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Effects of labour taxes on hours of market and home work: the role of international capital mobility and trade

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The Prescott hypothesis that permanently higher marginal tax rates on labour income fully explain the decline in market hours worked in Europe (relative to North America) over three decades is subject to a theoretical investigation. The Prescott model consists of isolated economies that are not linked by international capital mobility or international exchange of goods. We study a two-country model with free international capital mobility. We find that imposing higher marginal labour tax rates in one country leads to international capital inflows into that country, which acts to counteract the negative employment effect of higher taxes. Market hours worked in the low marginal labour tax rate country fall with an increase in its net foreign assets. With identical preferences, total market hours worked are equalized across the two countries. With factor price equalization, the international equalization of hours worked result still holds with goods trade substituting for international capital mobility.

JEL classifications: E13, E22, E24, F11, F16, F21, H20.

1. Introduction

In an important paper, Prescott (2004) argued that the substantial decline in labour 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 labour. (Whereas 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 labour taxes discourages labour 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 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 labour could cause changes in the prices of domestic factors and goods, which would prompt international flows of goods and capital. The resulting cross-border flow of goods and capital, in turn, would have consequences for employment in each economy.

However, the Prescott argument that higher labour taxes in one region (Europe) cause permanently fewer market hours worked there is made in a model with two essentially isolated or autarkic economies that are not linked by international capital mobility or international exchange of goods.

In this article, we examine the effects of higher marginal labour tax rates on market and home work in a two-country world in which economies are linked through the international capital market. We study in detail a one-good model in which cross-border capital flows occur when the marginal tax rate on labour in one country is raised relative to the marginal labour tax rate in the other country. As a modelling strategy, Prescott (2004) adopted the Ramsey growth model to describe each economy. The Ramsey growth model has the property that, in steady state, the real interest rate is necessarily equal to the value of the time discount parameter. One consequence of this is that, in a multi-country world with free international capital mobility that is populated by representative infinitely lived Ramsey-type individuals, the long-run global distribution of wealth is indeterminate. Moreover, in such a world, if the rate of time preference differs across countries, the one with the lowest rate of time preference eventually comes to own the whole world's outside wealth (Obstfeld, 1990). Since the long-run global distribution of wealth is a key equilibrating mechanism through which the imposition of higher marginal labour tax rates in one country brings about an adjustment of labour supply in the rest of the world when economies are integrated through the international capital market, we need a model set-up that makes each country's wealth level a determinate variable in the long run. To this end, we adopt the overlapping generations model introduced by Blanchard (1985) in place of the Ramsey growth model to characterize each economy.[1]

With our modelling strategy, the question that naturally arises is: Does the Prescott (2004) result, namely, that differences in marginal labour tax rates across autarkic economies lead to long-run differences in market hours worked, still hold with the choice of an overlapping generations model in place of the Ramsey growth model? We show that the answer is in the affirmative so that the crucial result of the article—that market hours worked are equalized despite unequal marginal labour tax rates in the long run—is not a consequence of this particular modelling strategy. Instead, what overturns the Prescott (2004) result is departure from the assumption that countries or regions are not linked by international capital mobility or international exchange of goods. To highlight the role played by international capital mobility, we set up the model in such a way that, in the absence of unequal marginal labour tax rates, both countries are ex ante identical. However, when the marginal labour tax rates across the two countries are unequal, incentives are created for international capital flows despite identical time discount rates and preferences. With an overlapping generations model to

[1] The model of unconnected families of infinitely lived agents introduced by Weil (1989), and adopted by Obstfeld (1989) in the context of a global economy exhibiting free international capital mobility, also makes the long-run global distribution of wealth determinate.

describe each economy, the real interest rate in the integrated global economy differs from the time discount parameter in the long run and the resulting levels of net indebtedness of each country can be uniquely determined. We find that, in a two-country world with identical discount rates and preferences, the increase in marginal labour tax rates in one country (with tax revenue being used to finance government purchases) leads to a higher autarkic interest rate as residents in that country decumulate wealth by more than their aggregate hours fall. As a result, there is an incentive for capital outflow from the low marginal labour tax rate country until there is an equalization of the national interest rates. In effect, capital flows out of the low-labour-tax-rate country to work with labour in the high-labour-tax-rate country thus pulling up labour demand and counteracting the tax-induced disincentive to work in the latter. With capital flowing out of the low-labour-tax-rate country, labour demand declines there and labour supply also contracts as wealth is increased with an increase in the stock holdings of net foreign assets. We find that in the long run, with identical tastes and preferences, there is an equalization of the market and home work across the two countries.

