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A NOTE ON OPTIMAL CAPITAL TAXATION WITH PREFERENCE EXTERNALITIES

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This paper extends the Chamley–Judd framework by introducing preference externalities in a neoclassical growth model, and finds that the optimal capital tax increases with the extent of social-status seeking or negative leisure externalities. Furthermore, this paper finds that differences in leisure externalities lead to a distinct impact on optimal factor income taxes, and hence may serve as a plausible vehicle to explain the empirical differences in factor income taxation in the United States and Europe.

Keywords: Leisure externalities, Social status, Optimal taxation

1. INTRODUCTION

Many studies in the literature report differences in income taxation between the United States and Europe [e.g., Mendoza et al. (1994); McDaniel (2007); García-Peñalosa and Turnovsky (2011)]. To be more precise, the labor income tax rate in the United States is significantly lower than that in the European countries, while for the capital income tax rate the opposite occurs. Figure 1 indicates that the average capital income tax rate in the United States is about 33% for the period 1960–2007.[1] The corresponding tax rates for France, Germany, and Italy—the largest countries in continental Europe—are, respectively, 19%, 22%, and 15%. In the meantime, the labor tax rate in continental Europe is unambiguously higher than that in the United States. The average labor tax rates in France, Germany, and Italy are, 33%, 35%, and 30%, respectively, but only about 19% in the United States.

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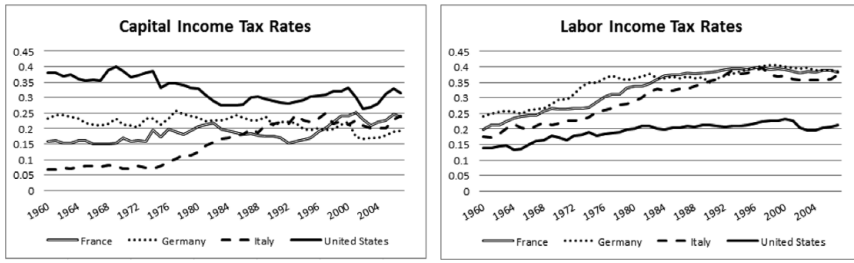


FIGURE 1. The average capital and labor income tax rates in the United States and Europe.

Up till now, to the best of our knowledge, there have been few theoretical analyses that have been devoted to exploring the differences in income taxation between the United States and Europe.[2] To address the importance of such differences in income taxation, in this paper, we develop an otherwise standard real business cycle model, in which we introduce preference externalities to study the optimal factor income taxation for the United States and Europe. Specifically, preference externalities in this paper focus on two types of externalities that have been examined in much of the recent literature, namely, wealth-induced preference externalities and leisure externalities.

In contemporary research, wealth-induced preference externalities are usually illustrated by the desire for social status represented by relative physical capital. Leisure externalities are a fundamental aspect of a presently interdependent economy and indicate that an individual may evaluate his/her own leisure relative to that of others devoted to leisure activities. Indeed, the existence of wealth-induced preference externalities and leisure externalities seems plausible and has been considered extensively in existing studies.[3] Furthermore, the presence of social-status seeking and leisure externalities will affect an agent's labor supply and therefore the accumulation of physical capital. This study turns the focus to the role of preference externalities in determining the optimal factor tax incidence.

In order to quantify the optimal income taxation in the United States and Europe, the model is calibrated to aggregate data for the US economy as well as the European economy. To be more precise, this paper, in line with Azariadis et al. (2013), designates leisure externalities as portraying long-standing cultural differences between the United States and Europe. We then use aggregate working hours data (i.e., the fraction of time allocated to the labor market) to calibrate the extent of leisure externalities.[4] We find leisure jealousy for the United States and leisure admiration for Europe, which are consistent with the Azariadis et al. (2013) assertion. Thus, the analytically tractable model allows us to highlight the important connections between leisure externalities and optimal factor income taxation from a normative perspective. The analysis is particularly important, since it is a new theoretical attempt to come up with the difference in income taxation between the United States and Europe. Furthermore, our theoretical analysis provides new insights into the assessment of the effects of leisure externalities as well as social

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status on factor tax incidence that have never been explored in a formal theoretical setting before.

This article is also related to the literature on optimal income taxation in real business cycle models. In their pioneering work, Judd (1985) and Chamley (1986) argue that the government should only tax labor income and not capital income to finance its expenditures if the factor income tax is the government's only option. This conclusion has been dubbed the Chamley–Judd result [see, e.g., Chen and Lu (2013)]. By contrast, Domeij (2005) assumes that the labor market exhibits search frictions that generate unemployment, and finds that the Chamley–Judd result of zero capital tax should be modified. In addition, in an overlapping generations model in which households face uninsurable idiosyncratic income risk and borrowing constraints, Conesa et al. (2009) find that the optimal capital income taxation is significantly positive. Straub and Werning (2015) adopt a constant relative risk aversion function in consumption in the classical real business cycle model, showing that the optimal capital tax is positive when the intertemporal elasticity of substitution (IES) in consumption is below one.[5]

The remainder of this paper is organized as follows. Section 2 describes the model economy. Section 3 analyzes the effects of changes in tax rates and preference externalities on the economy and examines optimal factor income taxation. Section 4 concludes our discussion.

2. THE MODEL

The economy under consideration consists of three types of agents: firms, households, and a government. In what follows, we in turn describe the behavior of each of these agents.

2.1. Firms

The economy consists of a number of identical competitive firms, which is normalized to unity. Each firm produces output y with the following technology:

$$y = Ak^{\alpha}h^{1-\alpha}, \tag{1}$$

where k and h, respectively, represent the capital stock and labor input hired by the firms, $1 > \alpha > 0$ is the share of capital, and $A > 0$ is the technology parameter.

