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Tax Efficiency in an Open Economy

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Abstract

This note assesses the relative efficiency of different tax bases in an open economy. If terms of trade effects are large, lump-sum taxation may be inferior to distortionary consumption or wage taxes. This result is demonstrated analytically using a simple neoclassical model. An overlapping generations, general equilibrium, simulation model is then employed to show the empirical significance of the effects involved.

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Contents

Summary

This note analyzes the relative efficiency of different tax bases in an open economy. With a simple neoclassical model, it shows analytically that the commonly supposed superiority of lump-sum taxes over disortionary consumption or wage taxes depends crucially upon the price elasticity of export demand.

Indeed, if the country faces infinitely elastic demand for its exports, then lump-sum taxes are more efficient. If export demand is inelastic, however, then the real exchange rate may fall to induce foreigners to demand the increase in production that follows a switch to lump-sum taxation. This shift in the terms of trade leads to welfare losses for domestic households, which, in some cases, more than offset the beneficial impact of the rise in output.

In a two-country model, when transfers are used to stabilize the utility of foreign consumers, the note shows that switching to lump-sum taxation always raises domestic welfare. The second part of the paper employs a general equilibrium simulation model to show that the effects described above continue to be important within a realistic framework.

I. Introduction

In this note, we consider the welfare impact of alternative tax bases in an open economy with variable terms of trade. In particular, we focus upon the relative efficiency of VAT, wage taxes and lump sum transfers.[1] A common view is that lump sum taxes are preferable to consumption taxes which are preferable to a tax on wages. Lump sum taxes rank highest since they are nondistortionary, while consumption taxes are seen as better than a wage tax since switching from a wage to a consumption tax imposes a lump sum tax on initial wealth.

The results below show that in an open economy facing an inelastic demand for exports, the above ranking is reversed. The basic reason is that substituting a lump sum tax for a wage tax leads to greater labor supply and increased domestic output. With production outpacing consumption demand, the supply of exports increases. If export demand is inelastic, a marked deterioration in the terms of trade may be required to maintain balance of payments equilibrium. The deleterious impact on domestic welfare of this worsening in the terms of exceeds the gains from higher production. The crucial role of the terms of trade effect is revealed by the fact that when the elasticity of export demand is large, the conventional ranking of the three taxes is restored. Alternatively, if the elasticity of substitution between imports and exportables for domestic consumers is large, then the extra domestic output can be absorbed without a large change in the terms of trade and once more the conventional ranking applies.

The note is organized as follows. Section 2 provides an analytical demonstration of the above results using a simple neoclassical open economy model. Section 3 shows that, as one might expect, in a two country model in which international transfers are used to stabilize the utility of foreign consumers, domestic residents gain from a switch from either wage taxes or VAT to lump sum taxation. Section 4 then compares the welfare impact of the different tax bases employing a steady state version of the general equilibrium simulation model developed by Perraudin and Pujol (1990). This model consists of overlapping generations of consumers supplied with goods by firms employing labor and capital in their production. Households fall into two groups, labelled rich and poor, depending upon their labor productivity, and poor households are subject to liquidity constraints which prevent them from borrowing against future labor income. Adopting realistic parameter values, we show the empirical importance of the analytical results of the previous section within a long run steady state.

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[1] A substantial literature has examined the related question of the relative efficiency of VAT and taxes on savings income. Kaldor (1957) and Meade (1978), amongst others, have argued that the double taxation of savings that results from having taxes both on consumption and on the income from savings imposes an excessive burden upon savings resulting in a suboptimal capital stock. More recent studies of this topic include Boskin (1978), Feldstein (1978), Summers (1981) and Pechman (1990). The issue of the relative efficiency of capital income taxation is not examined in this study.

II. Analytical Results

In this section, we present a simple neoclassical open economy model. Households optimize the following Cobb-Douglas utility function defined upon leisure, and current consumption:

$$U(C_1, C_2, L) \equiv C^{\alpha}(1 - L)^{\beta} \tag{1}$$

$$\text{where} \quad C = \left[\gamma_1 C_1^{1-\frac{1}{\sigma}} + \gamma_2 C_2^{1-\frac{1}{\sigma}} \right]^{\frac{1}{1-\frac{1}{\sigma}}} \quad \text{and} \quad \alpha + \beta = \gamma_1 + \gamma_2 = 1$$

Here, C_1 and C_2, represent the consumption of domestically produced and imported goods respectively, while L denotes the household's labor supply.[1] Good 1 serves as numeraire so that $P_1 \equiv 1$, while the price of the imported good, P_2, is equivalent to the exchange rate ϵ.

