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LAND VERSUS CAPITAL VALUE TAXATION: A GENERAL EQUILIBRIUM ANALYSIS***

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ABSTRACT

This paper analyzes via a computable general equilibrium model the effects of a reduction of the Jamaican income tax in favor of either a land value tax or a capital value tax. Important conclusions include: 1) There is less revenue potential from an LVT than from a CVT; 2) the welfare gains from the LVT are sensitive to the type of economy; and, 3) the declines in deadweight loss that result from a switch to a CVT are modest and it is possible that deadweight loss increases. This analysis also examines the effects of such a switch upon resource allocation and income distribution.

I. Introduction

A controversial issue in taxation concerns the efficacy of land taxation versus a more general form of property taxation that includes improvements as part of the tax base, i.e., the capital value tax (CVT). Proponents of the land value tax (LVT) argue that this tax has minimal allocative effects, is an adequate revenue raiser and places its burden on "nonproductive" members of the economy, landlords. Proponents of the capital value tax acknowledge the potential allocative distortions of a full property tax, but argue that they are minimal. Advocates of the capital value tax also argue that the land tax cannot provide sufficient revenue and the tax burden falls too heavily on land owners at the expense of the owners of all kinds of capital. This is especially true in situations in which large amounts of revenue need to be raised relative to land value. In such a case, land taxation is tantamount to confiscation of the land.

Currently, the pros and cons of an LVT versus a CVT are being debated in Jamaica.[1] To get a better sense of this debate in Jamaica, several salient aspects of the Jamaican economic situation need to be reviewed. Although the economy displayed some modest growth in the early 1980s, real GNP was still substantially below the levels experienced in the early 1970s. Like many countries, Jamaica experienced rising rates of inflation and substantial deficits by the national government in the 1970s and early 1980s. The deficit equalled 29 percent of GNP in 1982 and its size put pressure on the government to raise most revenue sources. The land tax, however, did not rise because the government relied upon land assessments developed in 1974 and refused to raise permanent property tax rates. As a result, the land tax declined to less than 2 percent of government receipts, down from nearly 5 percent in 1974.

The decline in the importance of the land tax combined with the pressure for new revenue sources has led to reevaluation of the role of the LVT in Jamaica. The discussion focuses on two questions. The first is whether to increase the existing LVT or replace it with a CVT. The second is whether to increase the property tax (either on an LVT or a CVT) substantially so that the other taxes, particularly the income tax, can be reduced.

Analyses of these questions require the use of a somewhat different method of analysis than is usually employed because of a unique aspect of the Jamaican LVT. In particular, the land tax in Jamaica is levied by the national government and the tax rate schedule is the same in all local government jurisdictions. In most countries, the LVT and the CVT are levied by local government units; therefore, most previous analyses of the choice between an LVT and a CVT employ a partial equilibrium approach. The partial equilibrium approach seems less plausible in the case of a national tax because it is less plausible to hold fixed some of the variables that affect or are affected by

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the choice of a property tax. For example, although it is reasonable to assume that an LVT levied by one small local government will probably have little effect on the market wage rate in the economy of that government unit, this is less likely to be the case if the LVT is levied by the national government for all areas of the economy. Consequently, this paper develops a general equilibrium model of the Jamaican economy and analyzes the effects of a reduction in the income tax compensated with an equal yield LVT or CVT. As such, the paper is useful to any country or large government unit considering either the LVT or the CVT.

The general equilibrium model employed in this study has two final goods (non-housing and housing), three primary inputs (labor, land and capital) and one intermediate good (real estate). Owing to the complexity of the model, analytical (versus numerical) analysis of the model yields few insights; thus, the general equilibrium model is analyzed by numerical methods. This approach provides a number of interesting results.

The remainder of the paper is structured as follows. The next section highlights some of the most important and relevant aspects of the large literature on the economic effects of an LVT versus a CVT. The main point is to substantiate the claim that the bulk of the literature employs a partial equilibrium approach. The model and its parameterization are discussed in the third section. The fourth section analyzes the solutions for a variety of interesting scenarios. First, a closed economy version of the model with fixed total supplies of both capital and land is analyzed. Second, an open economy model with perfect international capital mobility is analyzed. Finally, the effects of varying the labor supply elasticity are analyzed under both the open and the closed economy assumptions. The final section identifies results of the analysis that pertain to the broad debate about an LVT versus a CVT.

II. Literature Survey

The literature that analyzes the pros and cons of a land versus a property tax is a large and an old one. Recent reviews of various aspects of this literature by Break, Prest and Gaffney are contained in a book edited by Lindholm and Lynn.[2] An exhaustive survey is presented by Carmean.[3]

Given the availability of these broader reviews, attention is focused on aspects of the literature that are particularly germane to this paper. The first is the relationship of the model in this paper to the "new view" versus the "old view" of the property tax. The second is the relationship of the model used in this paper to other models of tax incidence.

The "New View" versus the "Old View"

In the economic literature, the debate over property versus land taxation is, for the most part, cast in terms of the "old view" of property taxation. The "old view" of property taxation assumes that capital is elastic in supply, in contrast to the "new view" which assumes that capital is fixed in supply.[4] Some versions of the "old view" are basically partial equilibrium models.[5] The two views have vastly different implications as to who bears the burden of the real property tax. The alternative assumptions on capital mobility also lead to different conclusions on other important issues such as the amount of welfare change and allocation of resources.

It seems at first glance that the new view is relevant for analyzing property taxation in Jamaica because the economy being modeled is national in scope. However, a small economy with large amounts of imports and exports does not conform perfectly to the closed economy model. Indeed, McLure has questioned the relevance of the new view to less developed countries.[6] He concludes that whether the old or the new view of property taxation is relevant depends on the mobility of capital across national boundaries for the particular country being studied. Although the elasticity of the supply of capital for Jamaica is not known, it is reasonable to believe the Jamaican economy is quite open and thus the elalsticity is large. As a result, analyses of both the open economy model and the closed economy model are conducted.

Relationship to Other Models of Tax Incidence

The model developed below can also be viewed as an extension of the model developed by Harberger.[7] The current model is a two-sector model with an intermediate good that is modified to evaluate the effects of a land versus capital value tax. The exact structure of the model is similar to that recently developed by Bhatia.[8] It differs from Bhatia's primarily in that the inputs and outputs are defined differently, an additional input is added, and different types of taxes are analyzed. The model also allows the labor supply to vary. It is, however, well short of the large computable general equilibrium models (CGE) with over 100 equations developed by Shoven and Whalley and others, for the U.S., Great Britain and Canada.[9] Extension of the model by disaggregating the nonhousing sector into commercial, agricultural, tourism, and other sectors might be useful for a variety of other questions, but data limitations preclude this expansion; furthermore the two sector model is sufficient to provide key insights into the issues being investigated here.

It should be noted that three other GE based analyses of tax changes are quite similar in spirit and design to this paper, Grosskopf and Johnson,[10] Ballentine and Thirsk,[11] and Schroeder and Sjoquist.[12] Grosskopf and Johnson develop a GE model that they use to analyze the effect of the switch from a property to a land tax on the price of land. The model developed in this paper is considerably more general than the Grosskopf and Johnson model. The other two papers modify the basic Harberger model to analyze the increase in the property tax as a replacement for another tax or set of taxes. Ballantine and Thirsk analyze the change from a residential to a non-residential property tax in Canada, while Schroeder and Sjoquist look at the effects of a switch of a property tax to a sales tax and an income tax for the Atlanta Metropolitan Area.