In a multi-good, two-country world, if the factor price equalization theorem (Samuelson, 1949) holds, the international equalization of hours worked result still holds with goods trade now substituting for international capital mobility. With wealth decumulation, the country that imposes a permanently higher marginal tax rate on labour ends up with a lower autarkic long-run capital-labour ratio. Under free trade, the high-labour-tax-rate country ends up as a net exporter of the relatively labour-intensive good à la Heckscher-Ohlin; the corresponding increase in labour demand there acts to counteract the tax-induced disincentive to work. On the other hand, the low-labour-tax-rate country becomes a net exporter of the relatively capital-intensive good; the corresponding decrease in labour demand there ends up decreasing employment. With unhindered international exchange of goods, there is an equalization of goods prices and real interest rates as well as of hours of market and home work across the two countries. Thus, we find that once international capital mobility or international exchange of goods is taken into account, the effect of an increase in the marginal tax rate on labour in one country is absorbed across both countries. In other words, the domestic labour supply response to any increase in the marginal tax rate on labour would be moderated either through international capital flows or through trade in goods if factor price equalization holds. Since the result of international equalization of market hours worked through trade in goods follows rather straightforwardly from the result obtained with free international capital mobility, we omit the formal analysis.[2]

The rest of the article is organized as follows. In Section 2, we discuss some related literature. In Section 3, we set up the household side of the model at both the individual and aggregate levels. Section 4 asks whether the Prescott (2004) result

[2] The interested reader is referred to the online Appendix for the details of the two-good model where international factor price equalization holds.

that different marginal labour tax rates across autarkic economies lead to long-run differences in market hours worked still holds with the adoption of an overlapping generations model in place of the Ramsey growth model. Section 5 presents the two-country analysis with free international capital mobility. Section 6 concludes.

2. Related literature

The role that wealth adjustment plays in determining aggregate employment when marginal labour tax rates are increased was first explored by the present author in the case of a small open economy and a single large economy in a conference paper presented in 2006 and published in Hoon (2011). That paper, however, did not conduct the full general-equilibrium analysis of the global economy where countries are linked via international capital mobility. The current article is intended to fill in this gap.

Blanchard (2004) asked how much of the decline in hours worked per full-time worker in Europe over the past three decades is due to an interaction between preferences and income growth on the one hand, and how much from increasing tax distortions on the other hand. He concluded, 'I read the evidence as suggesting an effect of [effective marginal labour] taxes but with a large role left for preferences' (Blanchard, 2004, p. 9). If we accept that the world economy of the past three decades is better represented by a theoretical model exhibiting a high degree of international capital mobility rather than one with no international capital flows, the analysis would support giving different preferences between American and European workers a greater role in explaining the different number of hours of market work.

The theoretical finding that moving away from an assumption of zero to free international capital mobility changes the effect of higher marginal labour tax rates on aggregate employment calls to mind the Mundell-Fleming results of the effectiveness of fiscal policy when allowing for free international capital mobility. In Mundell (1963), for example, with zero international capital mobility, a tax increase, in contracting effective demand, shifts down the IS curve along an unchanging LM curve thus contracting aggregate employment and lowering the domestic interest rate. In a small open economy that takes the world interest rate as given, and that operates under free international capital mobility and a flexible exchange rate system, there is an incipient capital outflow from the tax-increasing country, which leads to a real exchange rate depreciation. This boosts net exports and returns the economy to its original employment level. Dornbusch (1980) extends the analysis to a two-country world with free international capital mobility. A tax increase in one of the countries, in contracting effective demand, again contracts employment. However, the real exchange rate depreciation by the tax-increasing country hurts the net export of the other country. The result is that the burden of adjustment of aggregate employment is shared by both countries. The weaker real exchange rate of the tax-increasing country, in boosting net exports, partly offsets the contractionary fiscal shock while the other country's

