IMF WORKING PAPER

WP/94/88

INTERNATIONAL MONETARY FUND

Research Department

External Shocks, The Real Exchange Rate, and Tax Policy

Prepared by Stephen Tokarick

Authorized for Distribution by Peter B. Clark

August 1994

Abstract

This paper uses a computable general equilibrium model of the economy of Trinidad and Tobago to assess the effects of trade liberalization and terms-of-trade shocks on the real exchange rate and the overall fiscal position of the government. The model is also used to evaluate the implications of alternative tax policies designed to offset the increase in the budget deficit of the central government that results from both types of external sector shocks.

JEL Classification Nos.:
C68, F13

1/ I would like to thank David Bevan, Peter Clark, R. Anthony Elson, José Fajgenbaum, Samuel Itam, and Charles Kramer for helpful comments. I would also like to thank Branko Maric for useful discussions.

Contents

List of Tables

Summary

This paper uses a computable general equilibrium model of the economy of Trinidad and Tobago to assess the effects of two different external sector shocks (trade liberalization and terms-of-trade shocks) on the real exchange rate and the overall fiscal position of the government. The results of the model show that a policy of trade liberalization raises consumer welfare (although real wages would decline), induces a real exchange rate depreciation that increases trade flows, and leads to a more efficient allocation of resources. The simulations highlight the importance of price flexibility of nontraded goods in determining the ultimate effects of trade liberalization. If the price of nontraded goods is inflexible, many of the beneficial effects of trade liberalization will not be realized. In this case, there may be a role for a nominal exchange rate depreciation, in conjunction with trade reform, to help facilitate the necessary adjustment in relative prices. A policy of trade liberalization would also increase the central government's budget deficit, and further strain the government's ability to borrow. Simulations with the model show that it would be possible to replace the tax revenue lost from trade liberalization with increases in other taxes, and still generate an aggregate welfare gain.

The model was also used to assess the effects of a change in the terms of trade on trade flows, welfare, and the overall fiscal position of the government. A deterioration in the terms of trade lowers welfare, reduces trade flows, and worsens the fiscal deficit. In response to the terms-of-trade deterioration, a policy of trade liberalization would reverse many of these effects by inducing a real depreciation, but trade liberalization would lead to a widening of the fiscal deficit. Furthermore, the model shows that an increase in the value-added tax rate would be the most efficient means of replacing the revenue lost from a terms-of-trade deterioration.

These results have important implications for the appropriate policy response to a rise in the international price of a primary export good. A policy of trade liberalization would raise welfare, introduce a real depreciation, and increase trade flows. Conversely, more restrictive trade barriers would lower welfare and produce a real appreciation in addition to that already caused by the rise in the international price of the exportable good.

I. Introduction

Throughout the decade of the 1980s, many developing countries that depend heavily on the exports of a primary commodity or a natural resource, such as petroleum, have been forced to undertake restructuring as a result of fluctuations in the world price of their exportable good. Indeed, many of these countries adjusted to their new-found wealth after discovery of a natural resource only to face the need for adjustment after the boom had subsided. The general consequences of resource booms, known as the "Dutch Disease," have usually included de-industrialization, real exchange rate appreciation, and a loss of competitiveness (see Corden and Neary (1982) and Corden (1984) for relevant surveys). As the boom proceeds, the booming sector expands and draws resources away from other sectors of the economy, usually other traded, import-competing sectors and some nontraded sectors, as these sectors must contract to free inputs to the booming sector and thus, "de-industrialization" results. The new-found wealth translates into increased spending on all goods, and this spending effect will increase the prices of nontraded goods, introducing an appreciation of the real exchange rate and a loss of competitiveness, as the prices of traded goods (exogenous for a small country) fall relative to the prices of nontraded goods.

Against this background, many small, primary exporting countries have had to adjust to the consequences of the Dutch Disease. A typical response to the restructuring inherent in a boom has been a resort to a policy of protection, as in the case of Trinidad and Tobago. In the late 1970s and early 1980s, the economy experienced a major expansion in the petroleum sector as the international price of petroleum rose sharply. In the wake of this boom, the economy maintained its protectionist environment of high tariffs and expanded the number of imported goods contained on the "negative list" in an effort to shield domestic import-competing industries from the effects of the real appreciation induced by the rise in the international price of oil. The expansion of import protection, designed to sustain output and employment in the import-competing sectors, exacerbated the loss of competitiveness further because protection causes an appreciation of the real exchange rate. Only recently has the economy begun to liberalize its trading regime in the hope of restoring competitiveness and promoting exports.