Let w and r, respectively, denote the market wage and capital rental rate. Based on the assumption of perfect competition, the firm's optimal conditions for the physical capital and labor are given by

$$r = \frac{\alpha y}{k}, \tag{2}$$

$$w = \frac{(1-\alpha)y}{h}. \tag{3}$$

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2.2. Households

Consider an economy populated by a unit measure of identical and infinitely lived households. The representative household is endowed with T units of time and derives utility from consumption c, leisure time $l(= T - h)$ and the wealth-based social status represented by the relative physical capital. In addition, the household's utility is affected by the average leisure $\bar{L}$ of the whole economy. The intertemporal utility of the representative household is represented by

$$\int_0^\infty e^{-\rho t} U\left(c, l, \bar{L}, k, \bar{K}\right) dt, \tag{4a}$$

where the instantaneous utility function is

$$U\left(c, l, \bar{L}, k, \bar{K}\right) = \ln c + \frac{\left(l\bar{L}^{\gamma}\right)^{1-\sigma} - 1}{1-\sigma} + \varphi \ln\left(\frac{k}{\bar{K}}\right). \tag{4b}$$

Here, $\rho > 0$ is the time preference rate, and $\sigma > 0$ is the inverse of the elasticity of intertemporal substitution in leisure. In addition to consumption and leisure, the representative household cares about the wealth-based social status represented by its own capital relative to the average value of capital $\bar{K}$ in the whole economy.[6] Thus, the parameter $\varphi > 0$ portrays the desire for social status.

The parameter γ governs the degree of leisure externalities. Some points regarding γ deserve special mention here. First, if $\gamma > 0$ ($\gamma < 0$), then an agent's utility is positively (negatively) affected by the average leisure $\bar{L}$. Following Dupor and Liu (2003), we may refer to the individual as leisure admiring if $\gamma > 0$, and as leisure jealous if $\gamma < 0$ when other agents' leisure increases. Second, the sign of $\gamma(1-\sigma)$ governs whether the household will raise or reduce its leisure time in response to an increase in the average leisure. Based on the Dupor and Liu (2003) definition, $\gamma(1-\sigma) > 0$ refers to keeping up with the Joneses (KUJ), while $\gamma(1-\sigma) < 0$ signals running away from the Joneses (RAJ).[7] Third, we impose the condition $\gamma + 1 > 0$ when $\gamma < 0$ holds, implying that the negative effect of a leisure externality is dominated by the direct positive effect of its own increase in leisure. Finally, to ensure the concavity of the utility function, the condition $\gamma(1-\sigma) < \sigma$ needs to be imposed.

The representative household faces the following budget constraint:

$$\dot{k} = (1-\tau_w)wh + (1-\tau_k)rk - c - \delta k, \tag{5}$$

where τ_w (τ_k) is the labor (capital) income tax rate, and $\delta \in (0, 1)$ is the depreciation rate of physical capital.

The representative household seeks to maximize the discounted sum of lifetime utilities equation (4a) subject to the budget constraint equation (5). Accordingly, the optimum conditions for the representative household's problem are as

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follows:

$$\frac{1}{c} = \mu, \tag{6a}$$

$$l^{-\sigma}\bar{L}^{\gamma(1-\sigma)} = \mu(1-\tau_w)w, \tag{6b}$$

$$\frac{\varphi}{k} + \mu\left[(1-\tau_k)r - \delta\right] = -\dot{\mu} + \mu\rho, \tag{6c}$$

together with equation (5) and the transversality condition $\lim_{t\to\infty} \mu k e^{-\rho t} = 0$, where μ is the shadow price of physical capital.

2.3. The Government

At any point in time, the government levies factor income taxes to finance its expenditure. Following Turnovsky (2000) and Galí et al. (2007), we assume that government expenditure is a fixed fraction ($0 < g < 1$) of total output (Y) in the economy. Accordingly, the government's budget constraint can be expressed as follows:

$$G = gY = \tau_w wh + \tau_k rk. \tag{7}$$

2.4. The Decentralized Equilibrium

Since we confine the analysis to a symmetric equilibrium and the size of the population is unity, the following relations $k = \bar{K} = K$, $l = \bar{L} = L$, $h = H$, $c = C$, and $y = Y$ are imposed in equilibrium, where K, L, H, C, and Y, respectively, denote the aggregate capital stock, aggregate leisure, aggregate labor, aggregate consumption, and aggregate output. By combining the optimal conditions from firms and households together, we derive the competitive equilibrium conditions:

$$CL^{\gamma-(1+\gamma)\sigma} = \frac{(1-\tau_w)(1-\alpha)Y}{T-L}, \tag{8a}$$

$$\dot{C} = \left[\frac{\varphi C}{K} + \frac{(1-\tau_k)\alpha Y}{K} - \delta - \rho\right]C. \tag{8b}$$

We can derive the economy-wide resource constraint from equations (2), (3), (5), and (7):

$$\dot{K} = Y - C - \delta K - G. \tag{8c}$$

3. EQUILIBRIUM AND THE OPTIMAL TAXATION

We are now in a position to deal with the effects of income tax rates in the steady state. Setting $\dot{K} = \dot{C} = 0$, the steady state of the economy is summarized by

$$\tilde{C}\tilde{L}^{\gamma-(1+\gamma)\sigma} = \frac{(1-\tau_w)(1-\alpha)\tilde{Y}}{T-\tilde{L}}, \tag{9a}$$

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TABLE 1. Effects of increases in taxes and externalities on equilibrium values

	$\tilde{L}$	$\tilde{K}$	$\tilde{C}$	$\tilde{Y}$
Increase in τ_k	+	−	?	−
Increase in τ_w	+	−	−	−
Increase in γ	?	?	?	?
Increase in φ	−	+	?	+

$$\frac{\varphi\tilde{C}}{\tilde{K}} + \frac{(1-\tau_k)\alpha\tilde{Y}}{\tilde{K}} - \delta = \rho, \tag{9b}$$

$$(1-g)\tilde{Y} = \tilde{C} + \delta\tilde{K}, \tag{9c}$$

$$\tilde{Y} = A\tilde{K}^{\alpha}(T-\tilde{L})^{1-\alpha}. \tag{9d}$$

The above four equations determine four endogenous variables: $\tilde{L}$, $\tilde{K}$, $\tilde{C}$, and $\tilde{Y}$, where a tilde ($\sim$) over the variables denotes their steady-state level.

