E C O N O M I C S   B U L L E T I N

The effect of the government temporal horizon on the optimal tax structure

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Abstract

The government temporal horizon is shown to be a key determinant of the optimal tax structure in an endogenous growth model of the US economy. As the temporal horizon lengthens, wage taxation is gradually substituted by consumption taxation. The optimal tax mix depends notably on the leisure specification.

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1. INTRODUCTION

It is generally assumed in the optimal taxation literature that a benevolent social planner would set taxes so as to maximize the representative agent's utility over an infinite horizon (e.g., Chamley, 1986, Jones et al., 1993, 1997, Milesi-Ferretti and Roubini, 1995). The optimal tax rates on human as well as physical capital income and on consumption would be zero in the long-run under alternative specifications of the leisure activity (see, e.g., Milesi-Ferretti and Roubini, 1995). The government expenditure would be financed by the interest earned on the assets raised by accumulating budget surpluses during an initial phase of relatively high taxation. To some authors (e.g., Jones et al., 1993, Milesi-Ferretti and Roubini, 1995, Coleman, 2000) this feature might cast some doubt on the practical relevance of the optimal tax policy. Perhaps as a consequence, much of the public finance literature has focused on the long-run properties of such a tax policy. However, as Coleman (2000) points out, the tail end of the optimal dynamic tax policy need not be optimal by itself and welfare may even fall if initial high tax rates are not implemented. Thus, more restrictions need to be placed on the tax codes to obtain an optimal policy plan that seems reasonable.

Furthermore, the government could be interested in maximizing the agent's utility over a finite horizon, instead of over an infinite horizon, which could be dictated for example by political considerations. As Islam (1995) argues, there is considerable uncertainty regarding the choice of parameter values to estimate the welfare effects of taxation, and these parameters could also change over time if the adjustment process is slow. Moreover, the history of tax policy shows that tax reforms are not unusual. These facts could also induce the government to shorten its planning horizon.

This paper analyses the effect of the government temporal horizon on the optimal tax structure in a two-sector endogenous growth model calibrated to match US data. Here, tax structure refers to the mix of flat-rate taxes on physical capital income, labor income and consumption that keep the present value of government revenues equal to the present value of government expenditures. Thus, we shall consider deficit-neutral tax reforms. As noted by Jorgenson and Wilcoxen (1997), this is an effective device for separating the discussion of tax reform from the budget debate. The analysis in this paper is based on an endogenous growth model where human capital is a non-market good that is produced with effective labor and a flow of market goods and services.

The choice of the particular specification of the leisure activity has been shown to play a crucial role in the theory of endogenous growth. Stokey and Rebelo (1995) and Milesi-Ferretti and Roubini (1998) show that the effects of taxation on growth depend significantly on the specification of the leisure activity. Ladrón-de-Guevara et al. (1999) study the equilibrium dynamics of a two-sector model of endogenous growth in the Uzawa-Lucas framework, in which leisure enters the utility function as raw time. Ortigueira (2000) analyzes, instead, the equilibrium dynamics of this model when leisure enters the utility function as quality time. He shows that the consequences of including leisure as quality time in the model may differ drastically from those of modelling leisure as raw time and concludes that the choice of the leisure specification is an important issue in growth models. Thus, we shall also analyze the effect of the government temporal horizon on the optimal tax structure under alternative specifications of the leisure activity. Therefore, this paper complements the analysis made by Gómez (2003) on the quantitative implications that the choice of the leisure activity has on the welfare and growth effects of alternative tax structures. As Engen et al. (1997) point out, when testing for the sensitivity of the results, the recalibrated model should reflect the original long-run data. Hence, the model is recalibrated so as to reflect the original long-run data when testing for the consequences that the specification of the leisure activity has on the effects of tax reforms. It may be worth emphasizing that the contribution of this paper is on the empirical side since the theoretical model has been used in earlier research.

The paper is organized as follows. Section 2 describes the model. Section 3 analyzes the effect of the government temporal horizon on the optimal tax structure. Section 4 concludes.