This paper is also related to a recent paper by Brueckner.[13] In that paper Brueckner extended the standard partial equilibrium analysis of the choice of an LVT versus the CVT in several important ways. Two versions of the model are developed, one in which the price of housing services is fixed and one in which it is endogenous. Non-housing prices, capital assets and wage rates are fixed in both versions. His paper demonstrates that the effects of an LVT versus the CVT depend upon the size and nature of the economy in which the change is made. The next logical development of the Brueckner model, as he himself indicates, is to put the model into a still broader context in which all prices are free to vary. Therefore, the model developed in this paper can be seen as an extension of the Brueckner model. Unfortunately, the increased generality comes at a cost because, unlike Brueckner, this paper relies upon numerical solution techniques rather than strictly analytical methods.

III. The Model and Its Parameterization

The model consists of three factors—land (L), capital (K) and labor (N), an intermediate good—real estate (M), and two final goods—non-housing (X_1) and housing (X_2). The full listing of the 26 equations of the model are displayed in Table 1 and discussed below.

The production technology is represented by the CES functional form and exhibits constant returns to scale. Nonhousing output (X_1) is produced with equipment capital (K_1), real estate (M) and labor (N) (equation 1). Because the CES production function is used, the elasticities of substitution are constrained to be equal between all factors in the production of nonhousing goods. Housing services (X_2) are produced with structural capital (K_2) and land (L_2) (equation 2). Labor is excluded since the cost of labor services is a very small part of the total cost.[14] The intermediate good, real estate (M), is also produced with structural capital (K_M) and land (L_M) (equation 3). A distinction is made between equipment capital (K_1) and structural capital (K_2, K_M) because equipment capital is not subject to the CVT while structural capital is.

The factor demand functions in equations 4 to 10 are derived from the profit

Table 1

EQUATIONS OF THE MODEL

Producer sector:

(1) Production function for non-housing good:

$$X_1^S = \beta_1[\delta_{M1}M^{-\rho 1} + \delta_{K1}K_1^{-\rho 1} + (1 - \delta_{K1} - \delta_{M1})N^{-\rho 1}]^{-1/\rho 1}$$

(2) Production function for housing:

$$X_2^S = \beta_2[\delta_{K2}K_2^{-\rho 2} + (1 - \delta_{K2})L^{-\rho 2}]^{-1/\rho 2}$$

(3) Production function for real estate:

$$M^S = \beta_3[\delta_{KM}K_M^{-\rho 3} + (1 - \delta_{KM})L^{-\rho 3}]^{-1/\rho 3}$$

(4) Demand for capital in the non-housing sector:

$$r(1 + ty) = P_1\delta_{K1}(X_1^S/K_1)^{1+\rho 1}\beta_1^{-\rho 1}$$

(5) Demand for capital in the housing sector:

$$r(1 + ty)(1 + tc) = P_2\delta_{K2}(X_2^S/K_2)^{1+\rho 2}\beta_2^{-\rho 2}$$

(6) Demand for capital in the real estate sector:

$$r(1 + ty)(1 + tc) = P_M\delta_{KM}(M^S/K_M)^{1+\rho 3}\beta_3^{-\rho 3}$$

(7) Demand for land in the housing sector:

$$w(1 + ty)(1 + t_L) = P_2(1 - \delta_{K2})(X_2^S/L_2)^{1+\rho 2}\beta_2^{-\rho 2}$$

(8) Demand for land in the real estate sector:

$$w(1 + ty)(1 + t_L) = P_M(1 - \delta_{KM})(M^S/L_M)^{1+\rho 3}\beta_2^{-\rho 3}$$

(9) Demand for labor in the non-housing sector:

$$P_N(1 + ty) = P_1(1 - \delta_{K1} - \delta_{M1})(X_1^S/N^D)^{1+\rho 1}\beta_1^{-\rho 1}$$

(10) Demand for real estate in the non-housing sector:

$$P_M = P_1\delta_{M1}(X_1^S/M^D)^{1+\rho 1}\beta_1^{-\rho 1}$$

Consumer sector:

(11) Demand for non-housing goods:

$$X_1^D = \gamma_1 + (\psi_1/P_1)(\text{Totinc} - P_1\gamma_1 - P_2\gamma_2 - P_N\gamma_3)$$

(12) Demand for housing services:

$$X_2^D = \gamma_2 + (\psi_2/P_2)(\text{Totinc} - P_1\gamma_1 - P_2\gamma_2 - P_N\gamma_3)$$

(13) Supply of labor:

$$N^S = T - \gamma_3 - (\psi_3/P_N)(\text{Totinc} - P_1\gamma_1 - P_2\gamma_2 - P_N\gamma_3)$$

where

$$\text{Totinc} = P_N\bar{T} + rK + wL + \text{Totrev}$$

(14) Supply of land:

$$L^S = \bar{L}$$

(15a) Supply of capital fixed:

$$K^S = \bar{K}$$

(15b) Terms of trade fixed:

$$\frac{r}{P_1} = \left(\frac{\bar{r}}{\bar{P}_1}\right)$$

Market Clearing Conditions:

(16a) $X_1^S = X_1^D$

(16b) $P_1(X_1^S - X_1^D) + r(\bar{K} - K^S) = 0$

(17) $X_2^S = X_2^D$

(18) $M^S = M^D$

(19) $N^S = N^D$

(20) $L^S = L_2 + L_M$

(21) $K^S = K_1 + K_2 + K_M$

Tax Revenue:

(22) Total revenue:

$$\text{Totrev} = \text{Rev1} + \text{Rev2} = .25(P_1X_1^S + P_2X_2^S)$$

(23) Income tax revenue:

$$\text{Rev1} = ty(P_NN + rK + wL)$$

(24) Property tax revenue:

$$\text{Rev2} = \alpha\ \text{Totrev} = t_Lw(1 + ty)L + t_cr(1 + ty)(K_2 + K_M)$$

where α = percent of total revenue raised by property tax

(25) Capital value tax:

$$t_c = t_L$$

(26) Land value tax:

$$t_c = 0$$

maximizing behavior of producers. The assumption of a competitive economy requires that factors are paid the value of their marginal product. Thus, economic profits for producers are zero since the production functions are all assumed to be linearly homogeneous.

Consumers demand final goods as well as supplying primary factors. The demand functions for housing services and nonhousing goods and the supply function for labor are derived by maximizing a Stone-Geary utility function:

$$U = (X_1 - \gamma_1)^{\psi_1}(X_2 - \gamma_2)^{\psi_2}(X_3 - \gamma_3)^{\psi_3}$$

subject to a budget constraint:

$$p_1X_1 + p_2X_2 = p_NN + rK + wL + \text{Totrev}$$

and a time constraint:

$$N + X_3 = T$$

where X_3 is the time used for leisure, and T is the total fixed time allocated between labor and leisure. Income is derived from factor returns and redistributed tax revenues (Totrev).[15] The derived demand functions for X_1 and X_2 are shown in equations 11 and 12 while the resulting labor supply function is displayed in equation 13. The other primary factors, capital and land, are assumed to be fixed in supply in the closed economy model (equations 14 and 15a). Capital is assumed to be internationally mobile in the open economy and can be obtained at the fixed terms of trade in equation 15b. The domestic ownership of capital, however, is still assumed to be fixed.

The assumption of perfect competition requires that all markets must clear. Equations 16 to 21 display the market clearing equations. Note, in particular, equations 16a and 16b. The closed economy model uses equation 16a which states that the domestic supply of X_1 equals the domestic demand for X_1. The open economy model uses equation 16b. This permits domestic supply and demand to differ, but any differences must be matched by an offsetting flow of capital.