Households are subject to the following taxes: (i) a tax on wages (W) at the constant rate t_x.[2] ; (ii) a consumption tax levied on both domestically-produced and imported goods at rate t; (iii) a transfer or negative lump sum tax (T). The budget constraint of each household is, therefore:

$$\sum_{j=1}^{2} P_j(1+t)C_j \quad = \quad T + W(1-t_x) \tag{2}$$

Note the difference between consumption and wage taxes as revealed by this equation. Consumption taxes involve a lump sum levy on existing wealth, in this case transfers. If lump sum taxes are superior to distortionary wage taxes, then one might expect a combination of a lump sum and a wage tax to be preferable to a wage tax alone. Maximizing the utility function (1) subject to (2) yields the following consumption and labor supply rules:

$$W(1-t_x)(1 - L) \quad = \quad \beta R \tag{3}$$

$$(1+t)P_iC_i \quad = \quad \gamma_i^{\sigma}\left(\frac{P_i}{P}\right)^{1-\sigma} \alpha R \qquad i = 1,2 \tag{4}$$

$$\text{where} \quad P \quad \equiv \quad \left(\sum_{i=1}^{2} \gamma_i^{\sigma} (P_i)^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{5}$$

$$\text{and} \quad R \quad \equiv \quad T + a(1-t_x) \tag{6}$$

[1] A household's endowment of time is normalized to unity.

[2] We abstract from the distortions introduced by the progressivity of marginal tax rates.

Note that R represents the household's initial endowment. Now consider the behavior of firms. For simplicity, we suppose that the output of a single representative firm is proportional to labor input, $Y_1 = a\,L$. In equilibrium, the gross wage must, therefore, equal the marginal product of labor a. Substituting into the expression for labor supply, one may derive equilibrium labor input which, in turn, implies the level of output.

$$Y_1 \quad = \quad a(1-\beta) - \frac{\beta T}{(1-t_x)} \tag{7}$$

The market equilibrium condition for the domestic good is:

$$Y_1 \quad = \quad C_1 + X_1 \tag{8}$$

where the demand for exports, X_1, depends upon their price in foreign currency with an elasticity, $\epsilon > 0$, i.e. $X_1 = X_0 e^{\epsilon}$. Substituting for C_1 and rearranging gives the following implicit expression for the equilibrium exchange rate:

$$a(1-\beta) - \frac{\beta T}{1-t_x} \quad = \quad X_0 e^{\epsilon} + \gamma_1^{\sigma} \left(\frac{P_1}{P}\right)^{1-\sigma} \frac{\alpha R}{1+t} \tag{9}$$

Substituting the agent's optimal consumptions and labor supply rules into the government's budget constraint: $tC_1 + teC_2 + t_x W L = T$, and rearranging yields:

$$a \quad = \quad R\left(\frac{\alpha}{1+t} + \frac{\beta}{1-t_x}\right) \tag{10}$$

Substituting the agent's demand functions into the direct utility function, one may derive the following indirect lifetime utility function for households:

$$V \quad \equiv \quad U_0 R\,(1-t_x)^{-\beta}\,(1+t)^{-\alpha}\,P^{-\alpha} \tag{11}$$

where U_0 is a constant depending upon parameters of economy but independent of the tax rates and transfer level. Define the function $g(e) \equiv \gamma_1^{\sigma}(P_1/P)^{1-\sigma} = \gamma_1^{\sigma}/(\gamma_1^{\sigma} + \gamma_2^{\sigma} e^{1-\sigma})$. One may easily show that g represents the share of good 1 in total consumption. Taking derivatives of (9) the budget constraint (8) gives:

$$\frac{dV}{V} = \left[1 - (1-K)\frac{1+t}{1-t_x}\right]\left(\frac{\beta R}{a}\frac{\alpha}{1+t}\left(\left.\frac{dt}{1+t}\right|_T + \left.\frac{dt_x}{1-t_x}\right|_T\right) + \frac{\beta T}{R}\left.\frac{dt_x}{1-t_x}\right|_t\right) \tag{12}$$

where K is defined by $K \equiv (1 - g(e))/(\epsilon + (\sigma - 1)g(e))$ and where subscripts on the derivatives indicate the other fiscal variable which is being changed to maintain a balanced budget.