2. THE MODEL

The economy is inhabited by infinitely lived identical households. The representative household derives utility from consumption, c, and leisure, L, according to

$$\int_0^\infty \mathrm{e}^{-\rho t} \frac{(cL^\eta)^{1-\sigma}}{1-\sigma} dt, \tag{1}$$

where ρ is the rate of time preference, and $1/\sigma$ is the elasticity of intertemporal substitution. Time can be allocated to work, u, learning, z, or leisure, l. If the endowment of time is normalized to one per period, the time constraint is

$$1 = u + z + l. \tag{2}$$

We specify leisure in three alternative ways: “raw time” (RT), “home production” (HP) and “quality time” (QT). In the first, utility depends on pure leisure time:

$$L = l. \tag{3a}$$

In the second, leisure is produced with a Cobb-Douglas technology that uses physical capital, k, and human capital, h, as inputs:

$$L = ((1-v)k)^\xi (lh)^{1-\xi}, \tag{3b}$$

where $1–v$ is the fraction of physical capital used in the leisure activity. In the third, leisure depends on effective time:

$$L = lh. \tag{3c}$$

Notice that the home production and quality time specifications coincide when $\xi = 0$.

The rate of return on physical capital is denoted r, and the wage rate, w. Income is spent on consumption and investment in physical and human capital, i_k and e, respectively. Following Trostel (1993), we assume that on-the-job training is paid for by lower wages. As these inputs are deducted from labor earnings, a constant fraction of goods invested in human capital, κ, is bought with foregone earnings. The government imposes flat-rate taxes on capital income, labor income and consumption, τ_k, τ_h and τ_c, respectively, and provides lump-sum transfers, s. Thus the budget constraint is

$$(1-\tau_k)rvk + (1-\tau_h)(wuh - \kappa e) + s = i_k + (1+\tau_c)c + (1-\kappa)e. \tag{4}$$

The stocks of physical and human capital evolve according to the dynamic equations

$$\dot{k} = i_k - \delta_k k, \tag{5}$$

$$\dot{h} = G(e, zh) - \delta_h h = Be^{\beta}(zh)^{1-\beta} - \delta_h h, \tag{6}$$

where δ_k and δ_h are the rates of depreciation of physical and human capital, respectively.

Output, y, is produced with a Cobb-Douglas technology:

$$y = (vk)^{\alpha}(uh)^{1-\alpha}, \qquad 0 < \alpha < 1. \tag{7}$$

Profit maximization implies that labor and capital are used up to the point at which marginal product equates marginal costs.

Measured output in national accounts does not count on-the-job training investments in human capital that are paid for by lower earnings. Henceforth, the term GDP will be used for measured output,

$$\text{GDP} = y - \kappa e. \tag{8}$$

We shall assume that government claims fractions, g_c and g_s, of GDP, for expenditure on consumption and lump-sum transfers, respectively. Adjustment in lump-sum transfers to households balances the government budget each period, so that

$$s = g_s \text{GDP} - d,$$

and the government's budget constraint can be expressed as

$$d = (g_s + g_c)\,\mathrm{GDP} - \tau_k rvk - \tau_h (wuh - \kappa e) - \tau_c c\,. \tag{9}$$

Thus, d is the amount of lump-sum taxation (or transfers) needed to keep a balanced budget and, therefore, expresses the primary budget deficit. For simplicity, we do not explicitly consider financing by debt issue since, because of Ricardian Equivalence, the lump-sum tax is equivalent to debt when the sequence of fiscal parameters is held fixed.

To calibrate the model to match US data we follow Gómez (2003), and consider the parameter values summarized in Table 1. See that reference for details on the solution and calibration of the model.

3. SIMULATION RESULTS

In this section, government is assumed to set tax rates so as to maximize the utility derived by the representative agent over a finite horizon:

$$\int_0^T \mathrm{e}^{-\rho t} \frac{(cL^{\eta})^{1-\sigma}}{1-\sigma} dt\,.$$

The optimal tax structure is calculated as the government temporal horizon, T, varies. Government expenditure and exogenous welfare transfers as a percentage of GDP, g_c and g_s, respectively, remain fixed at their pre-tax-reform levels displayed in Table 1. Taxes are set so that the present value of tax revenue equal that of government expenses. The government adjusts lump-sum taxes d (or equivalently issues debt) as needed to make up for any shortfall or excess of tax revenue over expenses. We explicitly solve for the non-linear transitional dynamics by using the time elimination method (Mulligan and Sala-i-Martín, 1993).

Figure 1 displays the optimal tax structure as a function of the government temporal horizon, T, for alternative specifications of the leisure activity. The optimal tax mix depends noticeably on the time horizon, T. The longer the government temporal horizon the more the optimal tax policy relies on consumption taxation and the less it relies on labor income taxation. This behavior is similar in the three leisure specifications. As the temporal horizon lengthens, the long-run growth rate effect becomes more important to achieve a higher welfare. Shifting to consumption taxation has a positive effect on the growth rate, so its potential benefit emerges in a relatively long run. This explains why the optimal tax mix does not include consumption taxation until the government temporal horizon is relatively long. These results are in agreement with those reported by Gómez (2003), who showed that the labor income tax is the most costly tax, specially in the raw time model.