The tax system is described by equations 22 to 25. The government budget (Totrev) is assumed to be constant in terms of the bundle of goods it can purchase (equation 22). It is assumed that the government is able to purchase 25 percent of the initial bundle of goods. However, the government does not actually purchase this bundle. Tax revenues are redistributed to consumers as a lump sum transfer, the traditional assumption in this literature.

Income tax revenues are derived from the taxation of all factors on the production side at the rate t_y (equation 23). In a closed economy, it does not matter whether the tax is imposed on the sources or the uses side—the results will be the same. However, this is not true for taxes imposed in an open economy. The implications of this assumption are discussed in section four. Property tax revenues are assumed to raise an exogeneously given level of total revenue (equation 24). All land and structural capital are taxed at equal rates under the CVT (equation 25a), although only land is taxed under the LVT (equation 25b).

The model is a barter economy model and monetary considerations are ignored. Thus, the analysis pertains to the structural effects of the tax change and the effects on real rather than nominal variables. In short, the solutions to the model are in terms of relative prices.

The parameters of the system are chosen to be consistent with the economic experience in Jamaica. Some of the parameter values must be selected exogenously, while others are chosen such that the initial equilibrium values of the system are reproduced by the model.[16] The first step in the "calibration" process involves selelcting values for the initial values of the variables by condensing the national income and products accounts for Jamaica into a form consistent with the model developed here. This procedure is discussed in detail in the appendix.

The demand elasticities for housing were selected exogenously. The income and price elasticities are set at 1 and −.8, respectively. These estimates were derived by members of the Jamaica Tax Structure Examination Project using a 1975 Consumer Expenditure Survey.[17] These estimates are consistent with those from an earlier cross-nation study by Lluch, Powell, and Williams,[18] as well as many estimates derived for the U.S.

The lack of estimates of the other parameters of the model for the Jamaican economy requires the use of estimates derived for other countries. In particular, the price elasticity of labor supply is based on U.S. estimates. Ballard, Shoven, and Whalley[19] use a value of .15 as the aggregate uncompensated elasticity of labor supply. This value is used for this model as well, and implies a compensated elasticity of .21. The total time allocated between labor and leisure is assumed to be 12 hours a day. It is chosen so that labor initially works 40 hours a week.

The parameter values for the elasticities of substitution in production are also based on U.S. estimates.[20] The remainder

of the parameters are selected so that the initial values of the endogenous values are realized. The current tax system is condensed so that all initial tax revenue is assumed to come from the income tax. The initial rate is assumed to be 25 percent on gross income, or 33 percent on net income. Table A-2 in the appendix describes all parameters and information about their derivation.

IV. Numerical Results

Three plans for the substitution of part of the income tax with a higher property tax are analyzed. The first plan requires the property tax to replace 5 percent of the income tax. The second and third plans require a replacement rate of 10 percent and 20 percent, respectively.[21] The model is solved with SAS's PROC SIMNLIN, which uses the Newton method. The closed economy results are discussed first, followed by an evaluation of the open economy results. The section concludes with an analysis of the sensitivity of the results to the wage elasticity of the labor supply.

Closed Economy Results

First, consider how a shift from an income tax to an LVT or a CVT affects tax rates. If the LVT is used for the substitution, sizable increases in the property tax rates are required to obtain minimal decreases in the income tax rates. If 5 percent of the income tax revenue is replaced with the LVT, the income tax rate on gross income can only be reduced by 1 percentage point, while the required LVT rate on the gross returns to land is 21.9 percent. Assuming an interest rate of 6 percent, the equivalent tax rate on the net *value* of land is 1.7 percent. However, if the LVT raises 20 percent of total revenue, a tax rate of 87.4 percent must be imposed on the gross returns to land. This is tantamount to expropriation of the land.

Property tax rates need not be as high if the CVT is used because the tax base is much larger. The tax rate under the heaviest CVT scheme, which raises 20 percent of total revenue, is only 20.3 percent of the gross income from property. This is lower than the tax rate required for even the most severe LVT plan.

A shift in the tax system will cause welfare changes in the economy, although neither the size nor the direction of the change can be determined using only analytical methods. In order to assess the relative magnitudes of the welfare gain or loss from the shift to the property tax, the total efficiency loss from the present system is calculated numerically using the model. Table 2 displays the estimated welfare loss.[22] It equals $10.7 million in 1982 dollars which is much less than 1 percent of GNP. Note that in the context of this closed model, the source of the welfare loss of the present system can be attributed solely to the labor supply elasticity.

The strongest defense of the LVT is that it generates no efficiency loss. Thus, a switch from a distortive income tax to the LVT should result in a welfare gain. The results in Table 2 are consistent with this view. When 5 percent of the income tax is replaced with the LVT, there is a 9 percent reduction in the welfare loss caused by the current system. At a 20 percent revenue replacement rate, 33.8 percent of the existing deadweight loss is eliminated.

When the CVT is used to replace part of the income tax, part of the revenue from a distortive tax is being replaced by revenue from another distortive tax; thus the effect of this change on welfare is ambiguous from a theoretical point of view. The results indicate that welfare improves if the CVT substitutes for a small fraction of the income tax but worsens if the fraction is large.[23] A CVT which raises 20 percent of total revenue will almost double the welfare loss from the current income tax.

The estimates of the welfare loss due to the present income tax system and the potential gains that can be realized by a switch to a property tax (either the CVT or the LVT) are small as a percent of GNP. Part of this is due to the highly aggregate nature of the model, and, as such, the estimates should be viewed as lower bound estimates. As is shown below, however,

Table 2

EXCESS BURDEN OF THE CURRENT INCOME TAX AND CHANGES IN WELFARE FROM REPLACING PART OF THE INCOME TAX WITH A PROPERTY TAX: Labor Supply Elasticity = .15

CLOSED ECONOMY MODEL

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Tax System	Increase in Value			Initial Tax System	Increase in Value		
Welfare Gain as a percent of GDP	-.186	.017	.033	.063	-.186	.005	-.014	-.139
Welfare Gain (in millions of 1982 dollars)	-10.7	0.9	1.9	3.6	-10.7	0.3	-.8	-8.0
Percent Reduction in Excess Burden:	-	9.0	17.7	33.8	-	2.8	-7.3	-74.4

OPEN ECONOMY MODEL

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Tax System	Increase in Value			Initial Tax System	Increase in Value		
Welfare Gain as a percent of GDP	-2.09	0.21	0.40	0.76	-2.09	-0.13	-0.29	-0.76
Welfare Gain (in millions of 1982 dollars)	-120.4	11.8	23.1	43.6	-120.4	-7.3	-16.7	-43.4
Percent Reduction in Excess Burden:	-	9.8	19.2	36.23	-	-6.1	-13.9	-36.1

the assumption of a closed economy and the labor supply elasticity are important reasons for the small welfare loss.

The effects of a switch from the income tax to an LVT or a CVT on output, input and relative prices are described in Table 3. A switch to the LVT has virtually no effect on the composition of output or the relative price of market goods. The CVT, however, has more visible effects. Housing services decline by over 6 percent while non-housing output rises by less than one percent when the CVT is at its highest level. The price of housing relative to the price of non-housing goods rises by over 10 percent.

These results are to be expected as real estate is the only factor in the non-housing sector subject to the CVT; thus, there is room for substitution away from real estate to the lower-taxed machinery and equipment capital (K_1) and labor (N). For example, under the heaviest CVT plan, the use of real estate in the production of non-housing goods declines by 8.3 percent and the use of both equipment capital and labor rises by 9.8 percent and 0.45 percent, respectively. Equipment capital and labor become less expensive in relation to real estate. Relative to the price of real estate, the price of capital falls by 18 percent and the price of labor falls by 9.6 percent. Thus, the non-housing sector can reduce the burden of the tax change by substituting away from the more heavily taxed factor.