We then calculate the effects of changes in taxes and externalities on aggregate leisure/labor supply, physical capital, consumption, and output, and further summarize the comparative statics in Table 1 above (see Appendix A for the derivation).

The intuition behind these results can be explained as follows. The capital tax rate (i.e., $\tau_k > 0$) is an essential factor affecting the household's intertemporal choice between saving and consumption (i.e., the substitution effect). As a result, in response to a rise in the capital tax rate, the household is motivated to reduce its accumulation of physical capital and raise consumption when it increases. Given that labor and physical capital are complements in production, this in turn leads the firms to reduce their labor demand. As labor demand is reduced, labor supply will decline in equilibrium, implying that the household's leisure will increase in response. Thus, less output will be produced. The fall in output in turn depresses consumption, which we refer to as the income effect. Under the situation where the social-status seeking motive is absent (i.e., $\varphi = 0$), we have $\partial\tilde{C}/\partial\tau_k < 0$ (i.e., an increase in the capital tax always decreases consumption), implying that the income effect dominates the substitution effect. By contrast, under the situation where the social-status seeking motive is present (i.e., $\varphi > 0$), a higher capital tax rate has an ambiguous effect on consumption. The ambiguity arises because when the household is concerned about its wealth-induced social status, it is willing to sacrifice more consumption in order to accumulate more physical capital as well as maintain its social status. That is to say, the desire for wealth-based social status further reinforces the substitution effect mentioned above. As a result, if the desire for social status is sufficiently strong, an increase in the capital tax could lead to an increase in consumption (i.e., $\partial\tilde{C}/\partial\tau_k > 0$), implying that the substitution effect is relatively strong and dominates the income effect.

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In addition, τ_w is the tax on the labor-leisure choice. An increase in the labor tax rate shifts the labor-leisure tradeoff in favor of the latter, thus reducing the fraction of time devoted to work. Given that labor and physical capital are complements in production, this would lead to a decrease in physical capital and therefore output, thus yielding a decline in consumption via the income effect.

The effect of leisure externalities on equilibrium values depends on how the household's marginal utility of leisure is affected by leisure externalities. To be more precise, the sign of $\gamma(1-\sigma)$ governs whether the household will increase or decrease its leisure time. As stated previously, the scenario $\gamma(1-\sigma) > 0$ signals a KUJ effect. Thus, given $\sigma < 1$, an increase in the degree of γ (i.e., $d\gamma > 0$) means a stronger KUJ effect which will lead to higher leisure. As leisure increases (i.e., labor supply decreases), physical capital and therefore output will decrease in response, thereby yielding a decline in consumption via the income effect. With similar intuition, we can infer that the opposite result would prevail under the scenario in association with $\gamma(1-\sigma) < 0$, i.e., an RAJ effect is present.

Since agents care about their social status (i.e., $\varphi > 0$), they will tend to reduce consumption today in order to raise capital accumulation (i.e., the substitution effect). Given that labor and physical capital are complements in production, this will lead to an increase in labor hours and therefore output, thus yielding an increase in consumption via the income effect. In fact, this result is reminiscent of Clark et al. (2008), who documented that status concerns result in excessive work effort and lead to higher income. Accordingly, we can therefore conclude that a higher value of φ (i.e., a high degree of social-status seeking) leads to an increase in consumption if the income effect dominates the substitution effect and vice versa.

3.1. Effect of Factor Taxation and Tax Incidence

This subsection studies the optimal factor tax incidence. To be more specific, a factor tax incidence refers to the scenario whereby an increase in a capital tax is accompanied by a decrease in a labor tax such that the government's budget constraint holds. With this understanding, the optimal factor tax incidence can be defined as the package of capital and labor tax rates that the fiscal authority chooses to maximize social welfare under a balanced budget. Moreover, to provide a more complete and precise picture, in line with Maebayashi et al. (2017), the ex-ante optimal income taxation is determined in a manner in which the equilibrium path includes transitional dynamics.

The social welfare function (i.e., the indirect lifetime utility of households) is given by

$$W = \int_0^{\infty} e^{-\rho t}\left[\ln C_t + \frac{\left(L_t \bar{L}^{\gamma}\right)^{1-\sigma} - 1}{1-\sigma} + \varphi \ln\left(\frac{K_t}{\bar{K}}\right)\right] dt. \qquad (\mathbf{10})$$

It should be noted that, following an adjustment in τ_k and τ_w, the welfare level stated in equation (10) will change in response by way of changes along the whole

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transition paths of C_t, L_t, and K_t. It is very difficult to provide a clear analytical result to solve how the welfare level would react following a change in τ_k and τ_w. We thus resort to a numerical analysis.[8]