Trade liberalization has important beneficial effects on the economy of Trinidad and Tobago, most notably, a restoration of competitiveness through real exchange rate depreciation. The effects of trade liberalization are less clear on the overall position of the public sector, however, and this aspect of trade liberalization is important because the central government's recourse to additional financing is clearly limited. The effect of trade liberalization on the fiscal position of the government has become an important issue, but according to Blejer and Cheasty (1988), Tanzi (1989), and Feltenstein (1992), no definite conclusions can be reached a priori concerning the direction of the change in the fiscal position from trade liberalization. According to Tanzi (1989), there is a presumption that trade liberalization will improve the fiscal position of the government, but the papers by Blejer and Cheasty (1988) and Feltenstein (1992) are less definite on this point, especially Feltenstein (1992), who finds that trade liberalization would worsen the fiscal position of Mexico.

Given this uncertainty, an empirical investigation of this issue is appropriate. Any policy which worsens the budget deficit, while it may help restore competitiveness, may impede the economic adjustment necessary to promote growth in the economy. As trade liberalization will usually result in lower tariff revenue, however, there are indirect effects on revenue which come from other types of taxes such as value-added taxes and export taxes. As an example, an indirect effect of trade liberalization occurs in economies that derive revenue from the taxation of exports. In this case, liberalization of trade will increase revenue from the taxation of exports because the real exchange rate depreciation that results from trade liberalization will increase exports, so this effect may offset, to some degree, any loss in tariff revenue. In addition, the overall revenue impact of trade liberalization is complicated if the consumption of imports is also subject to a consumption tax, such as a value-added tax. In this case, a reduction in tariff rates will increase import volume, so trade liberalization may generate additional revenue from the value-added tax. With the existence of a complex tax regime, however, the effect of trade liberalization on the fiscal position is complicated; there is a need, therefore to examine this issue using a fully specified, applied general equilibrium model.

The purpose of this paper is to determine the effects of two types of external shocks--trade liberalization and changes in the terms of trade--on the real exchange rate, trade flows, and the fiscal position of the economy of Trinidad and Tobago using a computable general equilibrium model. The model is sufficiently general to be applied to other small, open economies, and is applied to Trinidad and Tobago to demonstrate the methodology and usefulness of the techniques. The technique adopted in this paper--applied general equilibrium modeling--is especially appropriate for analyzing the effects of changes in commercial policy and terms-of-trade shocks as an advantage of this modeling technique is its ability to capture directly the important relative-price effects of various shocks, and both types of shocks undertaken here involve changes in relative prices. 1/ In this paper, the model is used to answer three broad questions: (1) to quantify the effects of trade liberalization on the performance of the fiscal and external sectors under different assumptions concerning the flexibility of the price of nontraded goods; (2) to quantify the effects of an adverse shift in the terms of trade and evaluate the effects of alternative policy responses to this shock; and (3) to rank the effects on efficiency of alternative tax policies designed to prevent an increase in the budget deficit following

---

1/ While other types of modeling techniques could conceivably be used, such as macro modeling, these types of models do not usually capture resource constraints, material balance constraints such as market clearing, and other elements grounded in general-equilibrium, microeconomic theory. In this paper, the focus is on the relative-price and welfare effects of changes in policy, rather than on the effects of external shocks on aggregate spending, output, and inflation. Inclusion of a monetary sector, for example, would not help reveal the inefficiencies of trade barriers which is a central message of the paper.

both types of external shocks. The next section presents the structure of the general equilibrium model. Section three describes the data and method used to determine the necessary elasticities. Section four describes the experiments performed. Section five presents the results from the experiments and section six contains the conclusions.

II. Model Description

This section contains a description of the general equilibrium model used to assess the impact of alternative trade and tax policies on the economy of Trinidad and Tobago. The model is a static, applied general equilibrium model of a small, open economy of the type used by Clarete and Roumasset (1987), Clarete and Whalley (1988), Benjamin, Deverajan, and Weiner (1989), and explained in detail by Dervis, De Melo, and Robinson (1982) and Shoven and Whalley (1984). 1/ The model is designed to compute the equilibrium real exchange rate--an important relative price defined as the price of tradeables to nontradables--which results from changes in exogenous variables and to provide an estimate of the effects of alternative trade and tax policies on the volume of imports, exports, and the surplus or deficit of the central government. Deverajan, Lewis, and Robinson (1991) use a much more simplified structure--a version of the Salter-Swan model--to show the usefulness of this type of model for calculating the new equilibrium real exchange rate which results from changes in commercial policy.