employment is decreased as its export sector is hurt by a strengthening real exchange rate brought about by an incipient capital inflow. The Mundell-Fleming analysis is short-run and built on Keynesian assumptions whereas the analysis here is long-run and built on neoclassical assumptions. Nevertheless, both analyses examine the economic consequences for aggregate employment of moving from zero to free international capital mobility.

A corollary result we obtain is that labour taxes, in affecting total labour supply and domestic capital stock, are a source of comparative advantage. This result is related to the trade literature that endogenizes the determinants of comparative advantage. The classic paper by 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) production 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 labour supply. Here we 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.

3. Individual behaviour 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 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.[3] Building on Benhabib *et al.* (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 *et al.* (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 workplace that one does not get by devoting all of one's time to leisure and

[3] 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.

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

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 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

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

and a transversality condition that prevents agents from going indefinitely into debt. In the variable $x(s,\kappa)$, time s refers to the date an agent is born (that is, the cohort by birth) and κ refers to the current time that the variable is evaluated at. 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.[4] 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:

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

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

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

Using (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 $l_n = (1-\mu)(A')^{-1}(\bar{L}-l_n-l_m)$, I 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

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

where

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

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 with uppercase 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, $L_m(t)$, eqs (11) and (12) give, 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 labour 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. 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,

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

4. The Prescott long-run result under Ramsey and overlapping generations

In this section, we examine whether the Prescott (2004) result that differences in marginal labour tax rates across autarkic economies lead to long-run differences in market hours worked still holds with the choice of an overlapping generations model in place of the Ramsey growth model. Our presentation will make use of a convenient feature of the Blanchard (1985) version of the overlapping generations model where setting the parameter representing the probability of death, θ, to zero (equivalently, setting the expected remaining life, θ^{-1}, to infinity) gives us the mathematical representation of the Ramsey growth model. We first describe the production-side conditions. Then, we obtain the long-run general-equilibrium autarkic solutions for the real interest rate and aggregate number of market

hours worked using the overlapping generations model and compare with the solutions using the Ramsey growth model.

There is a production technology for the output of the single Solow good (Y) that is constant returns to scale in labour (L_m) and capital (K). Following Prescott (2004), we let the production function be Cobb-Douglas so $y = k^{\alpha}$; $0 < \alpha < 1$, where $k \equiv K/L_m$ is the capital-labour ratio. Under perfect competition, the optimal choice of capital and labour by price-taking firms gives

$$r = \alpha k^{-(1-\alpha)}, \tag{15}$$

$$v^f = (1-\alpha)k^{\alpha}, \tag{16}$$

where r is the real interest rate and v^f is the gross hourly wage paid by the firm. The latter is related to the after-tax hourly wage received by the worker, v^h, by $v^h \equiv v^f/(1+\tau)$, τ being the marginal tax rate on labour income. The total tax revenue collected is $\tau v^h L_m$, which we assume is used to finance government purchases (G) so $\tau v^h L_m = G$.