3.2. Transitional Dynamics of Optimal Factor Tax Rates

By resorting to a numerical analysis, this section offers a quantitative assessment to determine the ex-ante optimal income taxation. The parameters we set are adopted from commonly used values in the existing literature or calibrated to match the empirical evidence. The technology coefficient is normalized to $A = 1$. Following Karnizova (2010) and Finkelstein Shapiro and Mandelman (2016), the capital share is set to $\alpha = 0.32$. The rate of time preference is set to $\rho = 0.04$, as used by Kydland and Prescott (1991), Aguiar-Conraria and Wen (2008), and Lai et al. (2017).[9] The annual depreciation rate is set to $\delta = 0.1$, as used by Aguiar-Conraria and Wen (2008), Karnizova (2010), and Finkelstein Shapiro and Mandelman (2016). The time endowment is normalized to $T = 100$, and the leisure time is set to $L = 67$ so that the fraction of time allocated to the labor market is one third. Imai and Keane (2004) estimate that IES in labor is 3.8, which is quite comparable to the results used in the macro literature. Rogerson and Wallenius (2009) report that the macro labor supply elasticity ranges from 2.3 to 3. Peterman (2016) estimates that the macro Frisch elasticity of labor supply is about 3. Additionally, Rogerson and Wallenius (2009) report that the micro labor elasticity ranges from 0.05 to 1.25. Chetty et al. (2011) document that the micro Frisch elasticity is about 0.82. Guided by these empirical results, we choose a macro elasticity of 3 as our benchmark case, implying that $\sigma = 0.7$.[10] Later, we will vary the value of σ to 2.5 (i.e., the micro elasticity is around 0.8) to study its effects on the optimal income taxation. Furthermore, both tax rates τ_w and τ_k are chosen such that they are equal to the average labor and capital income tax in the United States for the period from 1960 to 2007. This gives $\tau_w = 0.19$ and $\tau_k = 0.33$.[11] Given these preexisting tax rates, the ratio of government spending to output thus implies that $g = 0.2348$. As for leisure externalities, we use aggregate working hours data (i.e., the fraction of time allocated to the labor market) to calibrate its value.[12] Owing to the fact that a household's concerns about its social status are represented by the relative physical capital, we thus use the aggregate capital data to calibrate the value of the social status preference. According to Cooley and Prescott (1995), Hansen and Imrohoroglu (2008), and Huang and He (2015), the average capital/output ratio is about 3.32, which is close to that observed in the US economy. Given these values, we use equations (9a) and (9b) to calibrate $\gamma = -0.25$ and $\varphi = 0.58$. The parameter values are summarized in Table 2.

In the following, we will implement the quantitative analyses that are particularly interesting to our study.

Social status and the optimal capital tax rate. This subsection focuses on the effect of social-status seeking on the optimal factor tax incidence. It should be

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TABLE 2. Parameter values

A	α	ρ	δ	T	L	σ	τ_w	τ_k	g	γ	φ
1	0.32	0.04	0.1	100	67	0.7	0.19	0.33	0.2348	−0.25	0.58

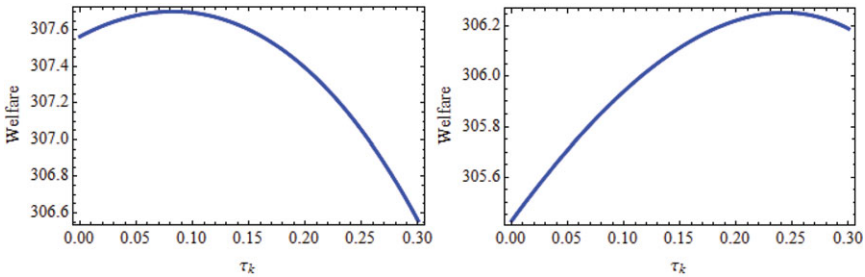


FIGURE 2. Optimal capital tax rate: A change in the extent of social-status seeking.

noted that this model consists of two distortions: the desire for social status and leisure externalities. To explore how the extent of social-status seeking will govern the optimal capital tax rate, we examine the optimal factor tax incidence when leisure externalities are absent (i.e., $\gamma = 0$). To this end, given the absence of leisure externalities (i.e., $\gamma = 0$), the desire for social status in association with $\varphi = 0$ and $\varphi = 0.58$ (the benchmark value) is exhibited in the left panel and the right panel of Figure 2, respectively.

Two important findings emerge from Figure 2. First, in the absence of social-status seeking (i.e., $\varphi = 0$), the optimal capital tax rate is $\tau_k = 8\%$, implying that the Chamley–Judd result is not valid. Second, in the presence of social-status seeking (i.e., $\varphi = 0.58$), the optimal capital tax rate is $\tau_k = 24\%$, implying that a higher degree of social-status seeking is associated with a higher value of the optimal capital tax rate.

The intuition behind these two results regarding the optimal capital tax rate can be explained as follows. First, as pointed out by Lu and Chen (2015), when government spending is a fixed fraction of total output, capital accumulation reduces the discounted net marginal product of capital by increasing its expenditure. It turns out that it is optimal to tax capital income so as to internalize the distortion.[13] Second, compared with the situation where $\varphi = 0$, the presence of social-status seeking leads the household to accumulate a large amount of physical capital from a social point of view. In order to correct for the undue level of physical capital, a capital income tax should be utilized to remove the distortion. As a result, the presence of social-status seeking leads to a higher value of the optimal capital tax rate.

Leisure externalities and the optimal capital tax rate. This subsection focuses on the effect of leisure externalities on the optimal factor tax incidence. To clarify

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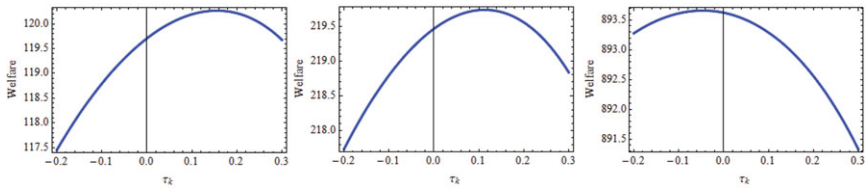


FIGURE 3. Optimal capital tax rate: A change in the extent of leisure externalities.