The model divides the economy into three sectors: an exportable, an importable, and a nontraded or home good. For Trinidad and Tobago, the exportable sector is comprised mainly of petroleum products. 2/ The importable sector consist of labor-intensive, manufacturing activities, while the nontraded sector is comprised of services and construction activities. It is assumed that Trinidad and Tobago is a "small country" and therefore the terms of trade (the relative price of exportables to importables) are exogenous. In contrast, the price of the nontraded good is determined locally by domestic demand and supply.

Each of the goods in the model is produced by combining three inputs: labor, capital, and imported intermediate inputs. The production process is assumed to take place in two stages. In the first stage, a representative firm in each of the three sectors hires an amount of labor up to the point where the value of the marginal product of labor equals the wage rate. In contrast, capital is assumed to be sector specific, so the return to capital is a residual after labor is paid the value of its marginal product. Thus, in this first stage, labor and capital are combined to form value added by sector. In the second stage, value added is combined, in fixed proportions,

---

1/ For an analysis of the effects of trade policy in a dynamic general equilibrium model, see Ho and Jorgenson (1993) and Lee (1993).

2/ Exports of petroleum and related products such as petrochemicals accounted for slightly more than 77 percent of exports in 1991.

with imported intermediate inputs to produce gross output by sector. The supplies of both labor and capital are fixed, so wages and rents adjust to bring about equilibrium in factor markets. Labor is fully mobile across sectors, whereas capital is sector specific. 1/

The government is assumed to collect taxes from a variety of sources. Government revenue consists of receipts from import taxes, a value-added tax, petroleum taxes, income taxes, and a broad category covering all other taxes. The government consumes some of all three goods, but its expenditure is assumed to remain fixed in real terms. The resulting surplus or deficit of the central government is equal to total government revenue less government spending.

The economy consists of a representative household who exhibits preferences over the three goods described by a Stone-Geary utility function. The representative household receives income from ownership of labor and capital and purchases the output of the three sectors with this income. The demand for imports is the excess of total domestic demand for the importable good over domestic production, while the supply of exports is the excess of domestic production of the exportable good over domestic consumption. The price of the nontraded good is assumed to adjust to bring about equilibrium in the market for the nontraded good. Thus, equilibrium will be determined when a set of relative prices is found so that the market for nontraded goods clears. The following sections describe the equations of the model in detail.

1. Production and factor markets

The domestic production process for all three goods consists of two levels of nesting. At the first level, labor and capital are combined to produce value added on a sectoral basis according to a constant elasticity of substitution aggregation function:

$$VA_j = AX_j \left[\alpha_j L_j^{-\Omega_j} + (1 - \alpha_j) K_j^{-\Omega_j}\right]^{(-1/\Omega_j)} \qquad (1)$$

where VA_j denotes value added in sector j (j= exportables, importables, and the nontraded sector), AX_j and α_j are constants, L_j and K_j are the quantities of labor and capital needed to produce good j, and

---

1/ This type of production structure is appropriate for an analysis of oil production. The assumption of fixed capital stocks reflects the fact that capital cannot be shifted into other sectors of the economy. Allowing for the use of imported intermediate inputs is also appropriate since most of the capital goods needed are not produced domestically. The oil sector can, however, compete with other sectors of the economy for labor. Finally, the scope for substitution between inputs, especially between value added and intermediate inputs is quite limited, hence the choice of a Leontief technology is appropriate.

$\Omega_j = (1 - \phi_j)/\phi_j$, where ϕ_j is the elasticity of substitution between capital and labor in the production of good j.

At the sectoral level, value added consists of payments to both labor and capital. Specifically:

$$PVA_j VA_j = WL_j + R_j K_j \tag{2}$$

where W is the wage rate, PVA_j is the value-added price, K_j is the stock of capital installed in sector j, and R_j is the return to capital in sector j. Since capital is sector specific, its return will differ across sectors and is computed as a residual after labor is paid the value of its marginal product. The demand for labor by a particular firm depends on the value of the marginal product of labor, which equals the value-added price multiplied by the marginal product of labor. A firm will hire an amount of labor up to the point where the value of the marginal product of labor equals the wage rate, as given by equation (3):

