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Taxation and Economic Efficiency in Jamaica

Miles K. Light

Georgia State University

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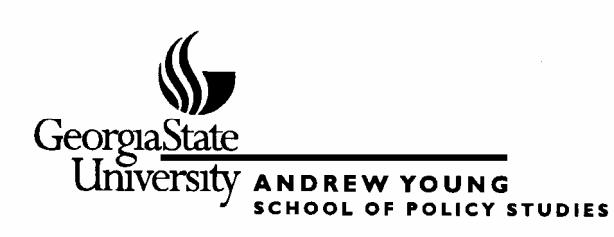

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Taxation and Economic Efficiency in Jamaica

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Abstract

This report presents a quantitative economic model used to determine the macroeconomic impact of tax reforms in Jamaica. We identify the magnitude and nature of changes to production, trade, and consumer welfare related to raising additional government funds. The current results suggest that simply increasing rates under the existing tax structure will produce a low tax yield and high efficiency costs. Although the Jamaican people are impacted in any scenario, the tax burden can be mitigated by improving tax compliance and by eliminating several pre-existing tax distortions. For example, the welfare cost of funds related to GCT taxation could be reduced by 50% by moving to a fully-uniform rate structure. Import tariffs could be improved by 12.5%. If Jamaican labor supply is elastic, as it seems to be, then labor taxation is inefficient. Conversely, labor taxes may be relatively efficient if supply elasticity is low, but the incidence is then borne mostly by workers. The aggregate welfare effects and tax collections of a comprehensive tax package will depend upon the magnitude of each tax change and the final rate structure. This report identifies why some tax streams are more or less efficient, and why they may collect more or less tax revenues. As an economic research report, several institutional and legal conditions known to exist in Jamaica are ignored here. Ultimately, tax collections and their effect upon the Jamaican population will depend upon economic forces as well as institutional conditions.

*This is a draft report prepared for the Government of Jamaica and is subject to change. Please do not cite this document without explicit permission of the authors. Errors and omissions are the sole responsibility of the authors. Prepared for the Jamaica Tax Reform Analysis Project, Andrew Young School of Policy Studies, Georgia State University, Atlanta.

Contents

1 Introduction **1**

2 A General Equilibrium Model for Jamaica **2**
2.1 Economic Flows . . . 2
2.2 Algebraic Formulation . . . 4
2.2.1 Production Functions . . . 4
2.2.2 Consumption, Investment and Government . . . 5
2.2.3 Steady-State Capital . . . 6
2.3 Tax Structure . . . 7

3 Jamaica's economic structure **9**
3.1 Production and Consumption Structure . . . 9
3.2 Structure of Value Added . . . 12
3.3 International Trade . . . 13
3.4 The informal economy . . . 16
3.5 Tax revenue . . . 16

4 Scenarios and Results **19**
4.1 Scenario Results . . . 20
4.2 Labor Taxes . . . 24
4.3 Trade Reform . . . 27

5 Model Extensions **33**

A Descriptive Statistics **34**

B Data issues **35**

C Model Files and Mechanics **35**

Executive Summary

How best to collect an additional J$8 Billion is not an easy question. Among the many constraints and considerations for tax reform are political feasibility, collection efficacy, compliance, equity, and the long-term effects on economic growth and productivity. This report attempts to quantify some of the macroeconomic and welfare effects of tax policy so that the committee is well-informed regarding the various trade-offs involved in the decision-making process.

The approach taken in this report differs substantially from other reports. Those reports carefully examine the legal and institutional framework related to a particular tax stream and then make detailed policy and regulatory prescriptions. In contrast, the approach used here substitutes the institutional and regulatory detail with rigorous economic theory in order to provide a clear interpretation of the macroeconomic policy response. Both types of reports can be used simultaneously to identify the broad economic effects related to a particular tax. This report provides broad economic impacts, while the detailed reports highlight the specific rules and institutions that may interact with the economy and government activity.

The central analysis tool used during this analysis is a Computable General Equilibrium (CGE) model. The model itself is not a means to an end, but the exercise of first combining production, consumption and tax data into a single framework, followed by viewing these actions through the lens of economic theory, provides additional insights into how Jamaica's economy interacts with the tributary system. This economic viewpoint is important because presumably, the purpose of the current tax-exercise is to benefit the people of Jamaica. The benefits from additional taxation are derived from the additional macroeconomic stability provided by improved credit and (eventually) lower debt service. The exercise inherent in this report is to quantify and characterize the *costs* related to extending the public reach, and how these costs can be minimized.

Findings The General Consumption Tax (GCT) is an obvious candidate to raise additional funds. Since the tax is applied to every transaction, the GCT is favored by the International Monetary Fund (IMF) as highly-compliant. In theory, the tax is also non-distortionary to business, but the actual efficiency of the tax is less clear in practice. Using the base CGE model, as described in section 2, the welfare cost of raising an additional 1% of GDP (about J$4 Billion) in revenues from the existing GCT is J$5.1 Billion. This constitutes a J$4 Billion transfer of income from private households to the government, plus an additional J$1.1 Billion in "deadweight loss." The efficiency of any particular tax proposal can be summarized more easily using the "Average Cost of Funds" (ACF) indicator. For example, the ACF to raise 1% GDP from the existing GCT structure is $ACF = \frac{J\$5.1}{J\$4.0} = 1.28$. The same exercise using import tariffs yields an ACF equal to 1.6 (i.e., it is less efficient asit currently stands).

The ACF for consumption taxes is generally lower than for import tariffs because the tax base is broader and there are fewer rate categories and exemptions. Ultimately, both taxes could be

more efficient. For example, if we consider raising an additional 1% of GDP and at the same time moving to a uniform rate structure, then the welfare cost falls from J$5.1 Billion to J$2.8 Billion. The ACF in this case is 0.7, which implies an overall increase in tax efficiency. A similar exercise for import tariffs lowers the ACF from 1.6 to 1.4. The gains from uniformity are larger for consumption taxes than import tariffs because there are few substitutes to final demand, but households can avoid import tariffs by purchasing more domestic goods.

Import Duties In light of Jamaica's common external tariff as part of CARICOM, and likely trade agreements, such as the Free Trade Agreement of the Americas (FTAA), import tariffs are not a sustainable revenue source in the long run. However, from a compliance perspective, imports are more easily taxed than any other activity in Jamaica. In the near term, it may be possible to extract some additional revenues from tariffs, and also to minimize the excess burden by moving to a "quasi-uniform" tariff structure. In the trade and tariffs report, Maskus calculates an import tariff structure that complies with CARICOM rules, but also raises additional revenues.

By applying this structure (provided in section 4.3), the government can raise J$3.4 Billion in additional funds, at a welfare cost of J$5.0 Billion. The ACF for this policy is 1.48. This formula was altered slightly, after discovering that a large share of the additional funds were coming from tariffs upon oil and petroleum products. After removing tariffs upon petroleum, the additional funds are J$2.2 Billion and the ACF rises to 1.57. This is still an acceptable cost in the short term. Of course, the long-term prospects for tariff revenues are limited. In general, despite their ease in compliance, import tariffs are considered to be a poor source of revenues because they impede competition and innovation in the supply of goods and services.

In an additional scenario, we consider the welfare and revenue effects from succession to the FTAA. If the FTAA were imposed in 2002, the government would stand to lose about J$7.7 Billion, about 80% of tariff revenues. If these revenues could be recovered using lump-sum taxation, then the average (national) welfare gain would equal 0.2% of total income. In a more likely scenario, the forgone tariff revenues are recovered using the GCT. Welfare is basically even in this case. The long-run effects, however, are substantial. For example, welfare and industrial activity would increase by 2.3% after capital has time to adjust to new market opportunities. In addition, long-run gains are captured mostly by workers – as wages increase by 4% as the capital stock expands and the marginal product of labor increases.

Labor Taxes Most formal sector employees consider the existing labor tax rate onerous. Although the statutory labor tax rate is not high by international standards (25%), when this tax is combined with a litany of payroll taxes, the rate of taxation can easily reach 40% on the margin. According to the Statistics Institute of Jamaica (STATIN), PAYE collections were approximately 10% of the total wage bill in Jamaica. Although the average rate is 10%, tax collections are sub-

stantially higher in certain sectors, such as Financial services, Government, and Communications. And they are quite low in other sectors, mostly agricultural and light-manufacturing. Unfortunately, we were not provided with PAYE or Payroll collections *by industry*. However, we can still use the total collections in order to show who would bear the burden, or reap the benefits, from a labor tax increase or decrease. An extension of the base CGE model is designed to include a labor-leisure choice. In this framework, if labor taxes increase, then workers can decide whether to increase or decrease their labor supply to the formal market. The time spent away from work is traditionally called leisure, but it could represent any other activity apart from formal labor supply.[1]

Traditional empirical studies have shown that workers cannot easily enter or leave the labor force. In this case, when the elasticity of labor supply is low, the current PAYE collection rate is relatively efficient[2] compared with most indirect taxes (GCT, SCT, etc..). If the supply-elasticity is indeed low, then the ACF related to additional funds from the PAYE system is unity ($ACF = 1.0$), which is the same as a lump-sum transfer. However, if the supply elasticity is high, as suggested by more recent empirical studies in developing countries, then labor taxation becomes highly-inefficient. The ACF for an additional 1% of GDP rises to 2.7 if σ_L, the substitution elasticity between labor and leisure, equals 8.

Interestingly, the *burden* of taxation falls on the worker when σ_L is low, but the burden is mostly shifted onto firms when σ_L is high. This effect is described in detail in section 4.2. When labor supply is inelastic, direct labor taxes are efficient, but burdensome to workers. When labor supply is elastic, the burden is shifted to firms (and ultimately, consumers), but the tax becomes highly distortionary. A good example of one such distortion is the exit from formal labor, into *in*-formal labor supply.

Comprehensive Tax Reform Some tax packages have been provided in the results section in order to combine the effects described above. The overall effect depends upon how much each tax is changed, and also upon the tax-interaction effects. For example, some of the revenues lost from lower import tariffs or lower labor taxes are recovered from the GCT automatically. This occurs if Jamaicans shift into consumption as a result of the tax-reform. To the extent that they purchase more goods and services, the GCT interaction-effect will be larger. Generally, however, these secondary effects are fairly small.

Extensions While this analysis measures the *efficiency* of various reforms, an important extension is to consider the equity impacts. We had initially planned to include 20 households (10 income deciles from rural and urban backgrounds) into the CGE model. Unfortunately, neither the

[1] We could provide a much richer formulation if the share of *informal* labor was estimated and provided.

[2] Of course, part of this relative efficiency comes from the fact that we have been forced to assume a "uniform" labor tax rate across all sectors.

PIOJ nor STATIN were able to provide household consumption and factor supply to the team.[3] If this information were supplied, then the current modeling framework can be extended to identify whether the poor or the rich bear more of the future tax burden.