In contrast, both inputs are taxed in the housing and real estate sectors under the CVT. Thus, there is no room for substitution, which tends to increase the price of housing. The substitution in favor of the CVT tends to increase the equilibrium price of capital relative to the price of land faced by real estate and housing

Table 3
VALUE OF OUTPUT MEASURES:
Labor Supply Elasticity = .15

CLOSED ECONOMY MODEL

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Value	Percentage Change			Initial Value	Percentage Change		
X_1	87.4	0.08	0.15	0.31	87.4	0.28	0.54	1.04
X_2	12.6	0.01	0.02	0.05	12.6	-1.46	-3.01	-6.37
P_2/P_1	1	0.09	0.18	0.37	1	2.32	4.84	10.58
K_1	13.425	-0.004	-0.009	-0.017	13.425	2.277	4.659	9.770
K_2	6.975	0.013	0.025	0.051	6.975	-1.990	-4.075	-8.567
K_M	6.975	0.004	0.089	0.018	6.975	-2.393	-4.891	-10.237
L_2	2.475	0.008	0.015	0.030	2.475	0.050	0.103	0.224
L_M	1.80	-0.010	-0.021	-0.041	1.80	-0.068	-0.142	-0.309
N	43.35	0.119	0.237	0.475	43.35	0.113	0.225	0.450
M	11.70	-0.006	-0.011	-0.023	11.70	-1.922	-3.940	-8.305
K_2/L_2	2.818	0.005	0.010	0.021	2.818	-2.039	-4.174	-8.771
K_M/L_M	3.875	0.005	0.010	0.024	3.875	-2.326	-4.756	-9.960
r/P_N	1	0.137	0.273	0.547	1	-2.349	-4.595	-9.388
$r(1+t_y)/P_M$	1.33	-0.001	-0.003	-0.006	1.33	-4.551	-9.086	-18.119
$P_N(1+t_y)/P_M$	1.33	-0.138	-0.275	-0.550	1.33	-2.255	-4.607	-9.636
$r(1+t_c)/w(1+t_L)$	1	-0.007	-0.015	-0.029	1	2.986	6.280	14.013

producers. Both sectors release capital to the nonhousing sector, but the real estate sector decreases its capital stock by slightly more. The allocation of land between these two sectors remains virtually unchanged, but because of the reduction in structural capital, structural density (the ratio of structural capital to land) falls by nearly 9 percent in the housing sector and almost 10 percent in the real estate sector. Indeed, the negative effect of the CVT on the ratio of improvements to land value is one of the main arguments against the CVT.

The level of employment increases very slightly under both the LVT and the CVT. Although the increase in labor supplied is less than 1 percent under all tax plans, labor is most affected relative to other factors by the substitution to the LVT. This is because labor is the only input with a positive supply elasticity in this version of the model. Thus, reduction of the income tax in favor of the neutral LVT has its primary effect on labor supply, but the size of the effect is limited by the low value assigned to the elasticity of supply in this version.

Table 4 displays the effects of the tax changes on the distribution of income among labor and the owners of capital and land. As theory would indicate, landowners bear the largest burden of an increase in the LVT. The returns to land relative to the returns to other factors decrease significantly depending on the level of the LVT. Land's share of income falls by 20.9 percent even when the LVT replaces only 5 percent of the income tax, and is reduced by 86.7 percent under the 20 percent revenue replacement scheme. Although land's share of income decreases

Table 4
RELATIVE FACTOR RETURNS AND THE DISTRIBUTION OF INCOME:
Labor Supply Elasticity = .15

CLOSED ECONOMY

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Value	Percentage Change			Initial Value	Percentage Change		
Relative Factor Returns:								
r/w	1	28.05	77.86	694.60	1	2.99	6.28	14.01
P_N/w	1	27.88	77.38	690.28	1	5.46	11.52	25.83
r/P_N	1	0.14	0.27	0.55	1	-2.35	-4.70	-9.39
Income Distribution:								
Share of Land In GDP	4.28	-20.89	-42.30	-86.74	4.28	-4.12	-8.31	-16.92
Share of Capital in GDP	27.38	1.30	2.63	5.39	27.38	-1.26	-2.55	-5.27
Share of Labor in GDP	43.35	1.28	2.59	5.31	43.35	1.23	2.48	5.01
Share of Government in GDP	25.0	-0.07	-0.14	-0.27	25.0	-0.05	-0.08	-0.02

OPEN ECONOMY

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Value	Percentage Change			Initial Value	Percentage Change		
Relative Factor Returns:								
r/w	1	24.91	68.05	502.85	1	4.60	9.78	22.32
P_N/w	1	27.71	75.62	557.91	1	5.43	11.49	25.93
r/P_N	1	-2.19	-4.31	-8.37	1	-0.79	-1.53	-2.87
Income Distribution:								
Share of Land In GDP	3.89	-20.08	-40.68	-83.51	3.89	-4.64	-9.36	-19.0
Share of Capital in GDP	33.98	-0.16	-0.32	-0.60	33.98	-0.25	-0.50	-0.95
Share of Labor in GDP	39.41	2.29	4.61	9.36	39.41	0.6	1.2	2.2
Share of Government in GDP	22.73	-0.28	-0.55	-1.06	22.73	0.13	0.31	0.83

as the LVT rate increases, both capital's and labor's share of income rise by approximately equal proportions.

Landowners also bear the greatest burden under the shift to the CVT, but the reduction in their rate of return is much less severe. In fact, landowners suffer less severely under the heaviest CVT than under the lightest LVT. Land's share of income falls by only 16.9 percent even in the case in which 20 percent of the income tax is replaced with the CVT. This is because capital owners bear part of the burden of this shift. Capital's share of income falls by 5 percent under the heaviest CVT. The net wage rate increases most, relative to the returns to other factors, and labor's share of income increases by up to 5 percent.

Open Economy Results

The analysis above is conducted under the assumption of a closed economy. Because this assumption may not be appropriate for a small country like Jamaica, this section analyzes the effects of increasing the importance of the property tax in a small, open economy that permits the international mobility of capital. Thus, the property tax is analyzed here under the "old view" in a general equilibrium setting. In addition, Jamaica's large trade deficit (in excess of 10 percent of GDP) can now be incorporated into the model.[24]

As mentioned before, the manner in which the income tax is imposed makes a difference in an open economy model. If the income tax is residence based, do-

mestically owned capital cannot escape taxation because all domestically owned factors are subject to the tax and foreign-owned capital is not. On the other hand, if the income tax is source based, i.e., imposed on the production side of the model, capital can escape the tax because only capital used in Jamaica is subject to the tax. Analysis of the Jamaican situation suggests that it is quite difficult to tax all residence based income; thus it is more appropriate to use the latter approach—only income originating in Jamaica is subject to an income tax.

The discussion of the results begins with an analysis of the tax rate. Both the income tax rates and the LVT rates necessary to raise the same level of real revenue are lower in an open economy relative to a closed economy. This is because the substitution from the income tax to the LVT in an open economy increases the supply of capital and labor. These increases, in turn, increase the marginal productivity of land, and expand the land tax base.

A substitution of the CVT for the income tax produces required tax rates that are similar to those for the closed economy case in most instances. The exception is the 20 percent revenue replacement plan in which the income tax rate in the open economy is almost 3 percent greater, and the CVT rate is almost 1 percent larger relative to the rate required in the closed economy.