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:

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

Using (15) and (16) and noting that in the autarkic economy, $W \equiv K$, the condition that $\dot{L}_m = 0$ in (17) gives

$$r = \rho + \frac{\theta(\theta+\rho)(1+\tau)}{1-\alpha}\left(\frac{\alpha}{r}\right)\frac{L_m}{\psi(L_m)}, \tag{19}$$

whereas the condition that $\dot{W} = 0$ in (18) gives

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{1}{1+\tau}\right]\left[\frac{\psi(L_m)}{L_m} - 1\right]. \tag{20}$$

Substituting out for $\psi(L_m)/L_m$ in (19) using (20), we obtain

$$r = \rho + \frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{r}\right)\left[\frac{\alpha}{1-\alpha} + \frac{1}{1+\tau}\right]^{-1}. \tag{21}$$

To study the effect of raising the marginal tax rate on labour income in the autarkic economy, we differentiate through (20) to obtain the following derivative, noting that the result does not require that τ be initially zero:

$$\frac{dL_m}{d\tau} = \frac{-\left(\frac{\alpha}{1-\alpha}\right)}{\frac{\psi(L_m)}{L_m^2} - \frac{\psi'(L_m)}{L_m}} < 0.$$

Hence, in the autarkic economy, raising the marginal tax rate on labour income unambiguously reduces the long-run number of market hours worked. In the overlapping generations model, raising the marginal tax rate on labour income, however, also raises the real interest rate in the autarkic economy as differentiating through (21) gives:

$$\frac{dr}{d\tau} = \frac{\frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{r}\right)\left(\frac{\alpha}{1-\alpha}+\frac{1}{1+\tau}\right)^{-2}(1+\tau)^{-2}}{1+\frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{r^2}\right)\left(\frac{\alpha}{1-\alpha}+\frac{1}{1+\tau}\right)^{-1}} > 0.$$

Comparing the results obtained here, where we have used the overlapping generations model to describe each autarkic economy, with the results where the Ramsey growth model is used as in Prescott (2004) is now straightforward; we simply have to examine (20) and (21). As noted at the beginning of this section, setting the probability of death, θ, to zero gives the mathematical representation of the Ramsey growth model. From (20), we note that the equation determining the equilibrium number of hours of market work is independent of θ. Thus, with the assumptions of logarithmic utility function and Cobb-Douglas neoclassical production function made in Prescott (2004), replacing the Ramsey growth model with the Blanchard (1985) version of the overlapping generations model does not change the quantitative effect on total number of hours of market work of raising the marginal tax rate on labour. From (21), however, with θ set equal to zero, we find that the autarkic real interest rate is equal to the rate of time preference, ρ. Thus, with the Ramsey growth model used to charaterize each autarkic economy, raising the marginal tax rate on labour has no effect on the real interest rate.

5. Allowing free international capital mobility

To build our economic intuition for the role played by free international capital mobility in obtaining the result of international equalization of total market hours worked despite different marginal tax rates on labour income within the two-country world setting, which is the main contribution of this article, it is helpful to start with the small open economy case. We present the small open economy case in Section 5.1 and the two-country case in Section 5.2.

5.1 Wealth adjustment in the small open economy

The small open economy takes the world interest rate, r^*, as parametrically given. With the domestic interest rate being equal to the world interest rate, r^*, the optimal capital-labour ratio is determined from (15): $k^* = (\alpha/r^*)^{1/(1-\alpha)}$. The

gross hourly wage is accordingly determined from (16): $v^{f*} = (1-\alpha)(\alpha/r^*)^{\alpha/(1-\alpha)}$. We set $r = r^*$ and $v^f = v^{f*}$ in (17) and (18) to obtain

$$\psi'(L_m)\dot{L}_m = (r^* - \rho)\psi(L_m) - \frac{\theta(\theta+\rho)(1+\tau)W}{v^{f*}}, \tag{22}$$

$$\dot{W} = r^*W + \left(\frac{v^{f*}}{1+\tau}\right)[L_m - \psi(L_m)]. \tag{23}$$

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 (22) and (23) that is also saddle-path stable in the two variables, L_m and W, the latter being a state variable:

Assumption 2 $\quad r^* < \theta+\rho.$

Figure 1 shows the dynamic properties of the system represented by (22) and (23) given an initial W_0. Suppose that the economy is initially in a steady state with a positive value of τ. 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 the marginal labour tax rate, τ, from its initial rate. We observe that, by setting $\dot{L}_m$ and $\dot{W}$, respectively, equal to zero, we obtain

$$(r^* - \rho)\psi(L_m) = \theta(\theta+\rho)\left[\frac{(1+\tau)W}{v^{f*}}\right], \tag{24}$$

$$\frac{r^*(1+\tau)W}{v^{f*}} = \psi(L_m) - L_m. \tag{25}$$

Inspecting (24) and (25), we see that an increase in τ leads to an equiproportionate decline in wealth that leaves $(1+\tau)W$ and L_m invariant. Figure 2 shows 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 marginal labour 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 marginal labour tax rate. We obtain the following proposition:

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

5.2 The two-country global economy

We consider two countries in the global economy, Country *A* and Country *B*, which are initially in autarky and are isolated from each other but have equal

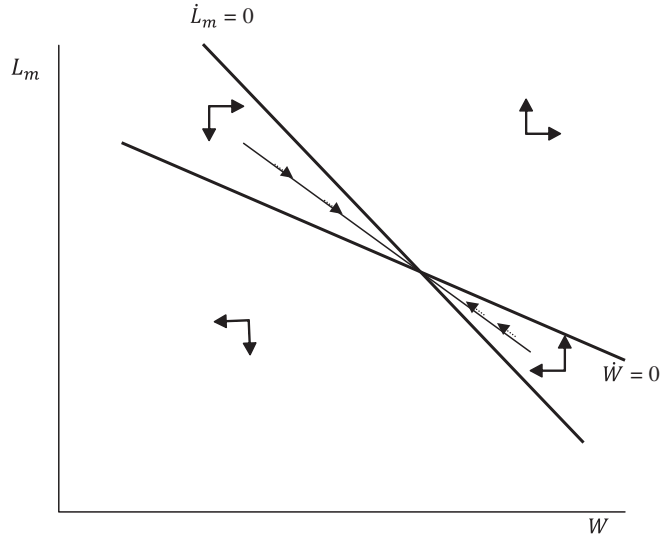

Fig. 1 Saddle-path stability.

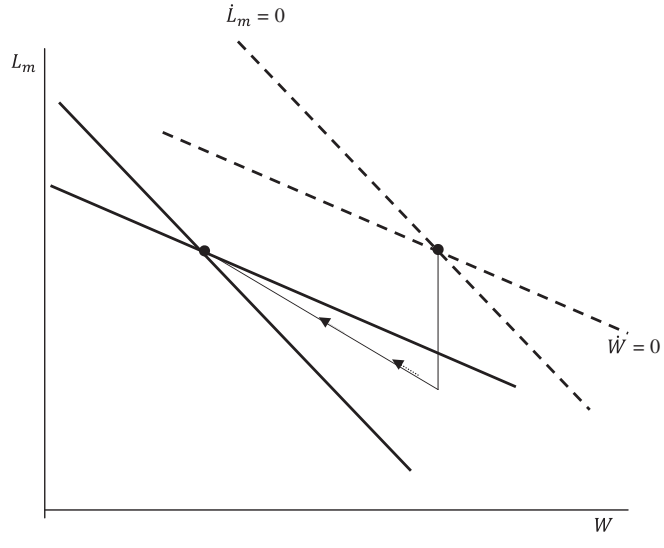

Fig. 2 Private wealth decumulation in response to payroll taxes.

marginal tax rates on labour income, $\tau^A = \tau^B > 0$. Without loss of generality, we now suppose that Country B's marginal tax rate on labour income is raised above the rate in Country A so that $\tau^B > \tau^A > 0$. From (20) and (21), we find that in Country B (the high marginal labour tax rate country) the number of hours of

market work (L_m) is lower and the domestic real interest rate (r) is higher compared to Country A, that is, $(L_m^B)_{autarky} < (L_m^A)_{autarky}$ and $(r^B)_{autarky} > (r^A)_{autarky}$.