One may immediately see that the ranking of the three taxes is determined solely by the sign of the term in square brackets. If this term has a negative sign then the conventional ranking holds, whereas, if the sign becomes positive, this ranking is reversed. In consequence, when either ϵ or σ are large, $K \to 0$ and the conventional ranking applies. The economic reason is that, for large values of these parameters, when domestic output increases, only small changes in the terms of trade are required to induce off-setting increases in export demand (with large ϵ) or in domestic consumption of the exported good (with large σ). On the other hand, when K is large and positive, because, say, $\sigma = 1$[1] and $\epsilon \to 0$, then wage taxes dominate VAT which dominates lump sum taxation. These results are summarized in Table 1 below.

Table 1: The Welfare Impact of Tax Base Changes

	$\epsilon \to \infty$ or $\sigma \to \infty$	$\epsilon + (\sigma - 1)g(e) \to +0$
$dt > 0$ $dT < 0$	⥊	⥋
$dt_x > 0$ $dT < 0$	⥊	⥋
$dt_x > 0$ $dt < 0$	⥊	⥋
Explanatory note: The policies considered here involve balanced-budget changes in two of the three fiscal variables, t, t_x and T, holding the third variable constant.		

One should note the close connection between the magnitude of K and the Marshall-Lerner condition. Letting $BT \equiv X_0\epsilon^\epsilon - eC_2$ denote the balance of trade, one may show that $dBT/de = (X/e)(\epsilon + (\sigma - 1)g(e) - 1)$. Thus, the Marshall-Lerner condition may be written as $K > 1 - g(e)$.

III. The Two Country Case

An obvious question to ask, given the results of the last section, is whether the

[1] Recall that this is the Cobb-Douglas case.

conventional ranking of different tax bases is restored when it is possible to redistribute income in a lump sum fashion between the inhabitants of the domestic country and the rest of the world. The obvious intuition would be that in this case the world as a whole could be considered as a closed economy and the standard results on the inefficiency of distortionary taxation would follow. To confirm this intuition, one may formulate a two-country model in which industry and representative consumers in each country have the same production technology and preferences as in the model of Section 2 above. Allowing for transfers between countries is equivalent to having only a single budget constraint for the two governments. Such a formulation yields the following system of indirect utility functions for the two representative agents, budget constraint for the governments, and market equilibrium for good 1:

$$U = U_0 R(1-t_x)^{-\beta}(1+t)^{-\alpha} P^{-\alpha} \tag{13}$$

$$U^* = U_0^* R^* P^{-\alpha} e^{\alpha} \tag{14}$$

$$\left(\frac{\alpha}{1+t} + \frac{\beta}{1-t_x}\right) R + \left(\frac{\alpha}{1+t^*} + \frac{\beta}{1-t_x^*}\right) R^* e = a(1+e) \tag{15}$$

$$\gamma_1^{\sigma} \left(\frac{P_1}{P}\right)^{1-\sigma} \alpha \left[\frac{R}{1+t} + \frac{R^* e}{1+t^*}\right] = a - \frac{\beta}{1-t_x} R \tag{16}$$

where asterisks denote variables for the rest of the world. To simplify the computation, assume that t^* and t_x^* are zero throughout. Initially T^* is also zero but then transfers are adjusted to offset the welfare effects upon foreign residents of the price changes that follow shifts in domestic taxes. Using (12) and (13) to eliminate R^* and R, one may show, after a certain amount of algebra, that:

$$\frac{dV}{V} = \left[\left[\beta - \frac{\frac{\beta}{1-t_x}}{S}\right] - \Phi\right] \frac{dt_x}{1-t_x} + \left[\left[\frac{\frac{\alpha}{1-t}}{S} - \alpha\right] - \Phi\right] \frac{dt}{1-t} \tag{17}$$

$$\text{where} \quad \Phi \equiv \frac{\frac{\beta}{1-t_x}}{S} \frac{(eg - 1 + g)\alpha}{\sigma + 1 - (1+e)\alpha g} \tag{18}$$

$$\text{and} \quad S \equiv \frac{\alpha}{1+t} + \frac{\beta}{1-t_x} \tag{19}$$

It is possible to show that the coefficients $\frac{dt_x}{1-t_x}$ and $\frac{dt}{1-t}$ in the above equation equal respectively $-\alpha(1-(1-g)A)(1-g-eg)/((1-e\alpha gA)(1-g))$ and $\beta[(\sigma+1-\alpha g(1+e))(1+\beta t-\alpha t_x) -(\sigma+\beta)(1+t)]/\ [(1+\beta t-\alpha t_x)(\sigma+\beta+\alpha(1-g-ge)]$ (where $A \equiv (\sigma+1-\alpha g)$) and that these two expressions are both unambiguously negative. To sum up, as one might expect, in the two country case with transfers between the inhabitants of the two economies, lump sum taxation is more efficient than VAT or labor income taxation when tax rates are initially zero in the foreign country.