[3]Not only is this data limitation unfortunate, it is also avoidable. A survey of living conditions and income was conducted in the year 2002. It is therefore incumbent upon some Jamaican think-tank to organize this data and generate useful household statistics that can be linked to the National Income and Product accounts.

1 Introduction

In order to maintain fiscal stability, the government of Jamaica has undertaken the task of comprehensive tax reform. These reforms are intended to restore fiscal balance and hopefully reduce the level of government debt. This report is part of a larger study of Jamaica's tributary structure, where specialists identify the strengths and weaknesses for each tax stream in the Jamaican economy. This study uses a computable general equilibrium model to consider the overall, macroeconomic effects of various tax-reform proposals in Jamaica. In each tax scenario, we indicate the possible impacts on GDP, household welfare, factor prices, international trade, and of course tax revenues. We also try to identify the underlying mechanisms behind the model results. For example, if we consider changes to border taxes, then trade diversion, import substitution, and export creation would be examples of the important mechanisms that determine the aggregate changes to production and welfare. Although the model distinguishes 48 production sectors, three factors, and several tax streams, it is designed as a "blunt instrument" for economic analysis. Many important details related to taxation are not captured, such as tax evasion or tax administration. Ideally, the results from this report should be considered together with each of the detailed tax reports in order to balance the benefits from improved design for each individual tax against the overall tax-interaction and macroeconomic effects described in this analysis.

We first briefly describe the methodology used to construct a computable general equilibrium model (CGE), based upon available data for Jamaica, then we present an overview of the Jamaican economy, as seen through the lens of a neoclassical economic model. Jamaica's tributary structure is presented, followed by some selected modeling exercises that quantify the potential gains from eliminating individual exemptions and moving toward tax-uniformity. These exercises are followed by the details of a labor-leisure model for wage taxes. The model shows that the existing labor tax is likely to be inefficient. If the supply elasticity for labor supply is large, then a reallocation toward indirect taxes could improve welfare. This sub-section also demonstrates that the tax incidence also depends significantly upon the labor supply elasticity. In subsection 4.3, we expand the base model to include an Armington trade structure, then consider two quasi-uniform tariff reforms, which are considered to be "feasible" under the CARICOM guidelines. It appears that a shift to the Quasi-uniform tariff system raises additional funds, but is not significantly more efficient. Complete tax-reform packages will be presented in a follow-on report. While reading this report, please remember that this is an introductory paper. It is brief and at times incomplete.

2 A General Equilibrium Model for Jamaica

The economic model for Jamaica is has been designed to be simple, so that extensions can be accommodated as necessary. The model represents Jamaica as a small open economy with 48 production sectors, a single, representative agent, and three factors of production. Overall, the model is consistent with an Arrow-Debreu economy that has constant returns-to-scale and perfect competition across all modes of production. As a small open economy, Jamaica faces fixed relative prices for imports and exports. Producers maximize profits taking prices as given, and consumers maximize utility subject to a budget constraint that depends upon the value of their endowments, transfers from the government, and remittances from abroad. These assumptions imply that no producer earns above-normal profits and that consumers cannot increase consumption of all goods. These are the basic economic concepts of economic scarcity and competition.

Following Mathiesen (1985) we formulate and solve the model as a complementarity problem with three types of equilibrium conditions: market clearance, zero profit, and income balance. Production technology and consumer preferences are characterized using the nested, constant-elasticity of substitution (CES) functional form. The model accommodates analysis of both the static and steady-state welfare effects through alternative representations of the capital stock.

The numerical equations are based on data derived from the 2002 Jamaican national accounts together with reports provided by the International Monetary Fund (IMF) and the original 1996 CGE Social Accounting matrix. The present version of the model distinguishes 48 industries, the government, and a single, representative consumer.

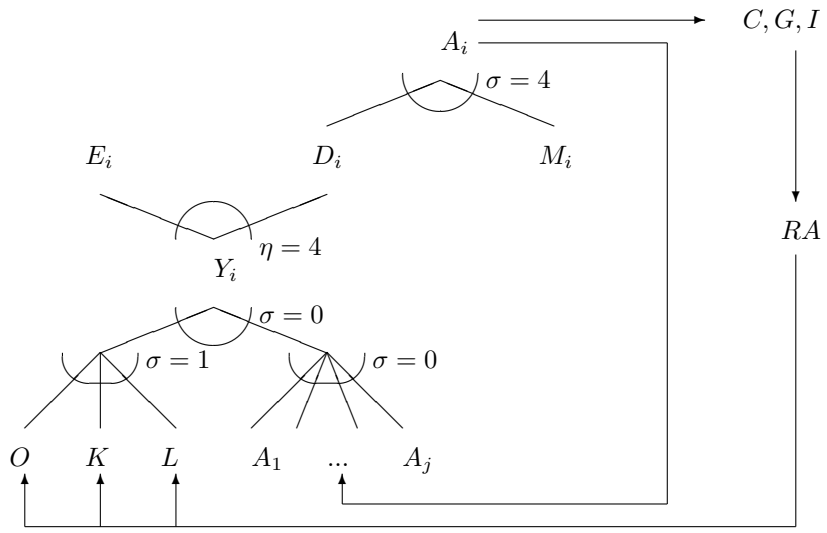
2.1 Economic Flows

The relationship between different sectors and consumers in the model is shown in Figure 1. Various aspects of the economy are depicted here, with the exception of taxes, which will be described in a separate section.

Production in sector i (Y_i) combines three primary factors: capital (K), skilled and unskilled labor (L), and an "operating surplus" (O), that has been calculated by the Statistical Institute of Jamaica (STATIN) as a residual. Intermediate inputs are added to produce outputs for the domestic (D_i) and export (E_i) markets. An "Armington composite good" (A) is a combination of domestic goods D and imports M. Armington aggregate goods are the basic consumption commodity. They are consumed by industry as an intermediate input and they are also goods for final consumption, C, government consumption G, and or investment I. Consumers are endowed with factors of production (L, K, O), which get sold to industry (Y). They are also the final consumers, who use income from factor sales to purchase Armington goods (C via A), to invest (I), or to create government services (G).

Currently, all production activity in the model is assumed to operate through formal channels,

Figure 1: Jamaican production structure



Description of Flows

Symbol	Description
Y	Goods Production
D	Production sent to the Domestic market
A	Armington aggregate good – this activity combines domestic production with imports to produce an *Armington aggregate good* for intermediate use or final demand.
E	Production which is Exported
M	Imports
L	Labor inputs – labor is either skilled or unskilled
K	Capital input
O	Operating Surplus - typically considered capital
I	Fixed Investment demand. Combines goods from A to produce an investment good.
G	Government demand. Tax revenues purchase goods from A to produce the *government good*.
C	Final consumption demand. Final demand by households. Households sell labor and capital endowments to pay for final consumption.

and that tax compliance is complete. Therefore, each sector is subject to various taxes (VAT, profits, payroll and income taxes). A possible extension would be to include an "informal" sector who pays only those taxes collected at the border (import tariffs and border-collected levies). Formal and informal activities would produce nearly identical goods that are consumed in final and intermediate demand.

2.2 Algebraic Formulation

Our model is based on constant elasticity of substitution (CES) functions. CES functions are widely applied because they are globally regular, and can be defined by their zeroth, first, and second order properties. This means that the location (price and quantity), slope (marginal rate of substitution), and curvature (or convexity) completely characterize a CES production or consumption function. This permits a *high-level* approach to the representation of production technology and consumer preferences.

Using this general approach, the supply side of the Jamaican model is shown in Figure 1. We use σ to denote the elasticity of substitution for production inputs and η is the elasticity of transformation for outputs[4]. In the model, any choice for σ and η in each sector can be applied in order to reflect local expertise related to particular sectors. For example, we typically assume a lower demand elasticity for goods facing excise taxes (tobacco, alcohol, and petroleum), than for other goods in consumption.

2.2.1 Production Functions

Production Inputs Goods are produced according to a nested Leontief-Cobb Douglas technology. Intermediate inputs and aggregate value-added enter at the top level:

$$Y_i = \min\left[\min_j\left(\frac{x_{ji}}{a_{ji}}\right), \frac{v_i}{b_i}, \frac{m_i^Y}{a_i^M}\right]$$

In this expression, x_{ji} represents intermediate inputs of good j from the domestic market and m_i^Y represents specialized imports for re-export in sector i.[5]

Value-added represents a Cobb-Douglas aggregation of labor (L) capital (K) and an operating surplus (O):[6]

$$v_i = L_i^{\alpha_L} K_i^{\beta} O_i^{\gamma}$$

in which constant returns to scale implies that $\alpha_L + +\beta + \gamma = 1$.

[4]The values for σ and η in the central scenarios are shown in Figure 1

[5]The greatest sectoral imports in the base year data are for sector MNM (mineral products and precious stones), in which total imports equal $230 million. The MNM sector also generates the largest level of exports, equal to $269 million. We characterize imports in this sector as specialized intermediate inputs to the production sector through technology parameter a_i^M rather than as part of final demand. For all other sectors $a_i^M = 0$.

[6]The numerical model permits the more general CES functional form for valued-added based on model input `esubkl`. When this input is unity, value-added aggregates are Cobb-Douglas as shown here.

Production Outputs Each production sector Y produces two types of commodities: domestic goods D_i and goods for export E_i. These goods are assumed to be imperfect substitutes, and they have a constant elasticity of transformation. An algebraic formulation of this transformation function is written:

$$Y_i = g(D_i, E_i) = \left[\alpha_i^D D_i^{1+1/\eta} + (1-\alpha_i^D) E_i^{1+1/\eta}\right]^{1/(1+1/\eta)} \tag{1}$$

where α_i^D is the benchmark value share of domestic sales in total output for sector i and η corresponds to the model input `etrndx`.

Imports The model adopts an Armington representation of the import demand. Armington goods, A_i, are produced by combining domestic goods with imports from the same sector. These goods are treated as imperfect substitutes (e.g., Autos from Russia vs. autos from Japan). We use σ_{DM} as the Armington elasticity, which corresponds to `esubdm` in the computer code.

$$A_i = \left(\alpha_i^M M_i^{1-1/\sigma_{DM}} + (1-\alpha_i^M) D_i^{1-1/\sigma_{DM}}\right)^{1/(1-1/\sigma_{DM})}$$

Some confusion can arise trying to distinguish between production, Y_i, output (D_i,E_i) and the consumption good (A_i). The Armington aggregate good, A_i combines domestic output, D_i with imports, M_i. A_i is the good used as an intermediate input and also for final demand.

Trade Balance The real exchange rate (ρ) is determined by supply of exports and demand for imports, which is determined in units of foreign currency.

$$\sum_i \overline{p}_i^E E_i + B = \sum_i \overline{p}_i^M \left(M_i + a_i^M Y_i\right)$$

Holding all else equal, rising import demand will increase ρ, which reflects increased demand for external currency. The fixed parameter B denotes the exogenously-specified current account balance. Because this is a small-open economy, import and export prices ($\overline{p}_i^E$,$\overline{p}_i^M$) are fixed exogenously.