Notable differences can be observed, however, across the different leisure specifications. As the temporal horizon lengthens, the fall of the labor income tax in the RT and QT models is remarkably higher than that in the HP model, in which the optimal τ_h remains positive even in the long-run. Furthermore, the optimal τ_h becomes zero earlier in the RT than in the QT model. On the contrary, the optimal τ_c becomes nonzero earlier in the HP case than in the QT and RT models. The behavior of the optimal τ_k also differ to a great extent across the leisure specifications: Whereas it remains relatively constant in the RT model, it decreases steadily as T increases in the QT and HP models. The relation between the optimal tax rates on capital and labor income when the government temporal horizon is relatively short is also strongly dependent on the choice of the leisure function. As one moves from the HP to the QT and the RT specification of the leisure activity, the optimal τ_h is higher for short temporal horizons.

It should be noted that by taking the limit as the temporal horizon T tends to infinity, we would obtain the same optimal tax mix as that reported by Gómez (2003). In fact, Figure 1 shows that the optimal tax mix remains roughly invariant from T=60 on in the RT model; from T=80 on in the QT model, and from T=100 on in the HP model. This result entails that, when computing the optimal tax structure for an infinite horizon, the government could truncate the temporal horizon but, in order to obtain an accurate approximation, the period considered should be longer in the HP model than that considered in the QT model, which in turn should be longer than that considered in the RT model.

The results displayed in Figure 1 differ to a great extent from those reported by the optimal taxation literature (e.g., Chamley, 1986, Jones et al., 1993, 1997, Milesi-Ferretti and Roubini, 1995). When taxes can vary over time and the government temporal horizon is infinite, the optimal tax rates on capital and labor income and consumption are zero in the long-run: The government expenditure would be financed by the interest earned on the assets raised by accumulating budget surpluses during an initial phase of relatively high taxation. Gómez (2003) computes the optimal structure of factor incomes and consumption taxation in a model calibrated to the US economy when the government temporal horizon is infinite. The optimal tax mix has a high reliance upon consumption taxation, and a moderate reliance upon capital income taxation. The optimal tax on labor income would be zero in the QT and RT models, whereas it is significantly nonzero (about 7.6 percent) in the HP model. When taxes are constrained to be constant, the optimal tax rate would be a compromise between these two opposite forces, which could result in imposing nonzero constant tax rates throughout. The magnitude of the tax rate would then be given by the distortion that it induces along with the requirements of the government's budget constraint. Figure 1 makes clear that the distortion induced by each tax rate depends to a great extent on the temporal horizon. In particular, as we have already noted, the potential benefits on the growth rate of shifting to consumption taxation would emerge in a relatively long run, which explains why the optimal tax mix does not include consumption taxation until the government temporal horizon is relatively long.

The estimates of the US tax rates on capital and labor income and consumption used in the calibration of the model have been taken from Mendoza et al. (1994). Their results show that the tax rates on capital income and consumption have been roughly constant in the postwar US economy, whereas the tax rate on labor income has increased slightly. Mendoza et al. (1997) reports the mean of quinquennial averages of tax rates over the period 1965-1991, which show that the US tax structure has a low reliance on consumption taxation: The average value of the tax rate on consumption is 5.648%, the average value of the tax rate on labor income is 25.360%, and the average value of the tax on capital income is 42.719%. Figure 1 shows that, regardless of the leisure specification, the longer the government temporal horizon the more the optimal tax policy relies on consumption taxation and the less it relies on labor income taxation. This result suggest that the low reliance on consumption taxation observed in US could be partly explained by a relatively short government temporal horizon.

4. CONCLUSION

This paper assessed the implications for the optimal tax structure of assuming that politicians who set tax policy might have a finite planning horizon. As the temporal horizon lengthens, wage taxation is gradually substituted by consumption taxation. Since the benefit of shifting to consumption taxation would take a relatively long time to set in, the optimal tax mix would not include consumption taxation till the government temporal horizon is relatively long. This result is robust to the choice of the leisure function. However, the time when the consumption tax becomes nonzero, the extent of the shift from wage to consumption taxation, and the evolution of the capital income tax are strongly dependent on the leisure specification. These results suggest that the low reliance on consumption taxation observed in US could be partly explained by a relatively short government temporal horizon.