IV. Numerical Simulations

This section analyzes the relative efficiency of lump sum, consumption and wage taxes within the framework of the general equilibrium simulation model developed by Perraudin and Pujol (1990).[1] This model may be viewed as somewhat more realistic than the analytical model of the last section. Domestic industry includes two sectors, of which sector 1 produces a nontraded good, and sector 3 produces an export good. Firms face convex costs of adjusting their factor inputs leading to a tradeoff between the high profits that may be obtained by producing at optimal input levels and the high adjustment costs that rapid movement towards such optimal levels entails.[2] The production functions of the two firms are taken to be identical Constant Elasticity of Substitution functions of labor and capital inputs while the adjustment costs are quadratic.

Households derive utility from leisure, from the two domestically-produced goods and from an imported commodity denoted good 2. Their utility functions are nested C.E.S. functions, additively separable over time.[1] The population comprises two types of household, labeled Rich and Poor. Poor households are identical to Rich except that their labor productivity is lower and they face liquidity constraints which prevent them from borrowing against their future labor income.[2] Each household works for eight periods and then spends two periods in retirement before dying. Enough new households are 'born' each period to maintain a constant population.

The simulations of the model reported in this paper are based on a parametrization quite close to the one adopted in Perraudin and Pujol (1990). That parametrization (of which full details may be found in the other paper) was based on the French economy in the period around 1985. Microeconomic studies of firm and consumer behavior and estimates of trade elasticities were used to establish many parameter values, while the remaining free parameters were set at levels that reproduced income and consumption shares prevailing in 1985, in steady state simulations of the model. The only difference between the parametrization of this paper and that of Perraudin and Pujol (1990) is that the elasticity of export demand is here set to a range of values i.e. -0.5, -1, and -50, rather than to -1 alone.

Table 2 shows the long run consequences of switching between different tax bases within the framework of this model. Simulations (1), (3), and (5) involve cuts in VAT financed by higher lump sum taxation. Simulations (2), (4) and (6) look at similar cuts

[1] This model is a generalization of the closed-economy overlapping generations simulation model of Auerbach and Kotlikoff (1987).

[2] In this paper, we report only steady state results. Since there is no net investment in the steady state, adjustment costs have no impact on our results.

[1] The two tradeables contribute to a C.E.S. sub-utility function which in turn combines with the non-tradeable to form another sub-utility function. Total utility in a particular period is then a C.E.S. function of this latter sub-utility function and leisure.

[2] Hubbard and Judd (1986) have stressed the potential importance of credit constraints in determining the deadweight losses imposed by different tax systems.

financed by an increase in the wage tax. Since we are interested in whether or not these policies constitute Pareto improvements, lump sum transfers are carried out between the two types of household so as to maintain constant the utility of the Rich (household 1).

Assuming a low elasticity of export demand of -0.5, one may see from simulation (1) that the switch from VAT to lump sum taxation lowers domestic welfare. The change in taxes induces higher labor supply and production that outpaces the increased domestic demand. The maintenance of balance of payments equilibrium requires a deterioration in the terms of trade of which the impact upon domestic welfare more than offsets the gains from higher output.

As one may see from simulations (3) and (5), this result is overturned as the elasticity of export demand increases. With $\epsilon = -1$, the increase in the labor supply is actually slightly higher than in simulation (1) but the benefits of the increase in output now accrue rather more to domestic residents since the terms of trade deteriorate by less than half as much. The net impact on domestic welfare if very slightly negative. With $\epsilon = -50$, as one may see from simulation (5), the switch to lump sum taxation represents a Pareto improvement. Labor supply increases very much in line with the rises of (1) and (3) but the full benefits of the extra production are now enjoyed by domestic households.

Turning now to the effects of a switch from VAT to wage taxation, one may see from (2) that once again the usual presumption (in this case of the superiority of VAT) is overturned for low elasticities of export demand. The switch leads to declines in savings and labor supply that, in turn, precipitate a substantial fall in domestic production. Consumption of goods 1 and 3 declines but the improvement in the terms of trade permits a large increase in the consumption of imports. The net effect is an increase in domestic welfare. With larger values of ϵ (see (4) and (6)), this terms of trade effect disappears and the higher consumption of leisure and imports are no longer sufficient to offset the declines in consumption of domestic commodities.