2.2.2 Consumption, Investment and Government

Final Consumption A single representative agent (RA) is endowed with primary factors of production: capital, labor, and resources. The RA demands final goods for consumption. Investment and government output also demand final goods, but the level is exogenously specified, while private demand is endogenously-determined by utility maximizing behavior. The RA utility function is Cobb-Douglass as shown below:

$$U(A_i) = \prod_i A_i^{\alpha_i} \qquad \sum_i \alpha_i = 1$$

The RA maximizes utility subject to a budget constraint:

$$\begin{aligned} & \max_{A_i} U(A_i) \\ \text{s.t.} \quad & \\ & \textstyle\sum_i p_i A_i \leq p_K K + p_L L + p_O O + trn - I - B \end{aligned}$$

In this problem, the RA maximizes the utility function subject to a budget constraint. The Jamaican budget constraint is equal to the total value of factor endowments (K, L, O), plus any transfers from the government, minus the cost of investment, plus the net current-account balance. The current account balance for Jamaica is large and negative. This partially reflects the ratio of cash remittances to total trade volume (J$47.5 Billion in remittances versus J$110.0 B in exports).

Investment In the static formulation, investment demand is held constant at base-year levels. Investments are aggregated into a single, national investment pool, then distributed among production and government sectors according to base-year accounts. Investment funds come from households and government. The level of investment can be altered in the steady-state formulation, which is discussed in section 2.2.3.

Government The government spends money on the purchase of government services and investment. Purchases are supported with tax revenue, capital rents, and net foreign exchange transfers. The Jamaican tax system and total tax revenues are described in section 2.3.

2.2.3 Steady-State Capital

A major drawback of tax policy analysis in a state model is the fixed capital stock which does not respond to tax-induced changes in the net rate of return to capital. Logically, the level of investment depends upon depreciation, interest rates and the capital stock. Static CGE models usually fail to address the possible changes to investment and the capital stock the counterfactual. We remedy this drawback by including the *steady-state* formulation. The steady-state model allows capital and investment to change in response to policy directives, consistent with a long-run analysis. The long-run equilibrium condition links the cost of capital with the return to capital:

$$p_{inv} = r_K \qquad \perp \kappa$$

The capital-stock scale factor, κ, equilibrates this investment arbitrage condition, so when the return to capital rises relative to the price of investment, $(r_K > p_{inv})$, κ increases to scale up investment and reflect this arbitrage condition. Thus, in the steady-state equilibrium, κ adjusts investment so that the cost of capital is consistent with the return to capital. This condition is equivalent to assuming "Tobin's q" is initially equal to unity and returns to that value in the long-run.

2.3 Tax Structure

Production inputs are subject to six major types of taxes. Final consumption is taxed at rate *gct*. Special consumption taxes (*sct*) are also applied to excise goods such as petroleum, tobacco, and alcoholic beverages. Labor income in the formal economy is taxed at rate t_L, and capital earnings in the formal economy are taxed at rate t_K. Imports pay tariffs at rate t_m, and payroll taxes are imposed as a tax on labor income, payed by both the employer and employee, at rate t_{pyrl}. Producers pay specific taxes on production and other fees that are captured in t_y. Land rents are taxed like capital returns, where a national rate for profits taxes is applied. Differences in GCT, import, SCT, and Output tax rates across sectors leads to efficiency costs which are captured in the model.

An important segment of the tributary system is the invoice-rebate feature available for the VAT. Under this system, value-added taxes paid for intermediate inputs can be reclaimed by the firm. In theory, the rebate eliminates the tax-distortion between intermediate inputs. This distinction is less clear in practice, however, if the paperwork required for collection is complicated, or if the repayment time is especially long.

The tax-inclusive cost of production for formally-produced goods is then.

$$C_i = \sum_j p_j x_{ji} + p_L L + (1 + t_K)(rkK_i + O_i) + \rho \bar{p}_i^M a_i^m$$

Tax-inclusive revenue value for Y is denoted as R_i:

$$R_i = \left(p_i^D D_i + \rho \bar{p}_i^X X_i\right)\ (1 - t_i^Y\ )$$

In equilibrium, the tax-inclusive cost of production equals output value across all sectors ($R_i = C_i$), this represents the zero-profit equilibrium condition.

Import tariffs and value added taxes are included into the Armington commodity's unit cost function for formally-produced goods:

$$p_i = (1 + sct_i)\ \left[\alpha_i^M \left(\frac{p_i^M(1 + t_i^M)}{\bar{p_i}^M}\right)^{1-\sigma} + \left(\frac{p_i^D}{\bar{p_i}^D}\right)^{1-\sigma}\right]^{1/(1-\sigma)}$$

The benchmark tax rate applied on formal labor inputs (t_L) is based on direct tax payment by households in the SAM and gross payments to formal labor. The benchmark tax rate applied to private capital (t_K) is based on the direct tax payments by private firms and the gross payments to capital in all non-government sectors.

There is perfect arbitrage in factor markets, so there is a wedge between the marginal product of labor, capital and land in the formal and informal economies. One important aspect of the efficiency cost of taxation therefore corresponds to this difference in productivity. Any policy which leads to an increase in informal activity therefore exacerbates this inefficiency.

As of this draft, labor and payroll taxes are applied as income taxes paid by consumers. In this representation, firms pay for tax-inclusive labor, but workers receive labor income net-of-tax. Let w denote the wage for mobile labor and let LS be the aggregate labor supply, then

$$w = LS\,(1 + t_L + pyrl)$$

where the labor supply equals the national wage, net of t_L and payroll taxes. A better representation for labor taxes, especially to characterize those sectors that have a significant portion of *informal* activity, is to include sectoral labor tax collections. This is a goal for the upcoming model. In the interim, a separate labor-leisure model is constructed to indicate the relative efficiency of labor taxes under different assumptions about labor supply.

3 Jamaica's economic structure

This section contains a description of Jamaica's economy using of the STATIN national accounts for 2002.

3.1 Production and Consumption Structure

Table 1 describes the sectors which are in our model, and Table 2 ranks these sectors by output. A detailed description of the sectoral classification and composition will be included in Appendix A in the next draft.

According to STATIN, construction and distribution margins were the largest single sectors in the Jamaican economy in 2002. Transportation and hotels and restaurants are third and fourth largest production sectors, which implies that tourism services may be larger than we first believed. Service sectors such as financial services and insurance, real estate, and communications are significant sectors, together with the traditional export sectors for Bauxite and Alumina.

Table 1: Economic Sectors in the Jamaican Model

Code	**Description**	Y_0 **(mln.$)**
	Agriculture	
RUM	Sugar, Rum & Molasses	9369.5
CKN	Poultry and Eggs	8642.0
FED	Other foods and Animal Feeds	8160.6
MIL	Dairy	8094.6
PVF	Fruits & Vegetables	7294.2
BAN	Banana & Plantain	7278.1
COF	Cocoa & Coffee	11138.1
OCR	Other Crops	5866.8
VOL	Grain Mill, Oils & Fats	5239.3
RRT	Root Crops	5179.2
LVS	Livestock and Milk	4694.6
SGR	Sugar Cane	3860.0
CTR	Citrus	445.6
GRN	Pulses, Grain & Vegetables	748.0
XCR	Other Traditional Crops	302.4
	Industry	
MRG	Distribution Margins	103439.0
CON	Construction	90717.2
TRN	Transport & Storage	64542.6
BAX	Bauxite Mining & Alumina	34597.9
MTL	Basic & Fabricated Metals	34019.6
COM	Communication	33660.7
CHM	Chemicals, Coal, & Petroleum Prods	28306.2
ELE	Prod & Dist of Electricity	25704.9
MAN	Machinery and Equipment	22745.4

Table 1: Economic Sectors in the Jamaican Model (cont..)

Code	**Description**	Y_0 **(mln.$)**
NMM	Non-Metallic Mineral	17411.5
BEV	Beverages	13709.3
WOD	Wood, Cork, Furniture	11024.0
OMT	Meat Products	9990.1
BAK	Bakery Products	7059.6
PAP	Paper Products	6381.5
PRT	Printing and Publishing	5573.2
RBR	Rubber and Plastic	5559.5
TEX	Textiles	3727.3
FSH	Fishing	3366.0
TBC	Tobacco Products	2436.5
WAP	Wearing Apparel	2200.5
MIN	Other Mining & Quarrying	1899.4
OMN	Other Manufactures	1581.7
FRS	Forestry and Logging	720.3
LTR	Leather Products & Footwear	604.4
	Services and Other	
REL	Real Estate Services	33027.9
OSR	Other Miscellaneous Services	11564.7
REC	Hotels Restaurants & Clubs	49870.4
SRV	Business and Professional Svcs	9482.5
FIN	Financial & Insurance	38485.3
DWE	Dwelling Services	9395.4
WTR	Water Collect & Dist	5034.3
PET	Refined Petroleum	–
TOTAL		774,151

Source: STATIN 2004.

Y_0 Base year (2002) sectoral output (Billions of Jamaican Dollars (J$)).

Table 2: Base year production and trade statistics by sector for Jamaica

		Y0	D0	X0	M0	VA%	Y0-%
MRG	Distribution Margins	103439.0	96802.1	6636.9		67.0	13.4
CON	Construction	90717.2	90139.2	578.1		24.0	11.7
TRN	Transport & Storage	64542.6	51272.8	13269.8	13535.3	40.4	8.3
REC	Hotels Restaurants & Clubs	49870.4	49799.8	70.6		34.3	6.4
FIN	Financial & Insurance	38485.3	35461.7	3023.6		58.9	5.0
BAX	Bauxite Mining & Alumina	34597.9	692.0	33906.0		44.0	4.5
MTL	Basic & Fabricated Metals	34019.6	32189.7	1829.9	8447.4	24.5	4.4
COM	Communication	33660.7	26017.8	7642.9		74.7	4.3
REL	Real Estate Services	33027.9	28401.8	4626.1		52.8	4.3
CHM	Chemicals, Coal, & Petroleum Prods	28306.2	22932.9	5373.2	15053.4	18.7	3.7
ELE	Prod & Dist of Electricity	25704.9	25557.9	147.0		41.7	3.3
MAN	Machinery and Equipment	22745.4	22498.8	246.5	56924.0	25.5	2.9
NMM	Non-Metallic Mineral	17411.5	16890.4	521.1	4745.6	30.1	2.2
BEV	Beverages	13709.3	10419.6	3289.7	1891.8	29.7	1.8
OSR	Other Miscellaneous Services	11564.7	11556.0	8.8		45.0	1.5
COF	Cocoa & Coffee	11138.1	1670.7	9467.4	271.9	39.8	1.4
WOD	Wood, Cork, Furniture	11024.0	10041.5	982.5	3520.0	26.4	1.4
OMT	Meat Products	9990.1	9778.7	211.3	1259.0	19.5	1.3
SRV	Business and Professional Svcs	9482.5	9223.1	259.4		72.7	1.2
DWE	Dwelling Services	9395.4	9395.4			73.7	1.2
RUM	Sugar, Rum & Molasses	9369.5	4211.4	5158.1		24.0	1.2
CKN	Poultry and Eggs	8642.0	8642.0			15.6	1.1
FED	Other foods and Animal Feeds	8160.6	8160.6		3319.8	26.8	1.1
MIL	Dairy	8094.6	7872.8	221.8		30.7	1.0
PVF	Fruits & Vegetables	7294.2	5841.0	1453.2	2013.0	34.9	0.9
BAN	Banana & Plantain	7278.1	1455.6	5822.5		27.4	0.9
BAK	Bakery Products	7059.6	6839.8	219.7	2127.9	22.7	0.9
PAP	Paper Products	6381.5	6131.2	250.3	6685.1	41.3	0.8
OCR	Other Crops	5866.8	5337.0	529.8		71.9	0.8
PRT	Printing and Publishing	5573.2	5476.1	97.0	2335.6	51.9	0.7
RBR	Rubber and Plastic	5559.5	5066.1	493.5	7643.1	49.4	0.7
VOL	Grain Mill, Oils & Fats	5239.3	5148.2	91.1	2360.8	22.6	0.7
RRT	Root Crops	5179.2	4888.6	290.6		78.7	0.7
WTR	Water Collect & Dist	5034.3	4975.5	58.7		57.1	0.7
LVS	Livestock and Milk	4694.6	4685.7	8.9		40.3	0.6
SGR	Sugar Cane	3860.0	3858.1	1.9	1986.0	52.6	0.5
TEX	Textiles	3727.3	2923.9	803.4	2651.4	65.1	0.5