The efficiency loss of the current tax system is larger in an open economy because the size of the capital stock in the economy as well as the labor-leisure choice are affected by the tax system. The welfare loss is 2 percent of GDP—$120 million in 1982 dollars (see Table 2). This implies that the average burden per dollar of revenue is approximately 8 cents.

A switch to the LVT reduces the current excess burden by 36 percent, or $43.6 million under the heaviest LVT. However, the excess burden is increased by about the same amount under the heaviest CVT. Thus, neutral taxes such as the LVT reduce a larger proportion of the existing burden while distortive taxes such as the CVT result in higher welfare cost in the open economy.

Output levels are also affected differently when the tax system is altered in an open economy rather than a closed economy. The effects are more visible in an open economy, as shown in Table 5. The production of both the nonhousing good, which is the traded good, and housing, the nontraded good, rises. Housing production rises by slightly more, at 3.6 percent compared to 3.3 percent for traded goods under the heaviest LVT. Housing also becomes less expensive relative to the traded good as the LVT increases. The demand for the traded good does not rise as much as domestic production does. Thus, there is a decrease in imports as the LVT replaces a greater proportion of the income tax.

One expected result from a shift to an LVT in the open economy case is that the size of the capital stock will increase. Indeed, the simulation results indicate that the size of the capital stock increases by 8 percent in the case in which the LVT substitutes for 20 percent of the income tax. Each sector uses some of the additional capital. The use of equipment capital increases by 9 percent, housing's use of capital increases by 5.4 percent, and real estate's use increases by 8.9 percent. The larger capital stock also increases the returns to labor; thus the quantity of labor supplied increases by as much as .8 percent, twice that observed in the comparable closed economy case.

Real estate and housing output also increase with the substitution of the LVT. The increase in real estate output is twice as great as that experienced in housing; thus the real estate sector pulls a small portion of land away from the housing sector as the LVT is increased. However, the ratio of improvements to land rises in both sectors: 7.4 percent in the real estate sector and 6.5 percent in the housing sector under the 20 percent revenue substitution. These results are expected given that land is more heavily taxed than capital when the LVT replaces a portion of the income tax.

If the income tax reduction is compensated by an increase in the CVT rate, the domestic production of both goods is hurt. The production of traded goods increases slightly when the CVT is imposed in a

Table 5

VALUE OF OUTPUT AND INPUT MEASURES:
Labor Supply Elasticity = .15

OPEN ECONOMY MODEL

	LVT				CVT			
	Share of Property Tax in Total Revenue (percent)				Share of Property Tax in Total Revenue (percent)			
	0	5	10	20	0	5	10	20
	Initial Value	Percentage Change			Initial Value	Percentage Change		
X_1^S	87.4	0.83	1.66	3.31	87.4	-0.22	-0.49	-1.17
X_1^D	97.4	0.19	0.37	0.70	97.4	0.17	0.33	0.58
Net import of X_1	10.0	-5.45	-10.96	-22.13	10.0	3.64	7.48	15.88
X_2	12.6	0.92	1.85	3.66	12.6	-2.11	-4.32	-9.12
P_2/P_1	1	-0.93	-1.84	-3.61	1	3.04	6.39	14.25
K^S	27.375	1.99	4.00	8.08	27.375	-1.33	-2.73	-5.80
Net export of capital	10.0	-5.45	-10.96	-22.13	10.0	3.64	7.48	15.88
K_1	13.425	2.23	4.48	9.07	13.425	0.77	1.52	2.89
K_2	6.975	1.35	2.70	5.39	6.975	-2.90	-5.92	-12.34
K_M	6.975	2.18	4.38	8.87	6.975	-3.81	-7.73	-15.98
L_2	2.475	-0.24	-0.50	-0.99	2.475	0.21	0.43	0.93
L_M	1.80	0.34	0.68	1.36	1.80	-0.29	-0.58	-1.28
N	43.35	0.21	0.42	0.82	43.35	0.06	0.12	0.23
M	11.70	1.80	3.61	7.28	11.70	-3.10	-6.32	-13.20
K_2/L_2	2.818	1.60	3.21	6.45	2.818	-3.10	-6.32	-13.15
K_M/L_M	3.875	1.84	3.68	7.40	3.875	-3.53	-7.19	-14.88
r/P_N	1	-2.19	-4.31	-8.37	1	-0.79	-1.53	-2.87
$r(1+t_y)/P_M$	1.33	-0.46	-0.92	-1.83	1.33	-4.26	-8.54	-17.21
$P_N(1+t_y)/P_M$	1.33	1.76	3.54	7.14	1.33	-3.50	-7.12	-14.77
$r(1+t_c)/w(1+t_L)$	1	-2.24	-4.41	-8.54	1	4.60	9.78	22.32

closed economy but falls when the CVT is imposed in an open economy. The production of traded goods is reduced by 1.2 percent, while its demand rises slightly under the heaviest CVT plan. Thus, imports rise by 15.9 percent.

The housing industry is even more severely hurt. Housing output falls by up to 9.1 percent, and its price relative to the price of traded goods rises by 14.3 percent when the CVT raises 20 percent of total revenue. Although the CVT is not analyzed alone here, since the CVT rate increase is higher than the income tax rate reduction, these findings seem to confirm the statements that the property tax burdens the consumers of home good (housing) under the new "old view."

The main reason for the decline in output becomes clear upon consideration of the impact of the switch to the CVT on the size of the capital stock. In theory, the qualitative as well as the quantitative effects of a decline in the income tax and an equal increase in the CVT on the capital stock are unclear because the switch

increases the tax burden on capital used to produce real estate and housing but decreases the burden on equipment. The net effect in this particular model turns out to be negative. For example, the replacement of 20 percent of the income tax with the CVT reduces the capital stock by 5.8 percent. Given this decline and the relatively inelastic labor supply, it is not surprising that the level of output would decline substantially.

The CVT also affects factor allocation and relative factor prices differently in an open economy compared to a closed economy. The use of equipment capital in the nonhousing industry rises by up to 2.9 percent, but this increase is not nearly as large as the 9.8 percent increase experienced when the income tax rate was reduced in the closed economy. Labor is also increased but by a very small amount because the production of the traded good declines. The rate of increase is half that experienced in the closed economy. The intermediate sector, real estate, suffers most from the switch. Because both its factors are taxed, real estate becomes much more expensive relative to the other factors used in the production of traded goods. As a result, firms reduce their usage of real estate by 13.2 percent under the heaviest CVT because firms producing traded goods must maintain constant real average cost in equilibrium.

Housing and real estate producers face higher capital prices relative to land prices and both sectors reduce their use of capital. Under the heaviest CVT, the housing sector reduces its capital stock by 12 percent, and the real estate sector reduces its capital stock by 15 percent. As expected with a CVT increase, structural density decreases by much more in the open economy. The ratio of improvements to land falls by 13.2 percent in the housing industry and 14.9 percent in the real estate industry under the heaviest CVT.

The effect of a switch to the LVT on income distribution is also sensitive to the openness of the economy. If 20 percent of the current income tax is replaced with the LVT in the open economy case, land's share of income falls by 84 percent while capital's share remains virtually unchanged and labor's share rises by over 9 percent. In the comparable closed economy case, land's share of income fell by 87 percent while labor's share only increased by 5 percent. Thus, land owners and labor would be better off in an open economy if the LVT is used to replace a portion of the income tax. Capital owners, on the other hand, are better off in the closed economy if such a policy is pursued. The fundamental reason for this result is that capital flows into the economy in the open economy case so that returns to capital are unchanged; however, the increased capital stock increases the productivity of the existing land and labor.