Table 2: Steady State Simulations

Export Demand Elasticity		$\epsilon = 0.5$			$\epsilon = 1$		$\epsilon = 50$	
Agent	Variable	Base Level	(1) % Chg	(2) % Chg	(3) % Chg	(4) % Chg	(5) % Chg	(6) % Chg
Household 1	Consumption 1	5.39	1.0	-1.1	0.9	-0.3	0.8	-0.1
	Consumption 2	1.15	-2.3	4.0	-0.3	0.5	0.7	-0.1
	Consumption 3	1.15	1.0	-1.1	0.9	-0.3	0.8	-0.1
	Leisure	3.52	-0.8	1.1	-1.4	0.9	-1.7	0.9
	Savings	4.38	1.9	-3.6	1.4	-1.6	1.2	-1.2
	Utility	-31.85	0.0	0.0	0.0	0.0	0.0	0.0
Household 2	Consumption 1	3.36	-0.3	-0.1	1.2	-1.1	2.0	-1.3
	Consumption 2	0.72	-3.6	5.1	0.0	-0.3	2.0	-1.3
	Consumption 3	0.72	-0.3	-0.1	1.2	-1.1	2.0	-1.3
	Leisure	5.06	-1.9	2.2	-1.7	0.7	-1.6	0.5
	Savings	1.25	2.7	-3.6	2.8	-1.7	2.8	-1.2
	Utility	-33.95	-0.4	0.3	0.0	-0.1	0.2	-0.2
Firm 1	Production	12.50	0.4	-0.5	0.8	-0.5	1.0	-0.5
	Capital Stock	7.14	-0.2	-0.1	0.5	-0.5	0.8	-0.6
	Employment	8.57	0.6	-0.7	0.9	-0.5	1.0	-0.4
Firm 2	Production	5.00	1.3	-1.9	1.2	-0.8	1.2	-0.6
	Capital Stock	2.86	0.7	-1.5	0.9	-0.9	1.0	-0.8
	Employment	3.43	1.5	-2.0	1.3	-0.8	1.2	-0.6
Government	Tax	1.63	-0.9	-0.2	-0.7	-0.6	-0.6	-0.7
	Deficit	0.88	1.7	0.4	1.3	1.2	1.0	1.2
	Public Debt	5.47	0.0	0.0	0.0	0.0	0.0	0.0
Aggregate Variables	Consumption 1	8.75	0.5	-0.7	1.0	-0.6	1.2	-0.6
	Consumption 2	1.88	-2.8	4.5	-0.2	0.2	1.2	-0.6
	Consumption 3	1.88	0.5	-0.7	1.0	-0.6	1.2	-0.6
	Labor Supply	12.00	0.8	-1.1	1.0	-0.6	1.1	-0.5
	Capital Stock	10.00	1.2	-2.0	1.0	-0.9	0.9	-0.7
	Exports	2.50	2.1	-3.1	1.5	-1.0	1.2	-0.6
	Imports	2.50	2.1	-3.1	1.5	-1.0	1.2	-0.6
	Trade Balance*	0.00	-	-	-	-	-	-
	Foreign Debt*	0.00	-	-	-	-	-	-
Prices	Wage (gross)	1.08	-0.6	0.5	-0.3	-0.1	-0.2	-0.2
	CPI	2.41	-1.6	-3.1	-2.0	-2.4	-2.2	-2.2
	Exchange Rate	1.00	4.3	-6.1	1.5	-1.0	0.0	0.0
	Terms of Trade	1.00	-4.1	6.5	-1.5	1.0	0.0	0.0
	Interest Rate	0.20	1.7	0.4	1.2	1.1	1.0	1.2

(1), (3) and (5) show the results of cutting VAT rates from 12.5% to 10% financed by an increase in lump sum taxes.
(2), (4) and (6) show the results of a similar cut in VAT financed by higher wage taxes.

V. Conclusion

The primary message of this paper is that, in the absence of international coordination and transfers, desirable tax policies for an open economy may differ substantially from those for an economy which is near to being closed. If the country faces inelastic demand for its exports, terms of trade effects may be sufficient to reverse the conventional ranking of tax bases, making distortionary taxes superior to lump sum taxes at least so far as domestic consumers are concerned.[1]

The implication of this argument is not, of course, that countries should systematically adjust their tax system so as to reap the maximum benefit from their ability to influence their terms of trade, but instead is that tax policy decisions may have important spillover effects upon trading partners which should ideally be taken into account in the decision making process.[2]

[1]The traditional theory of open economy tax policy, as exposited by Dixit (1985), assumes fixed terms of trade and derives Ramsey-type optimal tax formulae based on the elasticities of substitution of consumers' demands.

[2]Two recent studies that have looked at tax spillover effects in multicountry models with a single good (i.e. abstracting from terms of trade effects) are Frenkel and Razin (1987) and Frenkel, Razin and Symansky (1989).

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