$$W = (\partial VA_j/\partial L_j) PVA_j \tag{3}$$

At the second level of nesting, value added is combined with imported intermediate inputs in fixed proportions to produce gross output. Demand by the firm for value added and imported intermediate inputs is given by:

$$VA_j = \alpha_{VA} X_j \tag{4}$$

and

$$MI_j = \alpha_I X_j \tag{5}$$

where α_{VA} is the amount of value added required per unit of output X_j, α_I is the amount of imported intermediate inputs required per unit of output, and MI_j is the amount of imported intermediate inputs used to produce good j. The total cost of production will then equal:

$$PX_j X_j = PVA_j VA_j + PMI\ MI_j \tag{6}$$

where PX_j is the output price of the jth good and PMI is the price of imported intermediate goods. The price of imported intermediate goods is determined by:

$$PMI = PWI_M(1 + TMI) \tag{7}$$

where PWI_M is the world price of imports, which is fixed relative to the numeraire, and TMI is the ad-valorem tariff rate on imported intermediate inputs. An increase in the tariff rate on imported intermediate inputs will thus increase the cost of producing a given level of output.

In the factor markets, the sectoral demand for labor is determined by equation (3). Total demand for labor is just the sum of each sector's

demand for labor. The supply of labor is assumed to be invariant with respect to the wage rate, as in the theoretical models of trade such as Jones (1965, 1971) and Mussa (1974), and in the applied model of Khan and Montiel (1987) for example. Labor is assumed to be perfectly mobile across all three sectors, so labor earns the same return regardless of sector of employment. Therefore, equilibrium in the labor market is given by:

$$\sum_j L_j = \bar{L} \tag{8}$$

where $\bar{L}$ is the fixed endowment of labor. Concerning capital, the model adopts a Ricardo-Viner type structure in that capital is assumed to be sector specific:

$$K_j = \bar{K}_j \tag{9}$$

where $\bar{K}_j$ is the fixed stock of capital by sector. This assumption is appropriate since the model is not dynamic, so there is no investment. Since capital is sector specific, its return is a residual after labor is paid the value of its marginal product, and this residual payment is determined by equation (2).

2. Government revenue and spending

The model contains a rich array of tax instruments, including a tariff on imports, a value-added tax, a petroleum tax, and income taxes. There are two tariff rates applicable to imports: tariffs on imports of consumption goods and tariffs on imports of intermediate goods. Tariff revenue collected on imports of consumption goods is determined by equation (10):

$$TARIFF = t_M \, PW_M \, MD \tag{10}$$

where TARIFF is tariff revenue, t_M is the tariff rate, PW_M is the world price of imports, and MD is the volume of import demand for consumption. Similarly, tariff revenue from imports of intermediate goods is given by:

$$ITARIFF = TMI \, PWI_M \sum_j MI_j \tag{11}$$

where ITARIFF is revenue from tariffs on imported intermediate goods.

Revenue from taxes on labor income is given by:

$$YTAX = t_Y \left(\sum_j WL_j\right) \tag{12}$$

where YTAX is revenue from taxes on labor income and t_Y is the tax rate. Revenue from petroleum taxes is given by equation (13):

$$OILTAX = RN_X \, t_P \, K_X \tag{13}$$

where OILTAX is petroleum tax revenue, RN_X is the net return to capital in the exportable (petroleum) sector, and t_P is the tax rate. Since capital is assumed to be sector specific, the petroleum tax is modelled as a tax on

profits (return to capital) in the petroleum sector. The net-of-tax rental rate on capital in the petroleum sector is related to the gross-of-tax rental rate R_X by:

$$R_X = RN_X\ (1 + t_P) \tag{14}$$

Revenue from the value-added tax is given by:

$$VATR = t_V\ [(PX_M X_M + PX_M\ MD) + PX_{NT} X_{NT}\ )] \tag{15}$$

where VATR is revenue from the value-added tax and t_V is the value-added tax rate. The model assumes that the value-added tax applies to consumption of the importable and the nontraded good; the value-added tax is not levied on the exportable. In the import-competing sector, the gross-of-tax consumption price PD_M is determined by:

$$PD_M = PX_M(1 + t_V)\ . \tag{16}$$

Similarly, the gross-of-tax consumption price of the nontraded good is:

$$PD_N = PX_N(1 + t_V)\ .$$

Government revenue, GR, is the sum of all the various components of revenue described in equations (10)-(15) and is given by equation (18):