Source: National Statistical Service (2002) (reconciled by authors)

Key:

Y0	Base year output (million J$)
VA%	Base year value-added as a percentage of output value.
D0	Base year supply to domestic market
E0	Base year exports (fob)
M0	Base year imports (cif, net tariff)

Table 2: Jamaican 2002 production and trade (continued..)

		Y0	D0	X0	M0	VA%	Y0-%
FSH	Fishing	3366.0	2441.3	924.6		50.3	0.4
TBC	Tobacco Products	2436.5	1558.7	877.8	227.7	18.7	0.3
WAP	Wearing Apparel	2200.5	1650.3	550.1	3552.3	24.4	0.3
MIN	Other Mining & Quarrying	1899.4	1861.4	38.0	959.6	49.6	0.2
OMN	Other Manufactures	1581.7	978.9	602.8	333.5	61.5	0.2
GRN	Pulses, Grain & Vegetables	748.0	736.6	11.5	4036.0	41.4	0.1
FRS	Forestry and Logging	720.3	719.8	0.5		50.7	0.1
LTR	Leather Products & Footwear	604.4	572.1	32.4	1175.2	25.9	0.1
CTR	Citrus	445.6	288.6	156.9		32.5	0.1
XCR	Other Traditional Crops	302.4	133.2	169.2		58.2	0.0
PET	Refined Petroleum				31560.0		
TOTAL		774151.9	663196.7	110955.2	178615.5		

Source: National Statistical Service (2002) (reconciled by authors)

Key:

Y0	Base year output (million J$)
VA	Base year value-added (million J$)
D0	Base year supply to domestic market
E0	Base year exports (fob)
M0	Base year imports (cif, net tariff)

3.2 Structure of Value Added

The Jamaican GDP in 2002 was J$402 billion. This represents total value added plus indirect taxation for all sectors and the government. We present a detailed review of the structure for the value-added component of production in Table 14, listed in Appendix A. Overall, the participation of labor, at least formally-reported labor, in total GDP is about 1/2 (51.5%). The remaining half can be partitioned into depreciation and operating surplus. Depreciation contributes about 10% to total value-added, sector-specific capital contributes 3% to total depreciation, while operating surplus represents the remaining 40%. Labor's share in total value-added would be closer to 40%, except that the government is about 98% labor intensive in value-added, according to national statistics. The contribution of the government to labor participation is an important consideration when determining where additional tax-revenues are spent. If additional funds are used to expand government services, then labor, especially skilled labor, benefits substantially. If, on the other hand, additional revenues are used to service debt, labor is impacted similarly to capital and operating surplus.

3.3 International Trade

The structure of Jamaica's foreign trade is described in this section. Tables 3 and 4 list exports, imports, share of trade, and value-added for each traded good. Jamaica's export structure is generally narrow. Over 75% of Jamaica's total exports come from just 8 of the 48 production sectors. Bauxite, alumina, transport (air passenger), coffee, rum, and communications are among the largest exports. Bauxite alone represents about 30% of total exports. The extent to which these export sectors can adjust to take advantage of international price movements determines the overall effect upon Jamaica's external trade balance and ultimately, the exchange rate.

Imports reflect Jamaica's situation as a small island. Manufactures and heavy industrial goods are imported and used for intermediate production. About 56% of all imports come from the manufacturing sector, crude and refined oil, transportation services, and basic metals. Imports are nearly two times as large as exports, which generates an annual current-account deficit of about J$80 Billion dollars, more than 1/3 of the total import value. This huge current account deficit is partly financed by massive remittances from abroad. It is these remittances that help to finance the current-account deficit, and to hold value for the Jamaican dollar.

Table 3: Benchmark export statistics for Jamaica (2002)

		X0	X0(%)	%-X	%VA
BAX	Bauxite Mining & Alumina	33906.0	30.6	98.0	40.2
TRN	Transport & Storage	13269.8	12.0	20.6	38.6
COF	Cocoa & Coffee	9467.4	8.5	85.0	34.1
COM	Communication	7642.9	6.9	22.7	73.6
MRG	Distribution Margins	6636.9	6.0	6.4	65.5
BAN	Banana & Plantain	5822.5	5.2	80.0	25.9
CHM	Chemicals, Coal, & Petroleum Prods	5373.2	4.8	19.0	17.4
RUM	Sugar, Rum & Molasses	5158.1	4.6	55.1	23.5
REL	Real Estate Services	4626.1	4.2	14.0	50.7
BEV	Beverages	3289.7	3.0	24.0	29.2
FIN	Financial & Insurance	3023.6	2.7	7.9	55.8
MTL	Basic & Fabricated Metals	1829.9	1.6	5.4	24.3
PVF	Fruits & Vegetables	1453.2	1.3	19.9	31.1
WOD	Wood, Cork, Furniture	982.5	0.9	8.9	25.9
FSH	Fishing	924.6	0.8	27.5	50.0
TBC	Tobacco Products	877.8	0.8	36.0	18.6
TEX	Textiles	803.4	0.7	21.6	63.5
OMN	Other Manufactures	602.8	0.5	38.1	60.0
CON	Construction	578.1	0.5	0.6	23.9

Key:

X0	Base year exports
X0 (%)	Base year exports as % of total exports
%-X	Base year exports as % of domestic production
% VA	Base year exports (fob) as percentage of sectoral value-added

Table 3: Export statistics (continued)

		X0	X0(%)	%-X	%VA
WAP	Wearing Apparel	550.1	0.5	25.0	21.9
OCR	Other Crops	529.8	0.5	9.0	71.0
NMM	Non-Metallic Mineral	521.1	0.5	3.0	29.2
RBR	Rubber and Plastic	493.5	0.4	8.9	47.8
RRT	Root Crops	290.6	0.3	5.6	78.6
SRV	Business and Professional Svcs	259.4	0.2	2.7	72.1
PAP	Paper Products	250.3	0.2	3.9	40.6
MAN	Machinery and Equipment	246.5	0.2	1.1	23.8
MIL	Dairy	221.8	0.2	2.7	29.7
BAK	Bakery Products	219.7	0.2	3.1	21.8
OMT	Meat Products	211.3	0.2	2.1	19.4
XCR	Other Traditional Crops	169.2	0.2	55.9	57.6
CTR	Citrus	156.9	0.1	35.2	27.2
ELE	Prod & Dist of Electricity	147.0	0.1	0.6	40.9
PRT	Printing and Publishing	97.0	0.1	1.7	50.7
VOL	Grain Mill, Oils & Fats	91.1	0.1	1.7	22.2
REC	Hotels Restaurants & Clubs	70.6	0.1	0.1	33.1
WTR	Water Collect & Dist	58.7	0.1	1.2	53.1
MIN	Other Mining & Quarrying	38.0	0.0	2.0	47.5
LTR	Leather Products & Footwear	32.4	0.0	5.4	22.6
GRN	Pulses, Grain & Vegetables	11.5	0.0	1.5	39.5
LVS	Livestock and Milk	8.9	0.0	0.2	37.4
OSR	Other Miscellaneous Services	8.8	0.0	0.1	41.7
SGR	Sugar Cane	1.9	0.0	0.0	49.6
FRS	Forestry and Logging	0.5	0.0	0.1	49.9
TOTAL		110955.2	1.0		

Key:

X0	Base year exports
X0 (%)	Base year exports as % of total exports
%-X	Base year exports as % of domestic production
% VA	Base year exports (fob) as percentage of sectoral value-added

Table 4: Benchmark import statistics for Jamaica

		M0	M0%	%-M	%VA
MAN	Machinery and Equipment	56924.0	31.9	66.8	23.8
PET	Refined Petroleum	31560.0	17.7	86.5	
CHM	Chemicals, Coal, & Petroleum Prods	15053.4	8.4	34.4	17.4
TRN	Transport & Storage	13535.3	7.6	20.9	38.6
MTL	Basic & Fabricated Metals	8447.4	4.7	20.7	24.3
RBR	Rubber and Plastic	7643.1	4.3	57.7	47.8
PAP	Paper Products	6685.1	3.7	51.3	40.6
NMM	Non-Metallic Mineral	4745.6	2.7	21.8	29.2
GRN	Pulses, Grain & Vegetables	4036.0	2.3	82.5	39.5
WAP	Wearing Apparel	3552.3	2.0	62.8	21.9
WOD	Wood, Cork, Furniture	3520.0	2.0	25.3	25.9
FED	Other foods and Animal Feeds	3319.8	1.9	28.4	25.7
TEX	Textiles	2651.4	1.5	46.8	63.5
VOL	Grain Mill, Oils & Fats	2360.8	1.3	31.3	22.2
PRT	Printing and Publishing	2335.6	1.3	29.8	50.7
BAK	Bakery Products	2127.9	1.2	23.4	21.8
PVF	Fruits & Vegetables	2013.0	1.1	25.0	31.1
SGR	Sugar Cane	1986.0	1.1	33.6	49.6
BEV	Beverages	1891.8	1.1	12.1	29.2
OMT	Meat Products	1259.0	0.7	11.3	19.4
LTR	Leather Products & Footwear	1175.2	0.7	62.6	22.6
MIN	Other Mining & Quarrying	959.6	0.5	33.1	47.5
OMN	Other Manufactures	333.5	0.2	24.5	60.0
COF	Cocoa & Coffee	271.9	0.2	13.9	34.1
TBC	Tobacco Products	227.7	0.1	2.8	18.6
TOTAL		178615.5	100.0		

Key:

M0	Base year imports
M0 %	Base year imports as % of total imports
%-M	Base year imports as % of domestic sales
% VA	Base year imports as a percent of sectoral value-added

3.4 The informal economy

According to STATIN, a portion of the officially reported economic statistics comes from a survey of the informal economy. This portion of economic activity is not reported to the government, but represents a certain amount of economic production and consumption. Traditionally, informal economic activity is small-plot farming, street marketing, and other small-volume activities. A typical modeling exercise is to identify this portion of the economy as the "informal economy." This represents a portion of employment and output that is not subject to taxation, either legally or illegally.