the role of leisure externalities, we examine the optimal factor tax incidence under the situation where the desire for social status is absent (i.e., $\varphi = 0$). Besides, given that leisure externalities can be either positive (i.e., leisure admiration, $\gamma > 0$) or negative (i.e., leisure jealousy, $\gamma < 0$), we thus decrease the extent of the leisure externalities γ from -0.25 (the benchmark value) to -0.75 and increase the extent of the leisure externalities γ to 0.75 to explore how the extent of the leisure externalities will govern the optimal capital tax rate. Given the absence of the desire for social status (i.e.,$\varphi = 0$), Figure 3 plots the relationship between the level of social welfare and the capital tax rate associated with different extents of leisure externalities, which gives rise to an inverse U-shaped relationship. More specifically, leisure externalities in association with $\gamma = -0.75$, $\gamma = -0.25$, and $\gamma = 0.75$ are exhibited in the left panel, the middle panel, and the right panel of Figure 3, respectively. It turns out that the corresponding optimal capital tax rates are, respectively, $\tau_k = 16\%$, $\tau_k = 11\%$, and $\tau_k = -5\%$ in these three panels.[14] As is evident, our quantitative results in Figure 3 reveal the fact that the government is motivated to impose a higher capital tax rate when the degree of leisure jealousy is relatively high.

The intuition behind the results in Figure 3 is straightforward. In the presence of leisure jealousy, the individual does not internalize the negative externality and hence tends to enjoy too much leisure time (i.e., the individual works too little) from a social point of view. In order to correct for the undue level of leisure, the government is inclined to lower the labor tax rate (i.e., to increase the capital tax rate) to remove the distortion. By contrast, in the presence of leisure admiration, the individual enjoys too little leisure time (i.e., the individual works too much). Thus, the government is inclined to increase the labor tax rate (i.e., to lower the capital tax rate) to remove the distortion. It should be noticed that in association with a higher degree of positive leisure externalities, the government would even use a capital subsidy to remove the distortion.

Before ending this subsection, one point concerning the optimal income taxation should be noted. It is very difficult for us to derive analytical expressions of optimal tax rates, in particular if we fully account for the transitional dynamics effect. However, to clearly isolate the impact of preference externalities on optimal tax rates and to provide a transparent intuition, we can characterize the optimal policy by deriving analytical expressions in the long-run steady state. To this end, we consider the case where the social planner chooses first-best income taxes to

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achieve the first-best optimum.[15,16] Under this situation, the first-best tax rates on capital and labor are set in accordance with $\tau_k = \frac{\varphi[(1-\alpha)\delta+\rho]}{\alpha(\delta+\rho)}$ and $\tau_w = \frac{\gamma}{1+\gamma}$. As is evident, our analytical results hold; that is, the first-best capital tax increases with the extent of social-status seeking and the first-best labor tax increases with the extent of the positive leisure externalities.

3.3. Cultural Predilection for Leisure and Optimal Taxation

The result that the difference in the extent of leisure externalities is associated with a distinctive value of optimal factor income taxes exhibited in Figure 3 can be taken to illustrate the difference in income taxation between the United States and Europe.[17] However, few empirical estimates are available for the difference in leisure externalities γ between the United States and Europe. We thus use aggregate working hours data in the United States and Europe to calibrate γ. As before, the time endowment is normalized to $T = 100$. Rogerson (2006) and Rogerson and Wallenius (2009) document that annual aggregate working hours in continental Europe only amounts to about 70% of that in the United States. Guided by these results, the amounts of leisure time in the United States and Europe are set to $L = 67$ and $L = 77$, respectively. To highlight the role of leisure externalities in explaining the income taxation difference between the United States and Europe, each of the other parameters used in Section 3.2 should remain the same. To be more precise, the parameter values we use are: $A = 1$, $\alpha = 0.32$, $\rho = 0.04$, $\delta = 0.1$, and $\sigma = 0.7$, where the capital/output ratio is set to 3.32. It should be noted that a factor tax incidence refers to the scenario whereby an increase in a capital tax is accompanied by a decrease in a labor tax such that the government's budget constraint holds. Thus, to confine the same constant level of fiscal spending to output, we set $\tau_w = 0.19$ and $\tau_k = 0.33$ for comparison purposes, resulting in $g = 0.2348$.[18] Given these, we can therefore use equation (9a) to calibrate γ for the United States and Europe.

The calibrated values of leisure externalities for the United States and Europe are, respectively, $\gamma = -0.25$ and $\gamma = 0.11$. It should be noted that Azariadis et al. (2013) impose a negative leisure externality (jealousy) for the United States and a positive leisure externality (admiration) for Europe to portray cultural differences. They show that leisure externalities play a significant role in explaining the difference in working hours between the United States and Europe. In departing from their analysis, this paper instead highlights the role of leisure externalities in terms of the difference in factor income taxation (rather than working hours) between the United States and Europe.

Table 3 reports optimal capital and labor income tax rates in the US economy and "European" economy against the data.[19] As documented above, the observed data reveal that the United States has a relatively high capital tax rate and low labor tax rate, while these relative rates are reversed in Europe. Based on the observation that Europe has a leisure culture characterized by $\gamma > 0$ and Americans are workaholics characterized by $\gamma < 0$, the distinct values of γ for the United States

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TABLE 3. Optimal factor tax rates

		Capital tax rate		Labor tax rate	
	Leisure externalities	Optimal value (%)	Data (%)	Optimal value (%)	Data (%)
US Economy	$\gamma = -0.25$	28	33	21	19
"European" Economy	$\gamma = 0.11$	20	19	25	33

and Europe provide a plausible vehicle to replicate the empirical data in these two societies. Equipped with this result, it is plausible for us to conclude that the different tax structures between the United States and Europe can be partly explained by the cultural differences between societies, and this finding contributes a new insight into existing studies on optimal income taxation.[20]

Before ending our discussion, one point should be noted. As mentioned above, micro labor supply elasticities are much smaller than the corresponding macro elasticities. As such, one might wonder whether the above results would be the same if we were to vary the value of σ from 0.7 (i.e., labor supply elasticities are 3) to 2.5 (i.e., labor supply elasticities are 0.8). To clarify this point, we calculate the optimal income taxation in association with $\sigma = 2.5$, while maintaining other parameter values the same as those used above. In this case, the optimal capital tax rates for the United States and Europe are $\tau_k = 23\%$ and $\tau_k = 17\%$, respectively. Besides, the optimal labor tax rates for the United States and Europe are $\tau_w = 24\%$ and $\tau_w = 27\%$, respectively. As is evident, the US taxes capital more, and labor less, than Europe. Thus, in response to a decrease in the elasticity of labor supply, the result remains the same and the calibrated values of the optimal factor tax package for the United States and Europe are consistent with empirical observation.