$$GR = TARIFF + ITARIFF + YTAX + OILTAX + VATR \tag{18}$$

In the model, the behavior of the government is modelled very simply. Government expenditure consists of spending on goods, interest payments, and transfers. The overall government budget deficit or surplus is the difference between government revenue and government expenditure:

$$GBAL = GR - PD_N GD_N - PW_M GD_T - IRATE*DEBT - TRANSF \tag{19}$$

where ($PD_N GD_N$) is government expenditure on nontraded goods, GD_T is government consumption of traded goods (in units of the numeraire PW_M), IRATE is the exogenously determined interest rate, DEBT denotes the amount of government debt, and TRANSF is government transfers. 1/ Real government demand for traded goods (GD_T) and the nontraded good (GD_N) is assumed to be fixed.

3. Aggregate income and demand

Total domestic demand for all three goods is the sum of consumer demand and government demand. Consumer demand functions for each type of good are

---

1/ The stock of government debt and the volume of transfers are fixed in real terms.

obtained by maximizing individual utility subject to a budget constraint. The representative consumer maximizes a Stone-Geary utility function, which takes the following form:

$$U = (D_M - \lambda_M)^{\beta_M} (D_X - \lambda_X)^{\beta_X} (D_N - \lambda_N)^{\beta_N} \quad (20)$$

where U denotes the level of utility, D_j is the demand for good j, λ_j is the minimum or subsistence level of consumption of good j, and β_j is the marginal budget share of good j. Total income available for consumption Y, is the sum of labor and capital income, the budget surplus, and the trade deficit:

$$Y = \sum_j (WL_j + RN_j KD_j) + GBAL - TBAL \quad (21)$$

where TBAL denotes the trade balance. 1/ Disposable income equals total income Y less income taxes, plus government transfers:

$$DY = (Y - YTAX + TRANSF) \quad (22)$$

where TRANSF are government transfer payments. Maximization of equation (20) subject to the consumer's budget constraint gives the familiar form for the demand functions:

$$D_j = \lambda_j + (\beta_j / PD_j)[DY - \sum_j PD_j \lambda_j] \quad (23)$$

which show that quantities demanded of each good depend on prices and disposable income. Finally, GNP is defined in the usual manner:

$$GNP = C + I + G + X - M \quad (24)$$

where C is aggregate private consumption, G is government consumption, and (X - M) is the trade balance. 2/

1/ Equation (20) which defines income (Y), should not be confused with GNP. In equation (20), Y denotes the amount of "money" available for the consumer to spend before taxes and transfers. If the government runs a surplus, then the amount of money available for the consumer to spend rises, as the government is assumed to return the surplus to the representative consumer. Similarly if there is a trade deficit, the rest of the world is willing to lend, as domestic consumption exceeds income. This inflow of foreign lending (a capital inflow) represents resources available to the representative consumer, so it is included in the definition of Y. This is the approach adopted in Dervis, De Melo, and Robinson (1982), De Melo and Tarr (1992) and Rousslang and Tokarick (1994).

2/ Since the model is static, there is no investment (I = 0).

4. The external sector

The model consists of two sectors which produce tradable goods: exportables and importables. The model adopts the "small country" assumption for Trinidad and Tobago, so the terms of trade, the relative price of the exportable to the importable:

$$TOT = \frac{PW_X}{PW_M} \tag{25}$$

is assumed to be exogenous. The supply of exports to the rest of the world and the demand for imports are both determined as residuals. The supply of exports to the rest of the world equals total production less private demand and government demand:

$$EX = X_X - D_X - GD_X \ . \tag{26}$$

Total demand for imports for consumption is just the excess of private demand and government demand over domestic production:

$$MD = D_M + GD_M - X_M \ . \tag{27}$$

The domestic producer price of exports PX_X is related to the international price PW_X by:

$$PX_X = PW_X(1 + S) \tag{28}$$

where S is the subsidy rate applied to exports. For the importable good, the domestic producer price PX_M equals the world price PW_M multiplied by one plus the ad-valorem tariff rate:

$$PX_M = PW_M(1 + t_M) \ . \tag{29}$$

The trade balance (deficit or surplus) is the value (at world prices) of exports minus the value of imports:

$$TBAL = PW_X EX - PW_M MD - \sum_j PWI\ MI_j \ . \tag{30}$$

For most simulations undertaken in this paper, it is assumed that the real exchange rate (the price of traded goods relative to the price of the nontraded good) adjusts to clear the market for the nontraded good and the trade balance remains unchanged (capital inflow is constant). This assumption is adopted to reflect the fact that the country's recourse to borrowing is limited. Thus, holding the trade balance constant imposes a borrowing constraint on the economy.