In order to identify the nature and size of these activities, the statistics office conducts a survey of individuals and firms. Unfortunately, STATIN has not been able to provide us with indicators related to informal activities in Jamaica. If the information is provided to us, the informal economy will be included into the Jamaican model in two ways. Informal labor will be included in the production process, so that we can identify the extent to which changes to labor taxes will encourage workers to move into informal activities, or we will include service sectors that are completely informal and not subject to taxation.

3.5 Tax revenue

Tax revenues for the Jamaican government in 2002 were 99 Billion Jamaican dollars[7]. General consumption taxes, collected domestically and at the border are the largest revenue source, contributing about 25% of total tax revenues (J$25 billion). The PAYE labor tax is second largest with revenues of J$21 billion. When taken together with payroll taxes, the total wage bill represents almost J$30 billion. Excise taxes are also an important source of income, they represent 10.9% of total taxes. Import tariffs represent another J$10 billion, so that these taxes, taken together constitute about 76% of all tax revenues. Other income taxes (e.g., interest taxes) constitute the remaining 25% of government tax revenues.

Table 5: Benchmark tax collections and tax rates

		Y0	GCT	TY	TL	PYRL	SCT	TM	TOTAL
TOTAL		774152	25465	7532	18952	8928	21599	9641	92121
MAN	Machinery and Equipment	22745	5653.2	369.5	551.4	544.6		5851	12970
OSR	Miscellaneous Services	11565	133.1	376.1	4925.2	1624.6			7059

Y0	Total output value.
GCT	General Consumption Tax.
TY	Indirect taxes on production imposed upon firm output.
TL	Labor taxes (PAYE payments).
PYRL	Payroll taxes, including the Heart, NHT, and NIH.
SCT	Special Consumption Taxes.
TM	Import Tariffs.

[7]This is 1.98 billion USD at an exchange rate of 50 J$/USD.

Table 5: Tax collections and rates (continued)

		Y0	GCT	TY	TL	PYRL	SCT	TM	TOTAL
TBC	Tobacco Products	2436	616.6	0.6			6299.9	7.1	6924
CHM	Chemicals, & Petroleum	28306	737.7	22.9	118.5	77.7	5437.3	367.5	6762
BEV	Beverages	13709	1740.4	27.4	913.3	334.0	3133.2	231.9	6380
FIN	Financial & Insurance	38485	1972.0	702.7	2368.9	1060.5			6104
PET	Refined Petroleum		109.7		196.9	135.0	4793.4	121.9	5357
COM	Communication	33661	2145.9	337.7	1873.1	827.2			5184
MRG	Distribution Margins	103439	2950.4	1424.6					4375
SRV	Business and Prof Svcs	9482	1377.7	38.5	1265.7	938.9			3621
GOV	Government services		127.1	80.5	2679.5	630.4			3517
REC	Hotels Restaurants	49870	1055.7	573.3	743.4	631.3			3004
DWE	Dwelling Services	9395	62.4	132.3	349.1	114.5	1935.9		2594
TRN	Transport & Storage	64543	175.4	843.0	402.9	188.4		0.3	1610
RBR	Rubber and Plastic	5560	714.2	54.9				536.9	1306
BAK	Bakery Products	7060	280.0	40.5	432.2	266.0		119.0	1138
MTL	Fabricated Metals	34020	732.3	30.8	74.4	68.5		162.1	1068
WAP	Wearing Apparel	2200	464.1	48.4	29.2	66.8		456.5	1065
PVF	Fruits & Vegetables	7294	379.9	271.2	57.5	108.4		206.4	1023
NMM	Non-Metallic Mineral	17412	756.0	92.5				118.9	967
WOD	Wood, Cork, Furniture	11024	541.9	53.8				332.1	928
REL	Real Estate Services	33028	250.9	660.1					911
PAP	Paper Products	6381	533.9	45.7	60.5	32.8		202.8	876
FED	Other foods	8161	360.8	84.4	86.2	36.3		211.2	779
PRT	Printing Publishing	5573	278.4	59.7	137.2	81.5		30.3	587
OMN	Other Manufactures	1582	151.6	21.4	251.2	111.8		48.1	584
CON	Construction	90717	83.6		288.4	196.2			568
TEX	Textiles	3727	293.6	54.0				94.0	442
OMT	Meat Products	9990	163.0	17.8	121.0	48.9		79.3	430
MIL	Dairy	8095	163.6	69.8	77.4	84.2			395
SGR	Sugar Cane	3860	101.0	28.4	61.2	121.6		73.1	385
RUM	Sugar, Rum & Molasses	9370		31.1	240.2	108.9			380
CKN	Poultry and Eggs	8642	1.8	7.4	218.1	120.2			348
VOL	Grain Mill, Oils	5239	60.5	13.8	104.4	80.4		44.2	303
LTR	Leather Products	604	131.3	19.6	8.8	9.9		129.5	299
ELE	Electricity	25705		183.3	16.1	65.0			264
BAX	Bauxite	34598		194.5	37.9	26.5			259
RRT	Root Crops	5179		8.9	152.2	84.3			245
OCR	Other Crops	5867	16.7	54.7	80.6	80.1			232
WTR	Water Dist	5034	0.7	196.3	17.9	15.5			230
MIN	Other Mining	1899	80.6	21.9				75.5	178

Y0	Total output value.
GCT	General Consumption Tax.
TY	Indirect taxes on production imposed upon firm output.
TL	Labor taxes (PAYE payments).
PYRL	Payroll taxes, including the Heart, NHT, and NIH.
SCT	Special Consumption Taxes.
TM	Import Tariffs.

Table 5: Tax collections and rates (continued)

		Y0	GCT	TY	TL	PYRL	SCT	TM	TOTAL
LVS	Livestock and Milk	4695		136.2					136
GRN	Grains Vegetables	748	0.2	14.5				121.3	136
COF	Cocoa & Coffee	11138	36.0	48.1				20.5	105
FRS	Forestry and Logging	720	12.5	5.7	12.1	8.0			38
CTR	Citrus	446	19.0	12.5					31
BAN	Banana & Plantain	7278		19.7					20
XCR	Other Crops	302		2.0					2
FSH	Fishing	3366							

Y0	Total output value.
GCT	General Consumption Tax.
TY	Indirect taxes on production imposed upon firm output.
TL	Labor taxes (PAYE payments).
PYRL	Payroll taxes, including the Heart, NHT, and NIH.
SCT	Special Consumption Taxes.
TM	Import Tariffs.

In this table, we do not capture all of the tax revenues. Overall, 85% of all tax revenues are captured in the current model for Jamaica. Omitted tax revenues include the stamp-tax, miscellaneous fees, and specific taxes, such as the Bauxite tax. Many of these taxes (e.g., specific fees) are difficult to represent in a CGE model and are best left to each individual expert.

4 Scenarios and Results

In a typical policy analysis, hundreds of scenarios are considered. Some selected scenarios are presented here in order to spotlight important considerations during Jamaica's tax reform. Table 6 lists each scenario together with a brief description. A series of additional scenarios and results for labor and international trade are included as separate subsections.

Table 6: Trade Liberalization Scenarios for Jamaica

Scenario	**Description**
	Static scenarios
GCT	Proportional increase of the General Consumption Tax to raise an additional 1% of GDP (about J$4,000).
TM	Proportional increase of import tariffs to raise 1% of GDP.
UNI-GCT	Eliminate all exemptions and impose a uniform GCT across all goods. Compute the required GCT rate that raises and additional 1% of GDP.
UNI-TM	Impose two uniform import tariff rates: 5%, 10%, leaving higher rates unchanged. Compute the required rate to generate an additional 1% of GDP.
	Steady state scenarios
SSGCT	Long-run impact of GCT scenario.
SS-GCT-UNI	Long-run impact of UNI-GCT scenario.
SSTM	Long-run impact of TM scenario.
SS-TM-UNI	Long-run impact of UNI-TM scenario.

Each of the STATIC scenarios is a comparative-statics exercise with new prices and quantities presented in the resulting equilibrium. During each of these policy exercises, households and firms are simultaneously re-allocating production and consumption in order to maximize profits and utility, and relative prices adjust until supply equals demand for each commodity.

All of the new prices, quantities, taxes, revenues, and consumption levels can be observed after solving each scenario. We present some selected statistics that highlight those concepts that are important for tax-reform purposes. Excess burden, revenues, tax yield, changes to output and GDP, and consumption are a few examples. These statistics can be calculated for each tax instrument or tax package, then compared across scenarios and assumptions. Selected output statistics are described in Table 7.

Because the experiments forming the basis for these calculations consider infra-marginal changes in rates we label these estimates the "Average Cost of Funds" (ACF). The ACF measures the efficiency cost of raising an additional 1% of GDP (about J$4 billion Jamaican dollars) from different tax streams and under various circumstances.

The ACF values provide a useful input to the public policy debate, specifically related to the cost-benefit calculus of public expenditures. When the ACF equals 1.4, this means that $1 of

Table 7: Descriptive output statistics

Statistic	**Description**
ACF	Average Cost of Funds. Computes amount of foregone consumption for each Jamaican dollar of additional revenue. Computed as: $-\frac{\Delta C}{\Delta G}$.
OUTPUT %	Percentage change in production, measured relative to 2002 Benchmark production. This statistic is representative, but not identical, to % change in GDP.
OUTPUT J$	Output statistic calculated in Jamaican dollars.
WELFARE %	Percentage change in household consumption, measured as a percentage of initial income. This statistic represents the *Equivalent Variation* (EV), expressed as a percentage of initial income.
WELFARE J$	Welfare measure expressed in millions of Jamaican dollars.
WELFARE $	Welfare measure expressed in millions of US dollars, using an exchange rate of 60 J$/USD.
%M	Percentage change in import volume.
%X	Percentage change in export volume.
CPI	Percentage change in consumption prices measured using the new scenario consumption basket. (Laspeyres' Index).
PFX	Percentage change in the real exchange rate (Price of Foreign eXchange). Calculated as $100\,(\frac{pfx}{cpi} - 1)$.
REVS J$	Government revenues collected in scenario. Millions of J$.
P_F	Real factor return. For each production factor (labor and capital), the percentage change in the real return is computed relative to the consumer price index: $\frac{p_f}{cpi}$.

public funds costs the representative consumer $1.4. As the ACF increases, the requisite benefit through which a public project can be justified increases, and one would expect that as the ACF exceeds 1.5, far fewer public expenditures are justifiable than is the case when the ACF equals 1.2.