4. CONCLUSION

In this article, we have extended the Chamley–Judd framework by introducing the role of social status and leisure externalities to examine the optimal factor tax incidence in a neoclassical growth model. We have found that the optimal capital tax increases with the extent of social-status seeking or negative leisure externalities. In particular, based on the fact that the divergence of leisure externalities would lead to a critical impact on optimal factor income taxes, our analyses have suggested that leisure externalities may serve as a plausible vehicle to explain the empirical differences in factor income taxation in the United States and Europe.

NOTES

1. The data are downloaded from http://www.caramcdaniel.com/researchpapers

2. One exception is the model proposed by Klein et al. (2005, p. 31), who study time-consistent fiscal policies, finding that "differences in public spending and the size of the economy (population

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and productivity) may account for the higher capital taxation (and lower labor taxes) of the US relative to continental Europe."

3. With regard to wealth-induced preference externalities, social scientists have long stressed the role of status seeking as being a significant characteristic of human behavior [see Layard (2005), Alvarez-Cuadrado (2007), Fliessbach et al. (2007)]. Indeed, it has also been repeatedly emphasized in the literature that the desire for social status induces people to work more and therefore increases wealth accumulation [Layard (2005), Clark et al. (2008)]. With regard to leisure externalities, Alesina et al. (2006) argue that leisure externalities play an important role in explaining differences in hours worked between the US and Europe. Similarly, Azariadis et al. (2013, p. 844) document that "[l]eisure externalities are clearly part of the cultures of various communities, such as the US, Europe, Latin America or Asia." They further show that leisure externalities generate a significant impact on working hours and economic growth.

4. The calibration is plausible and can be explained as follows. In their previous studies, Hamermesh (2002) and Jenkins and Osberg (2005) found that an individual's participation in associational activity is affected by the leisure activity of others in their community. Besides, Alesina et al. (2006) and Azariadis et al. (2013) further point out that the difference in the extent of leisure externalities is beneficial in explaining the difference in working hours between the US and Europe. As stressed by Alesina et al. (2006, p. 46), "differences in hours of work reflect the difference between a European culture of leisure and American workaholism. One variant of this view is that these differences reflect long-standing cultural differences." Accordingly, given that leisure externalities play an important role in affecting working hours, we thus use the aggregate working hours data to calibrate leisure externalities. We thank an anonymous referee for pointing this out.

5. See also, for example, Cassou and Lansing (2006), Chen and Lu (2013), and Hiraguchi and Shibata (2015).

6. The wealth-based preference is in line with Futagami and Shibata (1998), Corneo and Jeanne (2001), and Fisher (2010) where the social status is represented by the relative physical capital. In addition, by using MRI techniques to measure the brain activity of individuals, Fliessbach et al. (2007) show that individuals care more about their position relative to others than their absolute level.

7. It should be noted that leisure externalities can be characterized as the KUJ effect if $dU_l/d\bar{L} > 0$, or equivalently $\gamma(1-\sigma) > 0$. Alternatively, the RAJ effect emerges if $\gamma(1-\sigma) < 0$ (i.e., $dU_l/d\bar{L} < 0$). Thus, in the scenario where $\gamma(1-\sigma) > 0$, $(1-\sigma)d\gamma > 0$ means that a higher KUJ effect leads to higher leisure. Alternatively, in the scenario where $\gamma(1-\sigma) < 0$, $(1-\sigma)d\gamma < 0$ means that a higher RAJ effect leads to lower leisure. See also Azariadis et al. (2013, p. 851).

8. Appendix B provides a detailed derivation to show how C_t, K_t, and L_t will change over time in response to changes in τ_k and τ_w.

9. Notice that quarterly data are used in Kydland and Prescott (1991), Aguiar-Conraria and Wen (2008), and Lai et al. (2017).

10. Since the value of the macro Frisch labor elasticity is set to $L/((T-L)\sigma) = 3$, this implies that σ is about 0.7. See also Chen and Lu (2013).

11. The data are from McDaniel (2007), following the methodology proposed by Mendoza et al. (1994). Besides, these two values have been used by Chen and Lu (2013).

12. As documented above, leisure externalities play an important role in affecting working hours. See, for example, Jenkins and Osberg (2005) and Azariadis et al. (2013). Thus, we use the aggregate working hours data to calibrate γ. It should be noted that in the later analysis working hours (hence the leisure time L) are endogenously determined and will change in response to changes in τ_k and τ_w.

13. See Lu and Chen (2015) for a detailed discussion.

14. We are grateful to an anonymous referee for calling our attention to the possibilities of a capital subsidy rather than only a capital tax in this paper.

15. At the first-best optimum, the social planner seeks to maximize the representative household's lifetime utility and internalizes all external externalities, subject to the economy-wide resource constraints. The implementation of the first-best income tax policies enables the competitive equilibrium to replicate the first-best equilibrium.

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16. We are grateful to an anonymous referee for bringing this extension to our attention. The detailed proof is available from the authors upon request.