5. Model closure

General equilibrium exists when a set of relative prices is found such that all the model equations are satisfied. For all markets, prices adjust

to equate quantity demanded with quantity supplied. The market clearing equation for the nontraded goods market is:

$$D_{NT} + GD_{NT} = X_{NT} \tag{31}$$

so the price of nontraded goods will adjust to bring about equilibrium in the market for the nontraded good.

The terms of trade are exogenous, since it is assumed that Trinidad and Tobago is unable to affect the terms of trade by how much it buys or sells internationally. The domestic prices of traded goods differ from the world prices by the applicable taxes. Since there is no money in the model, the model can only determine relative prices, rather than absolute prices. All demand and supply functions are homogeneous of degree zero in prices, so prices can be normalized in any fashion. The world price of importables, PW_M, is taken to be the numeraire, so its price is fixed at one.

As implied by Walras' Law, one equilibrium condition may be dropped because it can be deduced from the other equilibrium conditions. In this model, the equation defining the trade balance is dropped because it will be satisfied automatically if all the other equilibrium conditions hold. As a check, the trade balance was computed after each experiment and compared with its initial (pre-experiment) level. For every experiment performed, the trade balance computed from the model solution matched the initial trade balance, so this procedure served as check on the internal consistency of the model and showed that Walras' Law was satisfied. The equations of the model represent a system with an equal number of equations and unknowns.

III. Parameters and Elasticities

1. Parameter calibration

The model uses data for 1991 to determine the values for all the exogenous variables and parameters. 1/ To determine unknown parameter values, the model employs the technique of calibration, described in Mansur and Whalley (1984), which is standard practice in applied general equilibrium modelling. Calibration involves using data on exogenous and endogenous variables in the base year to "solve for" unknown parameter values. Because of this technique, the model will replicate the base year data exactly, that is, the model will produce values for all the endogenous variables that match the observed values. For example, equation (10) defines tariff revenue. Data exist on the value of tariff collections and

---

1/ The data on production, employment, and value added were provided by the Central Statistical Office, Trinidad and Tobago. Data on the fiscal accounts were provided by the Western Hemisphere Department of the IMF. All remaining information was taken from the Trade Policy Study completed by Maxwell Stamp (1992).

on the value of imports, so the tariff rate that is consistent with these data can be calculated by dividing the value of tariff revenue by the value of imports. A similar procedure is followed in calculating other unknown parameter values.

2. Elasticities

The model requires a number of elasticity values that are exogenous to the model. First, the model requires values for the elasticities of substitution between labor and capital in production. The values used for these elasticities (0.8 in the importable sector, 0.5 in the exportable sector, and 0.5 in the nontraded sector) were taken from the study by Maxwell Stamp (1992).

The second type of elasticities needed are elasticities of demand. As mentioned above, the representative consumer maximizes a Stone-Geary Utility function, which gives rise to demand functions for the three goods of the form given in equation (23). Values for the parameters in the three demand functions, λ_j and β_j, are chosen to give a specified set of price and income elasticities of demand, as shown in Table 1.

Since there are three consumer goods, there are three income elasticities of demand, a (3x3) matrix of compensated demand elasticities, and a corresponding (3x3) matrix of uncompensated demand elasticities. The procedure adopted to determine these elasticities is as follows. First, values for the income elasticity of demand for the exportable and the nontraded good were chosen to be consistent with the values used in the study by Maxwell Stamp (1992). The third income elasticity was determined by the Engel aggregation condition, as only two of the three income elasticities are independent. This procedure determines each β_j, since from equation (32), the income elasticity of demand for good j takes the form:

$$\eta_j = \frac{\beta_j}{S_j} \tag{32}$$

where S_j is the budget share spent on good j. Thus, each β_j determines the income elasticity in the initial equilibrium, along with the expenditure share.