4.1 Scenario Results

The summary results for scenarios listed in table 6 are presented in table 8.

The main purpose of table 8 is to quantify the economic cost of Jamaica's existing system of tax exemptions. In the first two columns of the table, existing collected GCT rates and import tariff rates are simply scaled proportionately until an additional 1% of GDP is collected. In the second two columns, the same amount of additional taxes are collected, but the *tax structure* is changed to be more uniform. The GCT is completely uniform, and import tariffs are uniform with two main rates, 5% and 10%.

We find that in order to raise an additional 1% of GDP using a proportional increase in the current GCT structure, rates would need to increase from 15% to 18.6%, a 24% rise in rates. Since

Table 8: Selected tax reform results for Jamaica. Focus upon GCT and Import Tariffs.

	GCT	TM	UNI-GCT	UNI-TM
Static Model Results				
ACF	1.3	1.6	0.7	1.4
YIELD	87.7	74.6	-	-
REVS J$	4,096.3	3,871.0	3,886.1	4,285.6
OUTPUT %	-2.1	-2.2	-1.5	-2.0
OUTPUT J$	-6786.6	-7124.0	-5086.3	-6754.0
WELFARE %	-1.3	-1.6	-0.7	-1.4
WELFARE J$	-5184.2	-6329.0	-2814.5	-5414.4
WELFARE $	-86.4	-105.5	-46.9	-90.2
GCT %	18.6	15.0	9.5	15.0
TM %	1.0	1.7	1.0	1.2
%M	-1.9	-7.0	-0.5	-7.3
%X	-2.3	-9.9	-0.4	-10.7
PFX	-1.4	-2.4	-0.7	-1.7
LABOR	0.5	0.6	0.4	0.8
CAPITAL	-2.4	-2.4	-1.9	-1.6
OP. SURPLUS	-2.7	-2.8	-1.6	-2.9

the import tariff base is smaller, a much larger increase, near 70%, is needed in order to collect 1% of GDP. Using central parameter assumptions, the *tax yield* for the GCT is about 88%. The yield for import tariffs is lower, at 74.6%. The tax yield calculates the ratio of net tax collections, after households and firms re-allocate consumption, to potential tax collections if initial revenues were scaled proportionately. The yield indirectly measures the elasticity of demand for goods included in a particular tax stream.

If instead of proportional scaling, the government were to eliminate all existing GCT exemptions and impose a completely uniform rate, then the additional revenues could be raised while at a lower economic cost. In this scenario (UNI-GCT), the existing 15% rate with exemptions could be replaced by using a uniform rate of 9.5%. The average cost of funds for the GCT falls from 1.3 to 0.7 in this case, and the percentage change in welfare falls from -1.3% to -0.7%[8] Similarly, the economic cost of revenues falls if we move toward a uniform import tariff structure. However, the gains are weaker when using import tariffs, because the base is relatively small. For import tariffs, the ACF

[8]The percentage change in welfare is the same as the ACF in this case, because in each scenario, 1% of GDP is collected. This represents the denominator in both statistics.

falls from 1.6 to 1.4 as rates are made more uniform (5% and 10%, respectively). The required increase in tariff rates also falls, from a 70% increase to a 20% increase. Of course, the 20% is in addition to increases in each rate that was below 5% and 10%, respectively.

Domestic production falls by a larger percentage than welfare, which reflects Jamaica's large current-account deficit. If a larger share of GDP were exported, then firms could mitigate the damage by shifting a larger share to the export market as domestic taxes increase.

We can also consider the long-run, steady-state effects from each tax package. The steady-state results should be considered an "upper-bound" estimate for a particular tax impact because they reflect fully adjustable capital stocks. In the long-run, the impact for tax packages where the incidence falls onto capital is typically large and negative. This impact reflects the fact that capital stocks are a "fixed factor" in the short run, and therefore an attractive target for revenues, but in the long-run, capital becomes the most volatile input factor, making capital taxes the least efficient instrument. The steady-state results listed in table 9 demonstrate this effect.

Factor returns, listed at the bottom of table 9, have now reversed compared to the static exercise. The (average) long-run stock of capital has adjusted so that the real return to capital is near zero, but the real return to labor now falls by 1.8% to 3.1%. This lower real return reflects less capital, and consequently a lower marginal product of labor.

Because the tax burden from GCT and TM are primarily upon capital, the long-run ACF is much higher than the short-run ACF. The long-run cost of proportionally increasing GCT rates to collect 1% of GDP can be as high as 2.9 if the capital stock decreases on average by 3.6%. Of course, the long run implications are only indicative. They represent an upper-bound estimate for the gains or damages imposed by a particular policy. Future scenarios should be considered in conjunction with additional policies intended to promote investment and growth.

Table 9: Long-run tax reform results for Jamaica. Focus upon GCT and Import Tariffs.

	GCT	TM	UNI-GCT	UNI-TM
Model Results: Steady-State				
ACF	2.9	3.1	1.7	2.5
YIELD	86.8	76.2	-54.7	332.4
REVS J$	2351.8	2168.8	2796.1	2983.3
OUTPUT %	-4.1	-4.2	-2.8	-3.6
OUTPUT J$	-13663.9	-13681.2	-9353.6	-11756.4
WELFARE %	-3.0	-3.2	-1.7	-2.6
WELFARE J$	-11648.7	-12592.7	-6807.9	-10168.3
WELFARE $	-194.1	-209.9	-113.5	-169.5
GCT %	19.0	15.0	9.6	15.0
TM %	1.0	1.8	1.0	1.2
%M	-3.7	-9.2	-1.6	-8.9
%X	-5.0	-13.1	-2.1	-13.1
CPI	3.1	4.7	4.5	6.3
PFX	-1.6	-2.7	-0.8	-1.9
κ	-3.6	-3.5	-2.3	-2.7
LAB	-3.1	-2.8	-1.8	-1.8
CAP	0.1	0.0	-0.4	0.3
OPS	0.1	-0.2	0.1	-0.8

4.2 Labor Taxes

In calendar year 2002, Jamaica's PAYE system generated revenues equal to 5% of GDP. This represents 1/5 of total tax revenues for that year. Labor income is taxed at a flat rate of 25%, with a single deduction equal to the average per-capita Jamaican income. In 2002, average annual per-capita income was J$148,000.

A common complaint about the Jamaican tax system is related to the high rate of labor-based taxation. Indeed, taken together with othe payroll taxes, the wedge between employee and employer payment is often close to 40%. Additionally, because there is only a single income tax rate, the jump from non-tax-status, to taxable status, is substantial.

In this study, the PAYE and Payroll taxes have been included as a wedge between the aggregate labor supply and the firm's wage bill. The *labor tax* is calculated using total PAYE payments as a share of aggregate labor demand.

$$t_L = \frac{PAYE_0}{\sum_i LD_0^i}$$

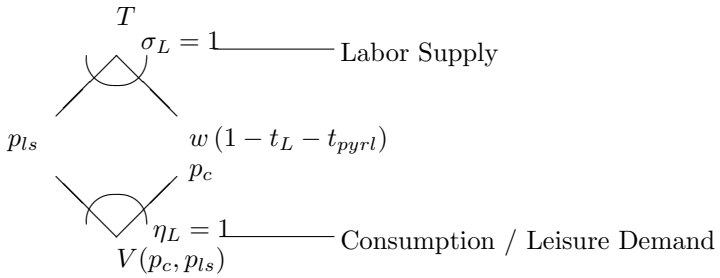
Using this formula, the average labor tax rate is 10% ($t_L = 10\%$), where LD_0^i is the total wage bill payed by employers. This means that on average, 10% of all (formal) wages in Jamaica are withheld. Payroll taxes are computed identically, so that $PYRL = 5\%$. The total payroll contribution can be broken down by component. HEART contributions represent 1% of total wages, NHT represents 2.5%, and NIS represents 1.2%. Taken together, taxes applied to labor, paid by the employer and the employee, represent about 15% of aggregate wages.

Unfortunately, these figures to not capture the true marginal rate of labor taxation. In reality, labor taxes are paid by only a fraction of the population, and the rate of taxation will depend upon that group's income. For example, a worker who earns J$296,000 per year pays, *on average*, 12% into the PAYE system, but the *marginal* tax rate of additional earnings is 25%. In order to conduct a more precise study of labor taxes and the impact upon labor markets, sectoral PAYE collections are needed. STATIN, as they prepare future analysis, should consider organizing PAYE and payroll collections by industry code in order to improve the analysis of labor taxation.

In light of the data-limitations, we can still capture, to a certain extent, the impact of changes to the labor tax system. The basic model described in section 2 is extended here to include a labor-leisure choice for workers. In this construct, the representative household is endowed with a fixed amount of time, which can be supplied to the formal labor market, with wage w, or consumed directly. Traditionally, the non-wage earnings represent the value of leisure, so we call this price p_{ls}. In Jamaica, some of this "leisure" time is actually used to work in the informal labor market. Unfortunately, this data was also not provided for the current study[9]. The structure for labor supply is presented in Figure 2.

[9]In a future study, the share of informal labor, taken together with the sectoral PAYE tax burden, will offer a rich depiction of the true labor tax burden for Jamaica.

Figure 2: Detailed Labor Supply and Leisure Demand



T represents the aggregate household time endowments, this endowment is supplied to either the labor market, earning wages equal to $w\,(1 - t_L - t_{pyrl})$, or the time is spent elsewhere. The elasticity of transformation between labor and leisure supply is σ_L. On the consumption side, the household can choose between consuming additional goods (p_c) or additional leisure (p_{ls}). The elasticity of substitution between consumption of goods versus leisure is η_L. In the base scenario, we assume that both of these elasticities are equal to unity.

As with other tax streams, we first consider the average cost of funds to raise additional revenues equal to 1% of GDP. IN this labor-tax exercise, the first three three columns of Table 10 are used to show the impact across different labor supply elasticities. Depending upon the net-elasticity of labor supply, the welfare cost of taxation through the PAYE system can be quite high. We capture this effect in Table 10.