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

$$(r-\rho)\psi(L_m^i) = \theta(\theta+\rho)\left[\frac{(1+\tau^i)W^i}{v^f}\right], \tag{26}$$

$$\frac{r(1+\tau^i)W^i}{v^f} = \psi(L_m^i) - L_m^i, \tag{27}$$

where $\tau^B > \tau^A > 0$. Using (27) to substitute out for $(1+\tau^i)W^i/v^f$ in (26), we obtain

$$(r-\rho)r = \theta(\theta+\rho)\left[1 - \frac{L_m^i}{\psi(L_m^i)}\right]. \tag{28}$$

Because the right-hand side of (28) 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 marginal tax rate on labour income is higher in Country 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 countries under perfect international capital mobility, $(L_m^B)_{capital\ mobility} = (L_m^A)_{capital\ mobility}$, by examining the net foreign asset position of each country. The countries start off in autarky with Country B facing a higher domestic real interest rate as a result of the higher marginal labour tax rate. Residents in Country A are then attracted by the higher return to invest in Country B until the real interest rate is equalized across the countries, 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 Country A (equivalently, net foreign liabilities of Country B), the non-human wealth of residents in Country B is given by $W^B \equiv K^B - F$ whilst the non-human wealth of residents in Country A is given by $W^A \equiv K^A + F$.

How does one calculate the size of F? Note from (26) that because $L_m^A = L_m^B$ and both countries face the same real interest rate (r) and gross hourly wage (v^f), we have $(1+\tau^B)W^B = (1+\tau^A)W^A$. With $\tau^B > \tau^A > 0$, without loss of generality, and $K^A = K^B = K$ under perfect international capital mobility, we must have $(1+\tau^B)(K-F) = (1+\tau^A)(K+F)$. Solving, we find that

$$F = \frac{\tilde{\tau}K}{2+\tilde{\tau}}; \quad \tilde{\tau} \equiv \frac{\tau^B - \tau^A}{1+\tau^A}. \tag{29}$$

Thus we prove that Country B (with the higher marginal labour tax rate) ends up as a net debtor and Country A becomes a net creditor. Using (29) and the definitions of W^A and W^B, we can show that

$$W^A = \left[\frac{2(1+\tilde{\tau})}{2+\tilde{\tau}}\right]K, \tag{30}$$

$$W^B = \left[\frac{2}{2+\tilde{\tau}}\right]K, \tag{31}$$

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

A question of interest is what happens to the number of hours of market work in Country A as a result of the net capital flows that occur in response to the higher marginal labour tax rate imposed in Country B? To get the answer, note from (20) that, in autarky, the number of market hours worked in Country A is given by

$$\left[\frac{\alpha}{1-\alpha}\right] = \left(\frac{1}{1+\tau^A}\right)\left[\frac{\psi((L_m^A)_{autarky})}{(L_m^A)_{autarky}} - 1\right], \tag{32}$$

and (21) gives us the autarkic real interest rate:

$$(r^A)_{autarky} = \rho + \frac{\theta(\theta+\rho)}{1-\alpha}\left(\frac{\alpha}{(r^A)_{autarky}}\right)\left[\frac{\alpha}{1-\alpha} + \frac{1}{1+\tau^A}\right]^{-1}. \tag{33}$$

With perfect international capital mobility so that $r^A = r^B = r$, using (30) in (26) and (27), and making a substitution, gives

$$r = \rho + \left[\frac{\theta(\theta+\rho)}{1-\alpha}\right]\left(\frac{\alpha}{r}\right)\left[\frac{\alpha}{1-\alpha} + \frac{2+\tilde{\tau}}{2(1+\tau^B)}\right]^{-1}, \tag{34}$$

$$\left[\frac{\alpha}{1-\alpha}\right] = \left[\frac{2+\tilde{\tau}}{2(1+\tau^B)}\right]\left[\frac{\psi((L_m^A)_{capital\ mobility})}{(L_m^A)_{capital\ mobility}} - 1\right]. \tag{35}$$

Comparing (32) to (35) we find that, with $(2+\tau^A+\tau^B)/[2(1+\tau^B)] < 1$ because, by assumption, $\tau^B > \tau^A$, we have $(L_m^A)_{capital\ mobility} < (L_m^A)_{autarky}$, that is, wealth accumulation through the generation of current account surpluses in Country A in response to the higher real interest rate (caused, in turn, by the higher marginal labour tax rate) offered by Country B leads to a decline in the number of hours of market work in Country A compared to autarky.[5] With capital flowing out of Country A, labour demand declines there and labour supply also contracts as wealth is increased with an increase in the stock holdings of net foreign assets.