Given that each β_j is determined by the income elasticities, each λ_j must be determined. The values chosen for λ_j must satisfy each demand function, as given in equation (23), for the values of β_j. To determine each λ_j, two of the three demand functions are used together with the expression for the uncompensated own-price elasticity of demand for the exportable, which is given by:

$$\epsilon_{XX} = \frac{-\beta_X \lambda_X}{D_X} \tag{33}$$

where ϵ_{XX} is the uncompensated own-price elasticity of demand for the exportable. The value chosen for the price elasticity of demand for

Table 1. Base Case Elasticity Values

	Imports	Exports	Nontraded	Income Elasticities (η_j)
Compensated demand elasticities (μ_{ij}):				
Imports	-0.88	0.07	0.81	1.72
Exports	0.20	-0.45	0.25	0.54
Nontraded	0.29	0.03	-0.33	0.80
Uncompensated demand elasticities (ϵ_{ij}):				
Imports	-1.30	-0.08	-0.34	
Exports	0.07	-0.50	-0.11	
Nontraded	0.10	-0.04	-0.86	

petroleum is -0.5, as suggested by Singer (1983) and the U.S. Department of Energy (1986). Thus, using this procedure, values for all six unknown parameters are determined. Once the values for λ_j and β_j are determined, values for the income elasticities can be computed from equation (32) and values for the uncompensated demand elasticities can be computed from equations analogous to (33). Once the income and uncompensated demand elasticities are known, the compensated elasticities of demand are computed by using the Slutsky equation. The complete elasticity matrices shown in Table 1 satisfy all of the necessary restrictions from consumer theory. For example, the demand functions are homogeneous of degree zero in prices, so the row sum of the compensated demand elasticities is zero.

IV. Policy Experiments

In the first set of experiments, the model was used to calculate the new equilibrium real exchange rate that results from the proposed trade reform program. 1/ This program of trade reform consists of two major parts. First, the average nominal rate of protection applied to imports was

1/ The government of Trinidad and Tobago has begun to implement the proposed program of trade liberalization.

reduced from 52.7 percent to 10.5 percent. 1/ In addition, the trade reform program contains a 5 percent tariff on imported intermediate inputs. In these experiments, the effects of the trade reform program are calculated for two cases: the case where the price of the nontraded good is fixed and the case where the price of the nontraded good is flexible. Comparing the results from these two scenarios highlights the role played by the price of the nontraded good in the adjustment process. Also, the model is used to quantify the efficiency effects of two alternative tax policies designed to offset the loss in government revenue from trade liberalization.

In the second set of experiments, the model is used to quantify the effects of a deterioration in the terms of trade on all the endogenous variables, noting especially the effects on trade flows and the overall fiscal position of the government. Over the last decade, adverse movements in the terms of trade suggest that the economy of Trinidad and Tobago has suffered a substantial contraction of its exportable sector. 2/ A policy of trade liberalization will promote production of exportables because it induces a real exchange rate depreciation, a rise in the price of traded goods relative to the price of nontraded goods.

In another component of these experiments, the model is used to evaluate the effects of compensatory tax policies designed to offset the revenue lost from a deterioration in the terms of trade. A deterioration in the terms of trade induces a fall in exports, and with it, a reduction in production and exports of petroleum. Since the government taxes profits in the petroleum sector, a terms-of-trade deterioration reduces oil-tax revenue. Specifically, the model is used to quantify the relative efficiency effects of increasing the value-added tax rate alone or an increase in the value-added tax rate combined with a tax on the production of the exportable good to replace the revenue lost from the terms-of-trade deterioration.

In all of these experiments, an important objective is to determine the new equilibrium real exchange rate which results from the proposed trade reform program, terms-of-trade changes, and changes in tax policy. Consistent with the literature, we define the real exchange rate to be an

---

1/ See Maxwell Stamp, PLC, p. 324. The initial nominal rate of protection of 52.7 percent includes the effects of the Common External Tariff (CET), Quantitative Restrictions (QRs), and stamp duties.

2/ In 1980, output of petroleum and petrochemicals accounted for 39 percent of GDP, while in 1991, their share was 23 percent.

index of the international prices of traded goods relative to the price of the nontraded or home good, expressed in the same currency. 1/

V. Results

This section presents the results from the simulation experiments described above, focussing on the effects of external shocks on trade flows, the real exchange rate, and the overall fiscal position of the government. The experiments performed are simple comparative static experiments. First, the set of equations describing the behavior of the model is solved. The resulting values for all the endogenous variables will replicate the values for the endogenous variables for the base year, so this represents a "check" of the calibration procedure and the programming. Next, a policy parameter is altered, a tax rate for example, and the equations of the model are solved again. The values for all the endogenous variables that result from this solution are compared to the initial values of all the endogenous variables, and the differences between these values represent the effect of the policy change.