Looking at the LAB row of Table 10, across the first three columns, the return to labor falls. However, who actually bears the burden of the tax depends upon σ_L. In column 2 σ_L is low (1/10), and the worker bears the burden of additional labor taxes. We see this because the market wage (w) only rises 0.7%, whereas the relative return to leisure falls by 7.1%, and the return to labor falls by 4.6%. This is an indication that as firms substitute away from labor, workers cannot respond easily. Consequently, they face lower wages, less hours, or layoffs. Clearly, the welfare burden here is payed by workers, rather than firms. Conversely, when the labor supply elasticity is high ($\sigma_L = 8$)[10] market wages rise by 3.1%, the price of leisure falls by 0.7%, and the return to the time-endowment falls by only 1.1%, compared to 4.6% in column 2. In this situation, workers respond to the tax by selling less labor than firms demand, and by shifting consumption away from

[10]N.B. σ_L represents the elasticity of substitution between labor and leisure, but it does not represent the net labor supply elasticity. The net elasticity is a mix between σ_L and η_L, where both the supply of labor and the demand for leisure are factors.

Table 10: Summary results for Labor Tax Scenarios

	TL REVENUES			EQUAL YIELD	
	$\sigma_L = 1$	$\sigma_L = 1/10$	$\sigma_L = 8$	L1	L2
ACF	1.3	1.0	2.7	0.9	0.5
OUTPUT %	-0.9	-0.6	-2.5	-2.4	-1.8
OUTPUT J$	-3055.6	-2099.4	-8331.4	-7923.0	-6094.3
WELFARE %	-1.3	-1.0	-2.9	-0.9	-0.5
WELFARE L%	-0.8	-0.8	-1.2	-0.8	-0.5
WELFARE J$	-5037.8	-3922.3	-11193.1	-3710.0	-2020.4
WELFARE $	-84.0	-65.4	-186.6	-61.8	-33.7
GCT %	15.0	15.0	15.0	20.6	8.9
TL %	1.3	1.2	1.4	0.8	0.8
CPI	1.3	2.9	1.4	1.0	0.5
REVS J$	4026.1	4017.6	4074.6	3968.1	3952.1
W	1.1	0.7	3.1	-1.5	-1.4
PLS	-1.5	-7.1	-0.7	-0.4	-0.1
LAB	-1.7	-4.6	-1.1	0.2	0.4
CAP	-0.8	-0.5	-2.3	-2.3	-1.8
OPS	-0.8	-0.6	-2.3	-2.4	-1.2

goods and into leisure. In this way, the burden is pushed onto firms and capital owners, relative to workers.

Although the workers bear less burden when σ_L is high, the efficiency of the tax falls. The average cost of funds (ACF) is unity for low levels of σ_L, but it increases rapidly as workers avoid taxation. When $\sigma_L = 8$, the ACF increases from unity to 2.7, almost twice the magnitude as the ACF for GCT taxes.

Traditionally, empirical evidence suggests that labor supply is in-elastic, with the net labor supply lying somewhere between $\{0.5, 1.0\}$[11]. Which implies that high labor taxes, while unfair from a distributional perspective, are relatively efficient compared to import tariffs or even the GCT. However, more recent analysis suggests that traditional micro-economic evidence for labor supply elasticities are not suitable for use in macro-economic models. Browning et al. (1999) and Domeij/Floden (2001), argue that because of incomplete markets, especially for the poor, the labor supply elasticity is probably two times as high as traditional studies indicate. In that case, increased labor taxes are relatively in-efficient, even when compared to import tariffs.

Indeed, when we consider a "central" estimate for labor supply elasticity ($\sigma_L = 1$, $\eta_L = 1$), we find that some of the existing labor taxes could be replaced 1:1 for a proportional increase in the

[11] See, for example, Heckman and MaCurdy (1981)

GCT. The ACF in this situation is equal to unity (scenario: L1). Furthermore, we could lower labor taxes by 20% and still raise about 1% of GDP by shifting to a uniform GCT tax rate close to 10%.

Although we could not identify the effects of informal labor supply and unemployment in this model, we capture the effect of an elastic labor supply to show that labor tax efficiency depends strongly upon the elasticity of labor supply in Jamaica. If the elasticity is low, then the current regime of high labor taxes may be justified. As the supply elasticity increases, so does the inefficiency of the PAYE tax system.

4.3 Trade Reform

Import tariffs have traditionally been used as a reliable source of tax income. Because goods can be inspected by customs authorities at the border, import taxation has the highest compliance rate among all major tax streams. Developing countries, where labor income is low, typically depend upon border taxes more heavily than countries from the OECD. Although import tariffs are beneficial to local producers because they limit the level of outside competition. High tariff rates and limited competition can be detrimental over time, because the domestic firms eventually become uncompetitive on the international market. This may currently be the case for Jamaican bananas, where Jamaican goods are uncompetitive compared to those from Ecuador.

Since we are considering alternative means to *raise* tax revenues, this section measures the impact of raising import tariff rates in Jamaica. Since raising rates has the side-effect of generating rents for domestic producers, at the expense of domestic consumers, a policy to raise tariffs in the short term should be implemented with caution. Rates should only be raised as part of an overall rationalization in order to generate government revenues.

Table 11: Summary results for Quasi-Uniform trade scenarios

	QUASI	QUASI2	FTAA	EYIELD	SSFTAA
ACF	1.49	1.57			
WELFARE %	-1.36	-0.94	0.21	0.09	2.39
WELFARE J$	-5044.63	-3494.55	789.61	334.49	8849.25
WELFARE $	-84.08	-58.24	13.16	5.57	147.49
%M	-10.18	-13.78	15.75	17.47	17.80
%X	-9.93	-7.60	12.97	12.67	17.14
CPI	1.38	0.95	-0.21	1.91	-0.37
PFX	-0.79	-0.99	2.06	0.12	2.15
LUMPSM			7,712		6870
DG	3,396	2,223		0.00	
KAPPA					4.92
GCT-SCALE				1.36	
LAB	-0.24	-0.28	1.78	-0.13	4.21
CAP	-2.00	-1.32	2.11	0.14	-0.02
OPS	-2.19	-1.20	2.06	0.09	0.08

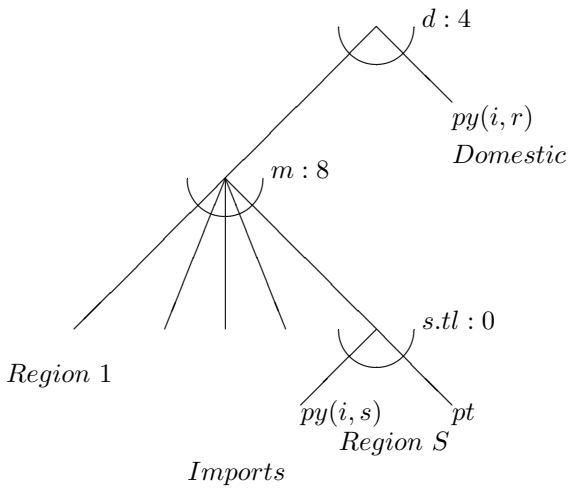
QUASI	Quasi-uniform import tariffs. Provided by Keith Maskus.
QUASI2	Quasi-uniform rates, but the petroleum sector (PET) is not included.
FTAA	Tariffs are lowered to zero for FTAA regions. Tariff revenues are replaced using lumpsum taxation.
EYIELD	FTAA scenario, except the GCT is used for revenue replacement.
SSFTAA	FTAA with Investment/capital stock adjustment (κ). Lumpsum revenue replacement.

Table 12: Changes in tax revenues by scenario. Difference column is computed between benchmark tariffs and the QUASI2 scenario

		BENCH	QUASI	QUASI2	DIFF (QUASI2)
SGR	Sugar Cane	73.13	149.36	147.88	74.76
COF	Cocoa & Coffee	20.50	28.67	29.92	9.42
GRN	Pulses, Grain & Vegetables	121.29	328.57	326.14	204.85
MIN	Other Mining & Quarrying	75.46	97.48	98.20	22.75
OMT	Meat Products	79.28	96.56	98.22	18.94
PVF	Fruits & Vegetables	206.41	272.60	281.62	75.20
VOL	Grain Mill, Oils & Fats	44.16	137.70	140.99	96.83
BAK	Bakery Products	118.95	178.05	181.86	62.90
FED	Other foods and Animal Feeds	211.19	235.17	237.19	26.00
BEV	Beverages	231.93	298.28	306.76	74.83
TBC	Tobacco Products	7.11	21.00	21.98	14.87
TEX	Textiles	93.96	121.83	124.14	30.18
WAP	Wearing Apparel	456.50	563.99	566.74	110.23
LTR	Leather Products & Footwear	129.51	192.24	193.31	63.81
WOD	Wood, Cork, Furniture	332.07	407.36	414.73	82.67
PAP	Paper Products	202.79	418.23	419.52	216.72
PRT	Printing and Publishing	30.34	47.71	48.66	18.32
PET	Refined Petroleum	121.88	2129.10	119.38	-2.50
CHM	Chemicals, Coal, & Petroleum Prods	367.49	647.31	651.67	284.18
RBR	Rubber and Plastic	536.86	683.35	690.63	153.77
NMM	Non-Metallic Mineral	118.93	303.28	301.04	182.11
OMN	Other Manufactures	48.11	48.80	51.20	3.09
MTL	Basic & Fabricated Metals	162.13	204.12	206.28	44.15
MAN	Machinery and Equipment	5851.49	7301.28	7332.30	1480.81
TRN	Transport & Storage	0.30	0.47	0.46	0.17
TOTAL		9641.77	14912.51	12990.82	3349.05

Like the labor-tax model, our trade model is an extension of the base CGE model. In this framework, we expand the foreign trade market from a single external consumer, the "ROW" agent, to include those regions that are important for Jamaican trade. The regions are included using an Armington aggregation procedure, where imports from different can be substituted at rate $\sigma_M M$. The default Armington elasticity between regions is 8. The Armington structure is shown in the following diagram.

Figure 3: Armington structure for imports in to Jamaica



Armington Aggregation Description

To be clear, a value of $\sigma_{MM} = 8$ means that if Jamaican trading partners tried to raise prices by 1% on world markets relative to an average of aggregate imports, this partner's imports would decline relative to aggregate imports by 8%. Given that there may be some economists who would prefer lower elasticity estimates, we also perform most of the important policy simulations with $\sigma_{MM} = 4$ and $\sigma_{DM} = 2$. We refer to these as our low elasticities. In our view, the high elasticity scenario is appropriate for an economy with little market power on world markets. The elasticity of transformation between exports and domestic production is assumed to be $\eta = 8$ as well for each sector. Elasticities of substitution between primary factors of production is unity. We assume fixed coefficients between all intermediates and value added.

The regions considered in this model are listed here.

Region		Import Share
CAR	CARICOM Regions	10.6%
USA	United States	42.5%
CAN	Canada	3.2%
MEX	Mexico	3.4%
LAT	Rest of Latin America	13.4%
EUR	European 15	10.6%
ROW	Rest of World	16.3%

The scenario results are listed in Tables 11, 12, and 13. Looking at table 11, the first item to note is that the efficiency of moving to a quasi-uniform tariff is only slightly higher than the existing rate structure. The ACF for both QUASI scenarios are 1.49 and 1.57, respectively. These rates are slightly lower than the ACF= 1.7 for Jamaica's existing structure. Thus, moving to this structure should be considered mainly for the potential to raise additional revenues (about J$2.5 Billion).

