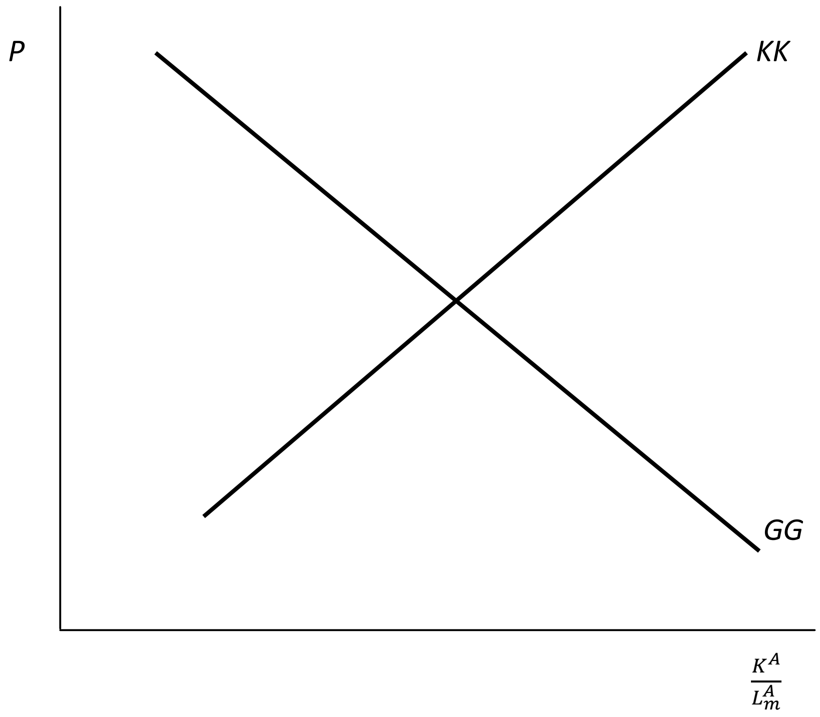

Figure 3. Free Trade Equilibrium

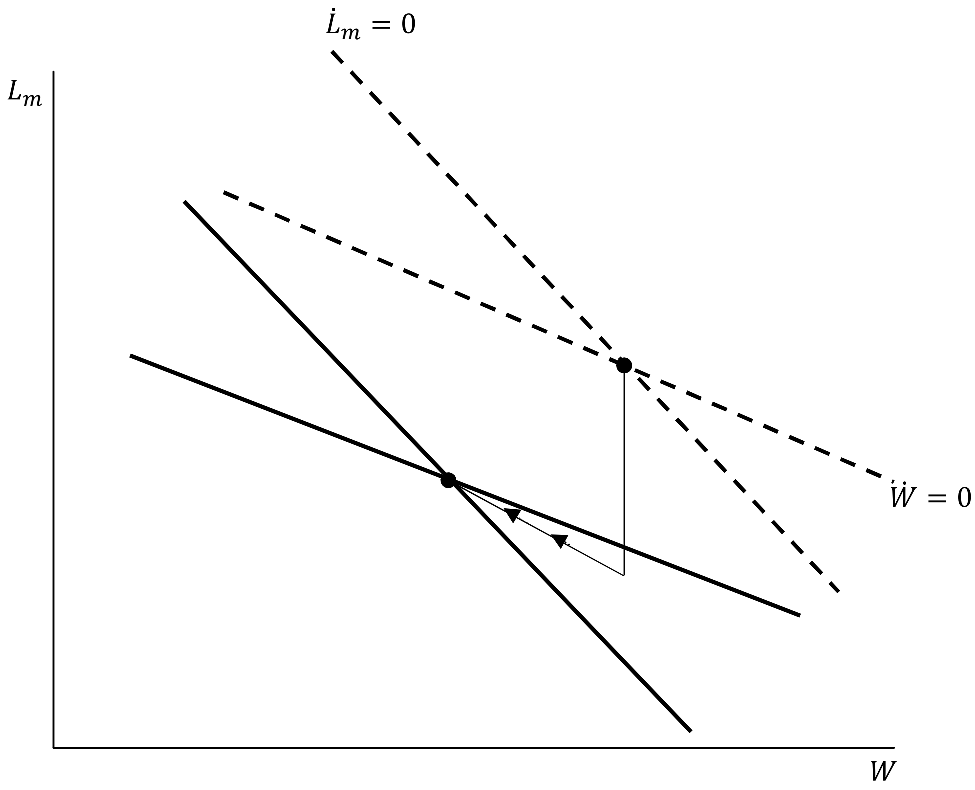

Figure 4. Private Wealth Adjustment in the Presence of Social wealth