17. Klein et al. (2005, p. 31) study time-consistent fiscal policies, and find that differences in government spending and the size of the economy may account for the higher capital taxes and lower labor taxes in the U.S. relative to continental Europe. More recently, Huang and He (2015) have concluded that differences in income taxation can account for a large fraction of the differences in the health expenditure-GDP ratio and in work time allocation between the US and Europe. In departing from these studies, this paper lays emphasis on the role of leisure externalities.

18. In this case, the extent of the desire for social status is $\varphi = 0.58$.

19. In Table 3, the factor income tax rate in the "European" Economy, consisting of France, Germany, and Italy, is the average value for the three countries for the period 1960–2007. The economic rationale for this specification can be explained as follows. First, France, Germany, and Italy are the largest countries in continental Europe, so we choose these three representative countries as the European economy. Second, in order to compare the differences in the leisure culture between the US and Europe, we further place these three European countries into a group, namely, the "European" Economy. By doing so, we are able to deal with how the importance of the leisure culture is related to differences in the tax structures between the US and Europe.

20. It should be noted that if we instead use the average income tax rates in the "European" Economy to calculate g for Europe, we can then obtain $g = 0.2852$. In this case, the optimal factor tax packages for Europe are $\tau_k = 17\%$ and $\tau_w = 34\%$, respectively. Although these values are much closer to empirical values in Europe, this result, however, relies on two differences, i.e., leisure externalities (γ) and the government spending-output ratio (g). Since the main purpose of this paper is to show how the importance of leisure externalities is related to differences in the tax structures between the US and Europe, each of the other parameters should remain the same.

21. Note that in our dynamic analysis the economy exhibits local stability rather than global stability. This point is raised by an anonymous referee, to whom we are grateful.

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APPENDIX A

This appendix provides a detailed derivation concerning the comparative statics summarized in Table 1. Total differentiation of equations (9a)–(9d) with respect to τ_k, τ_w, γ, and φ yields:

$$\frac{\partial \tilde{L}}{\partial \tau_k} = \frac{\alpha(1-\alpha)\delta \tilde{Y}}{\Omega \tilde{C}} > 0, \tag{A.1}$$

$$\frac{\partial \tilde{K}}{\partial \tau_k} = \frac{-\alpha \tilde{Y}}{\Omega}\left\{\frac{(1-\alpha)(\tilde{C}+\delta \tilde{K})}{(T-\tilde{L})\tilde{C}} - \left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right]\right\} < 0, \tag{A.2}$$

$$\frac{\partial \tilde{C}}{\partial \tau_k} = \frac{\alpha \tilde{Y}}{\Omega}\left\{\left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right] \times \left[\frac{\alpha(1-g)(\delta+\rho)-\alpha\delta(1-\tau_k)-(1-\alpha)(1-g)\delta\varphi}{\alpha(1-\tau_k)+(1-g)\varphi}\right] - \frac{(1-\alpha)\delta}{T-\tilde{L}}\right\} \gtrless 0, \tag{A.3}$$

$$\frac{\partial \tilde{Y}}{\partial \tau_k} = \frac{-\alpha \tilde{Y}^2}{\Omega}\left\{\frac{(1-\alpha)\delta}{(T-\tilde{L})\tilde{C}} - \left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right]\frac{\alpha}{\tilde{K}}\right\} < 0, \tag{A.4}$$

$$\frac{\partial \tilde{L}}{\partial \tau_w} = \frac{(1-\alpha)(\delta+\rho+\delta\varphi)}{\Omega(1-\tau_w)} > 0, \tag{A.5}$$

$$\frac{\partial \tilde{K}}{\partial \tau_w} = \frac{-(1-\alpha)(\delta+\rho+\delta\varphi)\tilde{K}}{\Omega(1-\tau_w)(T-\tilde{L})} < 0, \tag{A.6}$$

$$\frac{\partial \tilde{C}}{\partial \tau_w} = \frac{-(1-\alpha)(\delta+\rho+\delta\varphi)\tilde{C}}{\Omega(1-\tau_w)(T-\tilde{L})} < 0, \tag{A.7}$$

$$\frac{\partial \tilde{Y}}{\partial \tau_w} = \frac{-(1-\alpha)(\delta+\rho+\delta\varphi)\tilde{Y}}{\Omega(1-\tau_w)(T-\tilde{L})} < 0, \tag{A.8}$$

$$\frac{\partial \tilde{L}}{\partial \gamma} = \frac{(1-\alpha)(1-\sigma)(\delta+\rho+\delta\varphi)\ln \tilde{L}}{\Omega} \gtrless 0 \quad \text{if } \sigma \lessgtr 1, \tag{A.9}$$

$$\frac{\partial \tilde{K}}{\partial \gamma} = \frac{-(1-\alpha)(1-\sigma)(\delta+\rho+\delta\varphi)\tilde{K}\ \ln \tilde{L}}{\Omega(T-\tilde{L})} \gtrless 0 \quad \text{if } \sigma \lessgtr 1, \tag{A.10}$$

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$$\frac{\partial \tilde{C}}{\partial \gamma} = \frac{-(1-\alpha)(1-\sigma)(\delta+\rho+\delta\varphi)\tilde{C}\ln\tilde{L}}{\Omega(T-\tilde{L})} \gtreqless 0 \quad \text{if } \sigma \lesseqgtr 1, \tag{A.11}$$

$$\frac{\partial \tilde{Y}}{\partial \gamma} = \frac{-(1-\alpha)(1-\sigma)(\delta+\rho+\delta\varphi)\tilde{Y}\ln\tilde{L}}{\Omega(T-\tilde{L})} \gtreqless 0 \quad \text{if } \sigma \lesseqgtr 1, \tag{A.12}$$

$$\frac{\partial \tilde{L}}{\partial \varphi} = \frac{-(1-\alpha)\delta}{\Omega} < 0, \tag{A.13}$$