The FTAA scenarios consider the eventual case where tariff revenues from FTAA countries fall to zero. The first of the three columns in Table 11 show a small gain in welfare (.21%). This represents the welfare gain from tariff elimination and lump-sum tax replacement. The welfare gain is typically small in such an exercise, because the trade elasticities are high, producing small Harberger triangles. In the second column, we consider the FTAA, together with a more realistic revenue replacement scheme, raising the GCT. In this scenario, welfare is essentially the same. This implies that the GCT becomes more inefficient as the rate is increased, eliminating the welfare gains from tariff reductions. The final column, however, shows the long-run, steady-state effects of trade liberalization. Here, the gains are large. Welfare rises by 2.4% after capital has a chance to adjust. In this framework, investment and the capital stock can adjust to meet higher demand for capital, improving both productivity and the marginal product of labor (the wage). Sectoral effects from the Quasi-uniform tariff exercise are listed in Table 13 and 13. The first table shows the change to tariff revenues by sector, while the second table displays changes to trade volume, production and total import costs.

Table 13: Sectoral trade and output impacts from quasi-uniform tariffs: Jamaican Trade

		%m	%x	%y	%-pm	%-tm
SGR	Sugar Cane	-25.62	0.19	4.78	5.24	6.32
BAN	Banana & Plantain		-21.38	-17.89		
COF	Cocoa & Coffee	10.08	-21.18	-18.26	1.97	2.46
XCR	Other Traditional Crops		-5.03	-1.60		
CTR	Citrus		-2.64	1.77		
GRN	Pulses, Grain & Vegetables	-2.31	22.48	28.37	4.40	5.26
RRT	Root Crops		-1.25	0.04		
OCR	Other Crops		0.23	2.35		
CKN	Poultry and Eggs			0.50		

Table 13: Sectoral trade and output impacts of moving to quasi-uniform tariffs

		%m	%x	%y	%-pm	%-tm
LVS	Livestock and Milk		-3.67	0.06		
FRS	Forestry and Logging		2.23	3.99		
FSH	Fishing		-3.23	-0.94		
BAX	Bauxite Mining & Alumina		-11.34	-10.32		
MIN	Other Mining & Quarrying	-11.05	5.31	8.31	2.92	3.64
OMT	Meat Products	-7.97	-2.66	0.86	1.77	2.18
PVF	Fruits & Vegetables	-33.24	1.25	8.04	8.15	10.62
MIL	Dairy		-4.14	-0.51		
VOL	Grain Mill, Oils & Fats	-19.80	6.16	10.14	4.71	5.57
BAK	Bakery Products	-14.55	-3.25	2.69	3.61	4.41
RUM	Sugar, Rum & Molasses		-13.92	-7.19		
FED	Other foods and Animal Feeds	4.82		-1.84	0.33	0.46
BEV	Beverages	-28.57	-3.27	2.58	6.45	10.40
TBC	Tobacco Products	-3.41	-5.35	-1.97	1.29	6.88
TEX	Textiles	0.31	3.60	5.59	0.92	1.13
WAP	Wearing Apparel	-5.79	3.80	8.70	3.13	4.08
LTR	Leather Products & Footwear	-14.57	16.58	24.36	6.31	8.20
WOD	Wood, Cork, Furniture	-18.14	3.27	6.50	3.91	4.96
PAP	Paper Products	-10.06	5.42	9.79	3.31	3.94
PRT	Printing and Publishing	0.95	-3.27	0.51	0.62	0.77
PET	Refined Petroleum	-1.99			-0.05	
CHM	Chemicals, Coal, & Petroleum Prods	-7.25	-5.06	-1.45	1.64	2.23
RBR	Rubber and Plastic	-4.35	2.94	6.38	1.95	2.43
NMM	Non-Metallic Mineral	-20.27	3.67	7.79	4.58	5.45
OMN	Other Manufactures	-0.63	-3.60	-0.91	0.75	1.03
MTL	Basic & Fabricated Metals	1.36	-2.70	0.32	0.38	0.49
MAN	Machinery and Equipment	-3.19	0.19	6.24	2.37	3.03
ELE	Prod & Dist of Electricity		-1.10	0.73		
WTR	Water Collect & Dist		-2.43	0.46		
CON	Construction		-3.93	-0.40		
TRN	Transport & Storage	3.68	-5.17	-2.18	-0.05	0.00
COM	Communication		-1.81	-0.23		
MRG	Distribution Margins		-2.33	-0.21		
FIN	Financial & Insurance		-3.05	-0.42		
DWE	Dwelling Services			0.01		
REL	Real Estate Services		-2.77	-0.04		
REC	Hotels Restaurants & Clubs		-4.17	-0.32		
OSR	Other Miscellaneous Services		-4.40	-0.63		
SRV	Business and Professional Svcs		-3.11	-0.34		

5 Model Extensions

Further extensions of the base model can be useful for further tax and trade policy analysis. The most important addition to the model will is the incorporation of multiple-households, so that an indication of *equity* is possible. As a starting point, a household dataset for 20 groups would be useful. These would represent income deciles in urban and rural parts of Jamaica. Further household analysis can integrate many more households, even thousands, into the CGE model in order to identify the specific characteristics of those in poverty. Typical trade-reform exercises now require consideration of the country's poorest households. This in turn, requires the use of an entire living-standards household survey.

Some measure of informality by national accounting sector would be useful to identify the scope for tax compliance. Some sectors are known to have a large share of informal labor and informally-conducted markets. If these estimates of informal activity are included into the economic framework, then some prescriptions can be derived that relate to the marginal benefits and costs of additional collection effort by sector.

Finally, as trade policy and factor productivity becomes more important for Jamaica, a model that captures the potential for increased competition and productivity in the *services* market is useful in order to reveal the true prospects for future productivity in Jamaica, as well as some of the current institutional or economic barriers that are impeding this sort of productivity growth. The gains from competition and productivity must be included using accepted theory. Typically, a Dixit-Stiglitz product-variety approach is used together with the assumption of "large-group" monopolistic competition.

Additional improvements could also be made if the mapping between various taxes and sectoral production is made concrete by STATIN.

Appendix

A Descriptive Statistics

This portion of the appendix includes a battery of descriptive statistics for Jamaica. These statistics are often useful to uncover the mechanism behind a particular sector's change in output or international trade. The first table presented describes the structure of value added for each sector in the model.

Table 14: composition of value added in production by sector

		LAB	CAP	OPS	VA%	ID0%	RKS	VA
MRG	Distribution Margins	30	2	68	65	33		67733
CON	Construction	66	3	31	24	76		21679
TRN	Transport & Storage	54	11	35	39	60		24934
REC	Hotels Restaurants & Clubs	50	6	44	33	66		16491
FIN	Financial & Insurance	55	8	36	56	41		21475
BAX	Bauxite Mining & Alumina	28	7	57	43	56	7	14965
MTL	Basic & Fabricated Metals	62	3	35	24	76		8261
COM	Communication	32	25	44	74	25		24782
REL	Real Estate Services	54	13	33	51	47		16730
CHM	Chemicals, Coal, & Petroleum Prods	20	5	76	17	81		4926
ELE	Prod & Dist of Electricity	22	22	57	41	58		10524
MAN	Machinery and Equipment	56	3	41	24	74		5415
NMM	Non-Metallic Mineral	56	7	37	29	70		5084
BEV	Beverages	57	7	36	29	70		4004
OSR	Other Miscellaneous Services	95	5		42	55		4822
COF	Cocoa & Coffee	76	4	15	36	60	4	3981
WOD	Wood, Cork, Furniture	62	3	35	26	74		2853
OMT	Meat Products	56	6	39	19	80		1933
SRV	Business and Professional Svcs	53	4	44	72	27		6839
DWE	Dwelling Services	10	49	41	74	26		6922
RUM	Sugar, Rum & Molasses	49	8	42	24	76		2204
CKN	Poultry and Eggs	68	10	23	16	84		1340
FED	Other foods and Animal Feeds	80	15	5	26	73		2097
MIL	Dairy	28	6	66	30	69		2408

Source: Statistics Institute of Jamaica (STATIN) (2002) (reconciled by authors)

Key:

VA	Sectoral value-added at factor cost (million J$2002)
LAB	Labor share of sectoral value-added (%)
LND	Operating Surplus share of sectoral value-added (%)
CAP	Capital share of sectoral value-added (%)
RKS	Sector-specific capital share (%)
ID0%	Intermediate inputs as a share of total output value (%)
VA%	Value added as a share of total output value (%)

Table 14: Value added in production by sector (continued..)

		LAB	CAP	OPS	VA%	ID0%	RKS	VA
PVF	Fruits & Vegetables	40	6	54	31	65		2267
BAN	Banana & Plantain	82	5	9	27	73	5	1978
BAK	Bakery Products	21	5	74	22	77		1540
PAP	Paper Products	40	3	56	41	59		2591
OCR	Other Crops	23	1	76	71	28		4164
PRT	Printing and Publishing	40	4	55	51	48		2824
RBR	Rubber and Plastic	40	4	56	48	51		2660
VOL	Grain Mill, Oils & Fats	34	11	55	22	77		1165
RRT	Root Crops	24	0	76	79	21		4069
WTR	Water Collect & Dist	81	19		53	43		2674
LVS	Livestock and Milk	72	6	23	37	60		1756
SGR	Sugar Cane	71	4	20	52	47	4	2003
TEX	Textiles	31	3	67	64	35		2367
FSH	Fishing	22	17	61	50	50		1684
TBC	Tobacco Products	89	11		19	81		454
WAP	Wearing Apparel	89	11		22	76		481
MIN	Other Mining & Quarrying	63	6	32	48	50		903
OMN	Other Manufactures	36	2	61	60	38		948
GRN	Pulses, Grain & Vegetables	65	7	29	39	59		295
FRS	Forestry and Logging	34	1	64	50	49		360
LTR	Leather Products & Footwear	83	7	10	23	74		136
CTR	Citrus	78	11	11	27	67		121
XCR	Other Traditional Crops	56	3	41	58	42		174
GOV	Government services	99	1			0		49,008
TOTAL								369,025

B Data issues

An addendum to this report will describe some important data questions and issues that need attention – this will ensure we have consistent national accounts, and a relevant model for Jamaica.

C Model Files and Mechanics

After the tax exercise is completed, all model and data files will be organized and described in this section. These files will then be placed on the internet for use by experts at the PIOJ, STATIN, the Ministry of Finance, the Ministry of Foreign Affairs, or academics at the University of the West Indies. All efforts will be made to ensure that this work can be leveraged for future analysis.

File	Description
`JMProduction02.xls`	Macroeconomic production statistics for import into GAMS. This spreadsheet was taken from `MacroData.xls`. The spreadsheet reports *value-added* only, not the total production value. Nevertheless, the shares from this sheet for year 2002 are used to calculate the share of total production in Jamaica.