[5] Note that $[2+\tilde{\tau}]/[2(1+\tau^B)] \equiv [2+\tau^A+\tau^B]/[2(1+\tau^A)(1+\tau^B)]$.

Using (31) in (26) and (27) and making a substitution gives, with perfect international capital mobility so $r^A = r^B = r$, (34) and

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

Comparing (20) (applied to Country B in autarky with marginal labour tax rate $\tau^B > \tau^A > 0$) to (36), and noting that $(2+\tau^A+\tau^B)/[2(1+\tau^A)] > 1$ because, by assumption, $\tau^B > \tau^A$, we infer that $(L_m^B)_{autarky}$ with the imposition of a higher marginal tax rate on labour income is less than $(L_m^B)_{capital\ mobility}$. Thus the possibility of capital inflows increases the foreign indebtedness of residents in Country B, which acts as a spur to the supply of market work. The capital inflow from Country A also boosts labour demand, which counteracts the tax-induced disincentive to work in Country B. Although the imposition of higher marginal labour tax rates in Country B leads to a decline in market work in Country B in autarky, the possibility of running current 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 countries. We can summarize the results in this sub-section as follows:

Proposition 2 In a two-country world with both countries initially in autarky, the imposition of higher marginal labour tax rates in one country leads that country 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 country with the higher marginal labour tax rate ends up as a net debtor as it attracts capital inflows and the country with the lower marginal labour tax rate ends up as a net creditor. Market work, home work, and leisure end up being equalized across the two countries in the long run with free international capital mobility.

6. Conclusion

This article was motivated by the desire to evaluate the Prescott (2004) hypothesis that permanently higher marginal labour tax rates fully explain the decline in number of market hours worked in Europe (relative to North America) over three decades. The Prescott (2004) model, however, considered two essentially autarkic economies that are not linked by international capital mobility or international exchange of goods. As a modelling strategy, Prescott (2004) adopted the Ramsey growth model to describe each economy. The Ramsey growth model has the property that, in steady state, the real interest rate is necessarily equal to the value of the time discount parameter. One consequence of this is that, in a multi-country world with free international capital mobility populated by representative infinitely lived Ramsey-type individuals, the long-run global distribution of wealth is indeterminate.

We adopt the overlapping generations model introduced by Blanchard (1985), in place of the Ramsey growth model, to characterize each economy so that in a world with free international capital mobility, the long-run global distribution of wealth is determinate. We show that the crucial result of the article—that market hours worked are equalized despite unequal marginal labour tax rates in the long run—is not a consequence of replacing the Ramsey growth model with the Blanchardian (1985) version of the overlapping generations model. Instead, what overturns the Prescott (2004) result is our departure from making the assumption that countries or regions are not linked by international capital mobility or international exchange of goods. We study a one-good model where, for simplicity, there are no incentives for international capital flows with equal marginal labour tax rates but the imposition of higher marginal labour tax rates in one country leads to higher domestic real interest rate in that country. As a result, there are incentives for international capital inflows into the country with the higher marginal labour tax rate, thus boosting labour demand there and counteracting the disincentive effect of higher labour taxes. The number of market hours worked in the country with a lower marginal labour tax rate also declines as residents there become wealthier with the increase in net foreign assets. With identical tastes and rate of time discount across the two countries as Prescott (2004) assumed, we find that the number of hours worked in the market, home work, and leisure are equalized across the two countries. With factor price equalization, the international equalization of hours worked result still holds with goods trade substituting for international capital mobility.

Supplementary material

Supplementary material is available online at www.oep.oxfordjournals.org.

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