This conclusion is reversed if the CVT is used to replace the income tax in the open economy. If 20 percent of the income tax is replaced by the CVT in the open economy case, land's share of income falls by 1.9 percent, capital's share is virtually unchanged and labor's share rises by 2 percent. Comparison of these results to the closed economy case indicates that land owners and labor would be better off in a closed economy if the CVT is used to replace a portion of the income tax. Just the opposite is true for capital owners.

Sensitivity to the Labor Supply Elasticity

The previous results indicate that the welfare losses associated with an income tax and the potential gains from a switch to an LVT or a CVT are small in comparison to the amounts reported in other models. This section analyzes the sensitivity of these results to the value of the labor supply elasticity by increasing this value from .15 to .3. This translates to a compensated elasticity of .42. Ballard, Shoven, and Whalley[25] find that the welfare cost per dollar of revenue nearly doubles as the elasticity of labor supply is increased from 0 to .15 in their large model of the U.S. economy.

The effects of the higher labor supply elasticity on the excess burden estimates are displayed in Table 6. A comparison of these results to those of Table 2 shows that the estimate of the welfare cost of the present system does indeed rise with a larger labor supply elasticity. The excess

Table 6

EXCESS BURDEN OF THE CURRENT INCOME TAX AND CHANGES IN WELFARE FROM REPLACING PART OF THE INCOME TAX WITH A PROPERTY TAX: LABOR SUPPLY ELASTICITY = .3

	LVT				CVT			
Share of Property Tax in Total Revenue (percent)	0	5	10	20	0	5	10	20
	Initial Value	Increase in Value			Initial Value	Increase in Value		
	Closed Economy Model:							
Welfare Gain as a percent of GDP	-0.34	0.03	0.06	0.12	0.34	0.02	0.01	-0.09
Welfare Gain (in millions of 1982 dollars)	$-19.73	$1.79	$3.50	$6.70	$-19.73	$1.05	$0.70	$-5.04
Percent Reduction in Excess Burden:	-	9.0	17.7	34.0	-	5.34	3.54	-25.56
	Open Economy Model:							
Welfare Gain as a percent of GDP	-2.5	0.26	0.50	0.94	-2.5	-0.11	-0.26	-0.70
Welfare Gain (in millions of 1982 dollars)	-$143.87	$14.80	$28.76	$53.92	-$143.87	$-6.40	$-14.97	$-40.0
Percent Reduction in Excess Burden:	-	10.29	19.99	37.48	-	-4.4	-10.4	-27.8

burden of the current system is about 84 percent higher in the closed economy with the higher labor supply elasticity. In the open economy, it is 19 percent higher.

The higher labor supply elasticity also affects the magnitude of the change in welfare caused by the reduction in the income tax compensated by a property tax increase. Compared to the results obtained using the lower estimate of the labor supply elasticity, the welfare gains from a switch to the LVT are absolutely larger; however the gains as a percent of the initial burden are approximately the same in both cases. This is true regardless of whether the economy is closed or open.

In the closed model, the CVT has favorable effects on efficiency if it replaces 5 percent of the income tax, but unfavorable effects if it replaces a larger fraction of the income tax under the assumption of a labor supply elasticity of .15. A doubling of the labor supply elasticity to .3 increases the range for which the switch to the CVT has favorable efficiency effects. Efficiency is increased if the CVT replaces up to 10 percent of the initial income tax, but at 20 percent, the efficiency loss from the higher CVT rate outweighs the gain from the lower income tax rate, and the net burden is increased. However, the welfare loss is still less than that which would occur with the lower labor supply elasticity. A switch to the CVT in an open economy increases the excess burden under all tax plans, but by a smaller amount when labor is more elastic in supply.

IV. Conclusions

This paper analyzes via a computable general equilibrium model the effects of a reduction of the Jamaican income tax in favor of either a land value tax or a capital value tax. A number of specific results are presented in the text; here attention is focused on the implications of the analysis for the more general discussion of the pros and cons of these two types

of property taxes. Five main results emerge:

1. *Limited revenue potential of the LVT.* A frequently cited problem with the LVT is the limited amount of revenue that can be collected from it. The Jamaican case demonstrates this limitation vividly. If the land tax is used to replace 20 percent of the income tax, the LVT amounts to expropriation of land from the landowners. It should be noted, though, that there is much room to expand the existing land tax before expropriation is reached.

2. *Welfare gains from the LVT are sensitive to the type of economy.* The gain in welfare associated with a switch to an LVT from the income tax is quite small in a closed economy with a labor supply elasticity of .15. The gain amounts to about .06 of GNP, or about one-third of the deadweight loss generated by a system with only the income tax. The gain in an open economy with the same labor supply elasticity is over 10 times larger, and the gain is still larger in an open economy with a labor supply elasticity of .30.

3. *The declines in deadweight loss that result from a switch to a CVT are modest and it is possible that deadweight loss increases.* As with the LVT, the answer depends upon whether the economy is open or closed, but the results suggest that a modest CVT can improve welfare in a closed economy. A large CVT, especially in an open economy, has the opposite effect. The loss in welfare can amount to over .75 of one percent of GDP under the heaviest CVT plan in an open economy.

4. *Resource Allocation.* The results are consistent with the frequently cited result that an LVT will generate larger ratios of structure to land relative to the CVT. The replacement of 10 percent of the income tax with a CVT reduces the ratio of structure to land by about 5 percent in the closed economy model (see Table 3). Furthermore, a switch from the income tax to either the LVT or the CVT tends to increase employment and the use of equipment capital.

5. *Distribution of Income.* Labor gains from a shift to either the LVT or the CVT, and landowners lose from a switch to either the LVT or the CVT. For example, the share of income distributed to landowners declines by 42.3 percent and capital and labor increase their share by about 2.5 percent in the closed economy model when the LVT replaces 10 percent of the income tax (Table 4). The effect on capital owners depends on the state of the economy. In a closed economy, capital owners gain from an LVT and lose from a CVT. In an open economy, capital owners lose, but the effect is quite minimal.

This analysis is subject to numerous caveats. Foremost among these is the aggregate nature of the model. Indeed, it would be interesting, especially in the Jamaican case, to introduce an agricultural sector, which is a large part of the Jamaican economy. Another line of research is to estimate parameters used in the model. The parameters of the production functions for real estate and housing should be examined, as well as the labor supply elasticity. Of course, a complete economic analysis of the choice of an LVT versus a CVT must also consider the administrative costs of each tax. Despite these important caveats, it is hoped that this paper has extended the understanding of some of the elements associated with the choice of an LVT versus a CVT.

FOOTNOTES

***This paper was presented at the 1985 meeting of TRED in Cambridge, Massachusetts. This paper is a heavily revised version of Staff Paper No. 13 of the Jamaica Tax Structure Examination Project. The paper has benefited greatly from the comments of Roy Bahl, Dan Holland, Mohammad Moussavian, and two anonymous referees.

[1]For a full review of the debate and the current status of land taxation in Jamaica, see "Land Versus Property Taxation: A General Equilibrium Analysis," by James R. Follain and Tamar Emi Miyake, Staff Paper No. 13 of the Jamaican Tax Structure Examination Project and, "Property Taxation in Jamaica" by Daniel Holland and James R. Follain, Staff Paper No. 16, January 1985.

[2]George F. Break, "Henry George and Tax Reform—100 Years Later," in *Land Value Taxation: The Progress and Poverty Centenary,* edited by Richard W. Lindholm and Arthur D. Lynn, Jr. (Madison: The University of Wisconsin Press, 1978); Mason Gaffney, "Two Centuries of Economic Thought on Taxation of Land Rents," in Lindholm and Lynn, *Land Value Taxation: The Progress and Poverty Centenary;* and Alan R. Prest, "United Kingdom Land Taxation in Perspective," in Lindholm and Lynn, *Land Value Taxation: The Progress and Poverty Centenary.*

[3]Patricia A. Carmean, *Site Value Taxation* (Chicago: International Association of Assessing Officers, 1980).