$$\frac{\partial \tilde{K}}{\partial \varphi} = \frac{1}{\Omega}\left\{\frac{(1-\alpha)\delta\tilde{K}}{(T-\tilde{L})} - \left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right]\tilde{C}\right\} > 0, \tag{A.14}$$

$$\frac{\partial \tilde{C}}{\partial \varphi} = \frac{\tilde{C}}{\Omega\tilde{K}}\left\{-\alpha\tilde{C}\left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right] + \frac{[\gamma-(1+\gamma)\sigma](1-\alpha)\delta\tilde{K}}{\tilde{L}}\right\} \begin{matrix}>\\<\end{matrix} 0, \tag{A.15}$$

$$\frac{\partial \tilde{Y}}{\partial \varphi} = \frac{\tilde{Y}}{\Omega}\left\{\frac{(1-\alpha)\delta}{(T-\tilde{L})} - \frac{\alpha\tilde{C}}{\tilde{K}}\left[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}\right]\right\} > 0, \tag{A.16}$$

where $\Omega = -(1-\alpha)(\delta+\rho+\delta\varphi)[\frac{\gamma-(1+\gamma)\sigma}{\tilde{L}} - \frac{1}{T-\tilde{L}}] > 0$.

APPENDIX B

This appendix provides a detailed derivation to show how C_t, K_t, and L_t will change over time in response to changes in τ_k and τ_w. Substituting equations (1) and (8a) into equations (8b) and (8c), and linearizing the resulting equations around the steady-state yields:

$$\begin{pmatrix}\dot{K}\\ \dot{C}\end{pmatrix} = \begin{pmatrix}J_{11} & J_{12}\\ J_{21} & J_{22}\end{pmatrix}\begin{pmatrix}K-\tilde{K}\\ C-\tilde{C}\end{pmatrix} + \begin{pmatrix}J_{13}\\ J_{23}\end{pmatrix}d\tau, \tag{B.1}$$

where $J_{11} = \frac{\partial \dot{K}}{\partial K}$, $J_{12} = \frac{\partial \dot{K}}{\partial C}$, $J_{13} = \frac{\partial \dot{K}}{\partial \tau}$, $J_{21} = \frac{\partial \dot{C}}{\partial K}$, $J_{22} = \frac{\partial \dot{C}}{\partial C}$, $J_{23} = \frac{\partial \dot{C}}{\partial \tau}$, $\tau \in \{\tau_k, \tau_w\}$. Due to the complicated calculations, we do not list the analytical expressions for J_{ij}, where $i \in \{1,2\}$ and $j \in \{1,2,3\}$.

By letting s_1 and s_2 be the two characteristic roots of the dynamic system, we can infer that $s_1 s_2 = \frac{(1-\alpha)(\delta+\rho+\delta\varphi)\tilde{C}}{\tilde{K}}[\frac{(1-\alpha)\tilde{L}}{(T-\tilde{L})[\gamma-(1+\gamma)\sigma]-\alpha\tilde{L}} - 1] < 0$. This implies that in the dynamic system there exists one positive and one negative characteristic root. The literature on dynamic rational expectations models, such as Turnovsky (2000), claims that if the number of positive (unstable) roots equals the number of jump variables, then there exists a unique perfect foresight equilibrium solution. The dynamic system in equation (B.1) has one jump variable, C, and one predetermined variable, K, and hence the economy features a unique steady-state equilibrium.[21]

It follows from equation (B.1) that the general solutions for K_t and C_t are

$$K_t = \begin{cases}\tilde{K}(\tau_0); & t = 0^-\\ \tilde{K}(\tau_1) + A_1 e^{s_1 t} + A_2 e^{s_2 t}; & t = 0^+\end{cases}, \tag{B.2}$$

$$C_t = \begin{cases}\tilde{C}(\tau_0); & t = 0^-\\ \tilde{C}(\tau_1) + \left[(s_1 - J_{11})/J_{12}\right]A_1 e^{s_1 t} + \left[(s_2 - J_{11})/J_{12}\right]A_2 e^{s_2 t}; & t = 0^+\end{cases}, \tag{B.3}$$

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where A_1 and A_2 are unknown parameters, 0^- and 0^+ denote the instant before and after the policy change, respectively, and $s_1 < 0 < s_2$ for expository convenience. It should be noted that to simplify the exposition, the policy implementation in this paper is expressed as the exogenous variable τ changes from its benchmark value τ_0 to a new level τ_1, where $\tau \in \{\tau_k, \tau_w\}$.

The two unknown parameters A_1 and A_2 are determined by the two conditions: $K_{0^-} = K_{0^+}$ and $A_2 = 0$. We can therefore obtain $A_1 = \tilde{K}(\tau_0) - \tilde{K}(\tau_1)$. Accordingly, the transitional paths of K_t and C_t reported in equations (B.2) and (B.3) can be re-expressed as

$$K_t = \begin{cases} \tilde{K}(\tau_0); & t = 0^- \\ \tilde{K}(\tau_1) + (\tilde{K}(\tau_0) - \tilde{K}(\tau_1))e^{s_1 t}; & t = 0^+ \end{cases}, \tag{B.4}$$

$$C_t = \begin{cases} \tilde{C}(\tau_0); & t = 0^- \\ \tilde{C}(\tau_1) + \left[(s_1 - J_{11})/J_{12}\right](\tilde{K}(\tau_0) - \tilde{K}(\tau_1))e^{s_1 t}; & t = 0^+ \end{cases}. \tag{B.5}$$

By using equations (1) and (8a), leisure can be determined by

$$L_t^{\gamma-(1+\gamma)\sigma}(T - L_t)^{\alpha} = (1 - \tau_w)(1 - \alpha)AK_t^{\alpha}C_t^{-1}. \tag{B.6}$$

Finally, by inserting equations (B.4) and (B.5) into (B.6), we can infer the transitional path of L_t.

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