Table 1. Parametrization of the model

Technology					
α	B	β	ξ	δ_k	δ_h
0.391	0.520	0.201	0.08	0.066	0.057
Preferences					
σ	η	ρ			
2	1.48	0.042			
Fiscal policy					
τ_k	τ_h	τ_c	g_c	g_s	κ
0.415	0.291	0.044	0.162	0.207	0.25

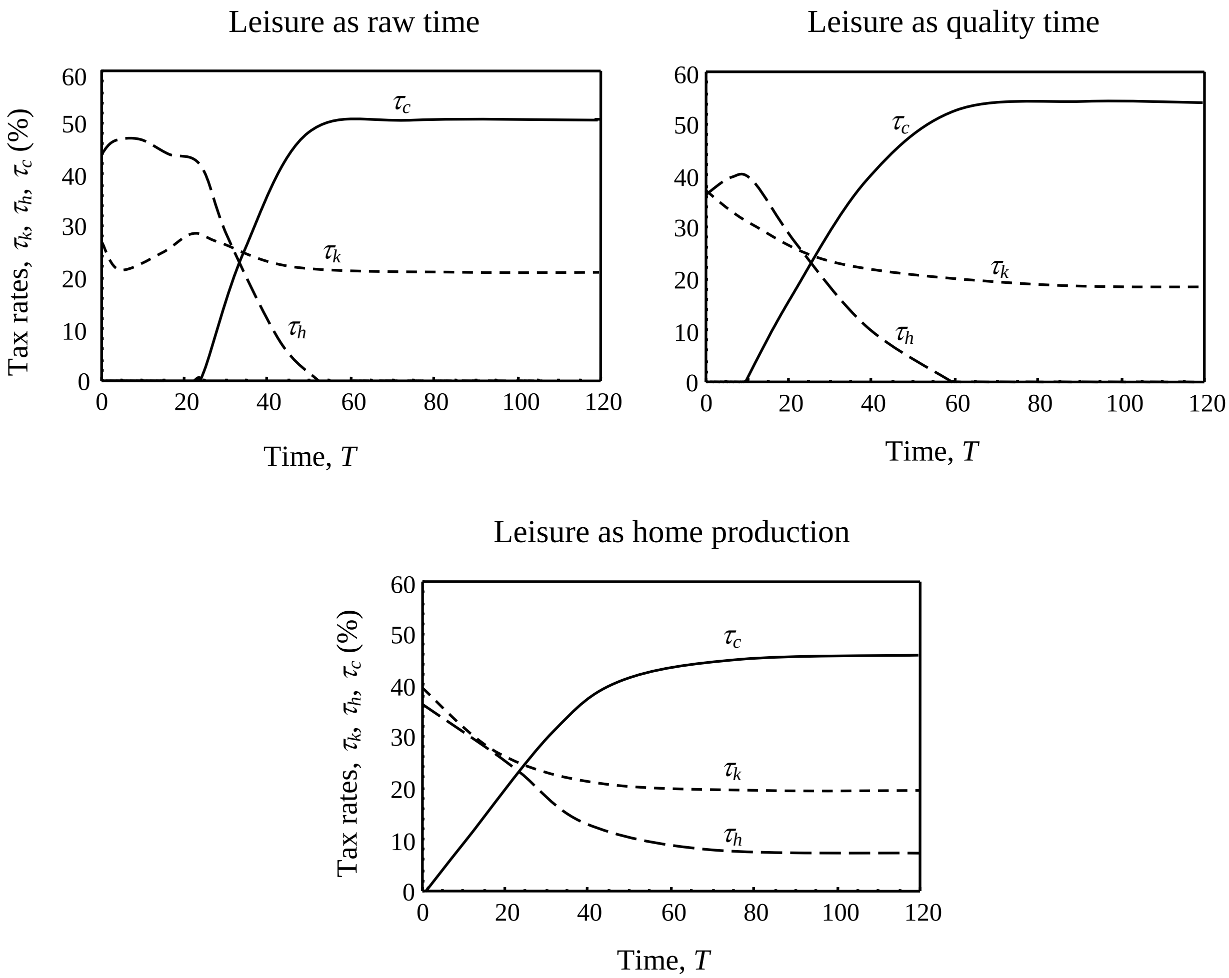

Figure 1: Optimal tax structure as a function of the government temporal horizon, T

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