[4]For a good discussion of the "new view" versus the "old view" see Charles E. McLure, "The 'New View' of the Property Tax: A Caveat," *National Tax Journal* 30 (1977): 69–75. This literature had its basis in the paper by Peter Mieszkowski, "The Property Tax: An Excise Tax or a Profits Tax," *Journal of Public Economics*, April, 1972.

[5]George E. Peterson, "Differential Taxation of Land and Improvement Values," in *Technical Aspects of the District's Tax System* (Washington, D.C.: U.S. Government Printing Office, 1978); and Richard L. Pollock and Donald C. Shoup, "The Effect of Shifting the Property Tax Base from Improvement Value to Land Value: An Empirical Estimate," *Land Economics* 53 (February 1977): 67–77.

[6]Charles E. McLure, "The Relevance of the New View of the Incidence of the Property Tax in Less Developed Countries," in *The Taxation of Urban Property in Less Developed Countries*, edited by Roy W. Bahl (Madison: The University of Wisconsin Press, 1979).

[7]Arnold C. Harberger, "The Incidence of the Corporation Income Tax," *Journal of Political Economy* 70 (June 1962): 215–240.

[8]Kul B. Bhatia, "Intermediate Goods and the Incidence of the Corporation Income Tax," *Journal of Public Economics* 16 (1981): 93–112.

[9]See Herbert E. Scarf and John B. Shoven, ed., *Applied General Equilibrium Analysis* (Cambridge: Cambridge University Press, 1984), John B. Shoven and John Whalley, "General Equilibrium with Taxes: A Computational Procedure and an Existence Proof," *Review of Economic Studies* 40 (1973): 475–490, and John B. Shoven and John Whalley, "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey," *Journal of Economic Literature* 22 (September 1984): 1007–1051.

[10]Shawna P. Grosskopf and Marvin B. Johnson, "Land Value Tax Revenue Potentials: Methodology and Measurement," in *Land Value Taxation: The Progress and Poverty Centenary*, edited by Richard W. Lindholm and Arthur D. Lynn, Jr. (Madison: The University of Wisconsin Press, 1978).

[11]Gregory J. Ballentine and Wayne R. Thirsk, "Taxation Without Representation: The Consequences of Taxing Non-residential Property," Technical Report (Ottawa: Canada Mortgage and Housing Corporation, 1983).

[12]Larry D. Schroeder and David L. Sjoquist, *The Property Tax and Alternative Local Taxes: An Economic Analysis* (New York: Praeger Publishers, 1975).

[13]Jan K. Brueckner, "The Effects of Site Value Taxation: A Modern Analysis," *National Tax Journal*, March, 1986.

[14]There is no evidence to support this statement for Jamaica, but the share of labor in residential building construction for the U.S. was less than 5 percent of total cost in 1978. See U.S. Department of Labor, *Employment and Earnings, United States, 1909–78* (Washington, D.C.: U.S. Government Printing Office, 1979) and *Economic Report of the President*, 1984 (Washington, D.C.: Government Printing Office, 1984).

[15]In order to focus on the effects of taxation alone, the government is assumed to redistribute all tax revenue to consumers in a lump sum fashion.

[16]An excellent description of the calibration process is provided in John B. Shoven and John Whalley, "Applied General Equilibrium Models of Taxation and International Trade: An Introduction and Survey," *Journal of Economic Literature* 22 (September 1984): 1007–1051.

[17]Jamaica Department of Statistics, *Household Expenditures Survey, July 1975* (Kingston, Jamaica, 1975).

[18]Constantino Lluch, Alan A. Powell and Ross A. Williams, *Patterns in Household Demand and Savings* (New York: Oxford University Press, 1977).

[19]Charles L. Ballard, John B. Shoven and John Walley, "The Welfare Cost of Distortions in the United States Tax System: A General Equilibrium Approach," Working Paper No. 1043 (Cambridge, Massachusetts: N.B.E.R., December 1982).

[20]J. M. Clapp, "The Substitution of Nonland for Land: A Reconciliation of Diverse Estimates," *Journal of Regional Science* 21 (1981): 123–125.

[21]Since the control variables are the shares of property tax revenue, the tax rates and the level of revenue are endogenously determined.

[22]The measure of welfare cost here is the Equivalent Variation.

[23]The positive effects of lowering the tax on labor is outweighed by the negative effects of the partial factor tax on capital (the CVT) as a higher proportion of the income tax is replaced by the compensating CVT.

[24]The authors have benefited tremendously from a reading of W. Max Cordon and J. Peter Neary, "Booming Economy," *Economic Journal* 92 (December 1982): 825–48. Their model consists of two goods traded at fixed terms of trade, and a nontraded good. We follow their assumptions in the modeling of the small open economy.

[25]Ballard, Shoven and Whalley, p. 26.

Appendix

Derivation of Data for the Simulation

The main source of data is the 1982 National Income and Product Accounts.[1] This year is chosen since it is the most recent available and since 1982 was a relatively good year for Jamaica. In addition, results of the 1983 Land Valuation is used to compute a few numbers.

The basic approach used to develop initial values of the exogenous and endogenous variables begin with the equality between Gross Domestic Product (GDP) and National Income. The left-hand side of this equality is:

$$GDP = X_1^C + X_2^C + X_1^G + X_2^G + X_1^E + X_2^E + X_1^M + X_2^M + X_1^I + X_2^I$$

All variables are defined in Table A-1. The right-hand side equals factor payments gross of direct taxes plus indirect taxes; it is discussed below.

Table A-1

CONSOLIDATION OF GNP ACCOUNTS
(millions of J$)

Item	Total Inclusion of Direct Taxes	Indirect Taxes	Gross Cost[a]	Shares[b]
Expenditure Shares				
P_1X_1	5,025	---	5,025	87.4
Components:				
X_1^C	3,300			
X_2^C	1,100			
X_1^E	2,165			
X_1^M	2,500			
X_1^I	870			
P_2X_2	725	---	725	12.6
Components:				
X_2^C	650			
X_2^C	200			
X_2^E	100			
X_2^M	450			
X_2^I	315			
Income Shares				
P_N	3,250	70	3,320	57.8
rK	1,500	600	2,100	36.5
K_1	650	380	1,030	17.9
K_2	475	60	535	9.3
K_M	375	160	535	9.3

Table A-1 (continued)

wL	300	30	330	5.7
L^2	175	15	190	3.3
L_M	125	15	140	2.4
T_I (Indirect Taxes)		100	700	
Total GNP	5,750	- --	---	100.0

[a]Calculated as: Column 1 + Column 2

[b]Calculated as: Column 3/GNP.

Source: Authors' calculations from Jamaican National Income and Product Accounts for 1982.

GDP is gross domestic product,

X_1^C is the amount of housing expenditures by consumers,

X_2^C is the amount of housing expenditures by consumers,

X_1^G is the amount of non-housing expenditures by government,

X_2^G is the amount of housing expenditures by government,

X_1^E is the amount of non-housing expenditures exported,

X_2^E is the amount of housing expenditures exported,

X_1^M is the amount of non-housing expenditures imported,

X_2^M is the amount of housing expenditures imported,

X_1^I is the amount of non-housing investment,

X_2^I is the amount of housing investment.

All other variables are defined in the text.

Table A-1 contains the final breakdown of expenditures (the last column) and the details underlying the final column. The remainder to this section discusses these details. The discussion is entirely in terms of Jamaican dollars in units of one million J$s.

First, consider the composition of consumption expenditures. Private consumption expenditures are split between non-housing (X_1^C) and housing (X_2^C) as $3300 and $650, respectively. This is based upon Table 22 in the national income accounts, and assumes that residents and non-residents spend the same portion of income in non-housing. X_2^C includes expenditures on rent and fuel for housing. Government expenditures are broken down in a similar way. This approach results in a higher number for housing than appears in the government budget, but we feel that the budget understates the amount of government's contribution in the form of subsidies to housing, e.g., fuel subsidies, and rent-free housing.

The export numbers are heavily weighted toward non-housing since housing is a non-tradeable good. Some expenditures are made by tourists for housing, so $100 million is allocated to X_2^E. Imports are divided in the same way as private consumption. This is clearly an assumption, but based upon our discussion with local builders it is justified because many of the materials used for housing are imported. Investment expenditures are more heavily weighted toward housing. This reflects the widely held view that much housing is produced informally.

The right hand side of the GDP equation comprises factor payments plus taxes. That is,

$$GDP = (1 + t_0)P_N N + (1 + t_0)(rK + wL) + T_I$$

where t_0 is the tax rate associated with direct taxes; and, T_I is the sum of indirect taxes. Although total factor payments are given in the national income accounts and reported in Table A-1, factor payments need to be allocated to the non-housing and housing sectors, as does the breakdown of T_I. Such a breakdown is not necessary for labor since labor is used in the model only to produce non-housing.

The numbers in Table A-1 for the subcomponents K_1, K_2, K_M, L_2, and L_M are arrived at as follows. We begin with the assumption that the rental rate for land is 6 percent of value. The 1983 land valuation indicates land value in 1983 is $5 billion, so rental income is about $300 million. Although this ignores the inflation in land values of 1982–83, it also ignores the likely understatement of value by the Office of Land Valuation. Given the estimate of land rents, the figure for capital's share of operating surplus is $1500 million ($1800 million–300 million).

Next, rental income to land is allocated between housing and non-housing as 58 percent for housing and 42 percent for non-housing. A partial basis for this is the Land Valuation Survey which indicates the land use of each parcel. The survey indicates 50 percent of the coded property is residential and 50 percent is non-residential. Unfortunately, 20 percent of land value is uncoded. Discussion with officials at the Land Office indicated that almost all of the uncoded property is residential. We assume 90 percent of it is residential, thus producing a 58–42 split.

The allocation of capital among its three uses begins with the allocation of capital to housing. It is assumed that the capital to land ratio for housing is 2.75. This is consistent with Risden's (1977) survey of capital to land ratios in 1976 and typical ratios in other countries. This implies a value of K_2 of about $475 million. The same process generates an estimate of K_M equal to $375 million by assuming a slightly higher capital to land ratio of 3.0. This, too, is consistent with the scanty evidence available. The allocation to K_1 is simply the residual. That is, $K_1 = K - K_2 - K_M = \$650$ million.

The most difficult part of the process involves allocating indirect taxes among the inputs. The indirect taxes are "defined as compulsory payments to government which the industries treat as part of the cost of production."[26] These include customs duties (8 percent of revenues), excise taxes (1.7 percent of revenue), the sales tax (.5 percent of revenues), excise duties (29 percent of revenues) and betting taxes (1.4 percent of revenues). The assumption is made that labor and housing are lightly hit by these taxes. This is based upon the idea that housing services is the output of the housing sector, and there is no tax on these services. The only way they would be taxed is via construction materials. Given that these are a small part of the value of the flow of housing services and that much residential construction is underground, i.e., hard to tax, this assumption seems reasonable. The specific allocation of T_I to housing is $75 million, $60 million to K_2 and $15 million to L_2.

Labor is also assumed to be lightly hit by indirect taxes and only $70 million is allocated to labor. This leaves $555 million to be allocated to K_1, K_M and L_M. It is assumed K_1 pays about two-thirds of this amount, L_M pays the same as L_2, and K_M gets the difference.

The numbers are then compiled to produce estimates of the shares of GDP by sector and the tax rates by factor. Although many assumptions are made to generate these two sets

Table A-2

PARAMETER VALUES

Parameter	Definition	Value	Assumed or Computed
	Production Function Parameters		
ρ_1	Substitution parameter for non-housing sector (X_1)	.111111	Computed at the initial values assuming elasticity of substitution of .9.
β_1	Efficiency parameter for non-housing sector	2.99839	Computed at the initial values assuming elasticity of substitution of .9.
δ_{K1}	Distribution parameter for capital in non-housing sector	.187901	Computed at the initial values assuming elasticity of substitution of .9.
δ_{M1}	Distribution parameter for real estate in non-housing sector	.120956	Computed at the initial values assuming elasticity of substitution of .9.
ρ_2	Substitution parameter for housing sector (X_2)	.428571	Computed at the initial values assuming elasticity of substitution of .7.
β_2	Efficiency parameter for housing sector	2.27383	Computed at the initial values assuming elasticity of substitution of .7.
δ_{K2}	Distribution parameter for capital in housing sector	.814592	Computed at the initial values assuming elasticity of substitution of .7.
ρ_3	Substitution parameter for real esate sector (M)	.25	Computed at the initial values assuming elasticity of substitution of .8.
β_3	Efficiency parameter for real estate sector	2.13867	Computed at the initial values assuming elasticity of substitution of .8.
δ_{KM}	Distribution parameter for capital in real estate sector	.844542	Computed at the initial values assuming elasticity of substitution of .9.

Demand Function Parameters

		Closed Economy	Open Economy	
T	Total time available per period	91	91	Assumed
ψ_1	Share parameter for non-housing goods	.814527	.829637	All demand parameters computed at the initial values assuming an income elasticity of demand for housing of 1, a price elasticity of demand for housing of −.8, and a price elasticity of demand for leisure of .15
ψ_2	Share parameter for housing services	.126	.114545	
ψ_3	Share parameter for leisure	.059473	.0558174	
γ_1	Minimum subsistence quantity for non-housing goods	24.5864	26.7531	
γ_2	Miminum subsistence quantity for housing goods	2.8833	2.846	
γ_3	Minimum subsistence quantity for leisure	43.0636	42.8969	

SOURCE: Authors' calculations.

of numbers, the final estimates strike us as reasonable. In particular, the allocation of income to inputs is similar to weights compiled for a U.S. case. So, although we may be off, it is unlikely we are well off the mark on shares.

There is much more uncertainty about tax rates. The numbers indicate an average tax rate on labor of about 17 percent and a tax on capital of 41 percent. The nominal tax rate on income is much higher, but probably half of income from labor and the self-employed is unreported, so perhaps .17 is pretty good. Computing more precise average and marginal tax rates is a difficult and much needed piece of research that we leave to others.

The total tax revenue is about 25 percent of GDP. All existing taxes are aggregated into one tax, which we call the "income tax." Since it is imposed on the production side of the economy, the value used for the benchmark tax rate is .33. All prices are set at unity, and the net of tax values are the initial quantities.

Net imports are approximately 10 percent of GDP. Therefore, in the open economy model, we set the value of non-housing goods demand (X_1) at 97.4 so that $X_1^D - X_1^S = 10$ percent of GDP. Because of the trade balance assumption, this requires a net export of capital services to also be $\bar{K} - K^s = 10$ percent of GDP. This is contrary to the information in the National Income and Products account as the net entrepreneurial income from the rest of the world is negative. The net income to the rest of the world is in excess of 5 percent of GDP. Thus, the assumption we implicitly make here is that the trade balance remains unchanged with the tax change.