Results of Experiment 1: Trade Liberalization

In this experiment, the model is used to determine the effects of the government's trade reform program. This program represents a reduction in the nominal rate of protection applied to imports of final goods from 52.7 percent to 10.6 percent and the imposition of a 5 percent tariff on imports of intermediate products. To demonstrate the role played by the real exchange rate in the adjustment process, the results of this experiment are provided in Table 2 for two cases: the case where the price of the nontraded good is inflexible, and the case where the price of the nontraded good is flexible. 2/ Of course, in the case where the price of the nontraded good is inflexible, the trade balance is endogenous; if the price of the nontraded good is flexible, then the trade balance remains unchanged.

1/ The real exchange rate calculations use the price of traded goods inclusive of tariffs, where the price of traded goods consists of an aggregation of the price of importables and exportables. Alternatively, two real exchange rates could be computed: the importables real exchange rate defined as (P_M/P_N) and the exportables real exchange rate defined as (P_X/P_N). Jones (1974), Edwards (1988), and Khan and Ostry (1991) show that protection will cause the importables real exchange rate to depreciate, a rise in (P_M/P_N), while the exportables real exchange rate appreciates, (P_X/P_N) falls. Hence, protection introduces a "bias" against exports.

2/ Certain institutional features of the economy of Trinidad and Tobago may make price flexibility unlikely. For example, the existence of administered prices are not consistent with the flexible price scenario. Furthermore, the two cases presented in the paper represent polar extremes and the actual degree of price flexibility may fall between the two.

Table 2. Effects of Trade Liberalization

(Values are in millions of 1991 TT dollars unless otherwise noted)

	Base Case	Effects of Trade Liberalization P_N Fixed	P_N Flexible
Real output			
Importables	2130.2	1249.2	1536.5
Exportables	8607.7	8704.6	9186.7
Nontraded	13568.2	14163.6	13543.4
Government revenue	6673.4	6787.6	6278.6
Oil tax	2504.9	2522.4	2809.6
Tariff			
Final goods	544.8	440.6	213.3
intermediate	0.0	179.6	191.6
VAT	1051.7	1151.3	831.8
Labor income tax	1474.0	1395.6	1134.3
Other	1098.0	1098.0	1098.0
Government expenditure	6761.1	6761.1	6689.5
Government balance	-87.7	26.5	-410.9
Export volume	6702.7	6741.8	7478.1
Import volume			
Final goods	1033.8	4156.4	2012.4
Intermediate	4035.2	3592.7	3832.0
Trade balance	1633.7	-1007.3	1633.7
Percent change in real wage	NA	1.5	-2.5
Equivalent variation	NA	4015.6	353.1
(Percent of base-year GDP)	NA	17.5	1.5
Real exchange rate index			
(Percentage change)	NA	-2.1	24.8

1/ The equivalent variation is computed by: $EV = E(P^0, U^1) - E(P^0, U^0)$, where $E(P, U)$ is the expenditure function, U^0 is the initial level of utility, U^1 is the new level of utility, and P^0 is the vector of initial prices.

2/ The real exchange rate index is computed by dividing a weighted average of traded goods prices (inclusive of tariffs) by the price of nontraded goods. A positive value indicates a real depreciation. The formula for the real exchange rate is:

$$RER = \frac{(0.09PW_M\,(1 + t_M) + 0.57PW_X + 0.34PWI)}{P_N}$$

As shown in Table 2, the proposed program of trade reform would increase consumer welfare in the economy. 1/ Consumer welfare improves because the price of the importable good falls as a result of the reduction in the tariff, so consumption of importables increases. In production, the reduction in the price of imports induces a contraction in both output and employment in the importable sector. As a result, the wage falls when P_N is flexible, since the production of imports is labor intensive. This result is a straightforward application of the Stolper-Samuelson Theorem (1941). 2/ The reduction in the tariff on imports of final goods contributes to a more efficient allocation of resources and an increase in consumer welfare, even though the tariff on imported, intermediate inputs is increased.

The degree of flexibility in the price of the nontraded good plays an important role in the ultimate effects of trade reform, a point that has been emphasized by Dornbusch (1974). 3/ A change in the price of the nontraded good, i.e., a reduction in P_N, is necessary for the full effects of trade reform to be realized. When P_N is fixed, the increase in exports from tariff reduction is much smaller than in the case where P_N is flexible. When P_N is fixed, tariff reduction results in a dramatic increase in imports, given the large reduction in the price of imports; however, no further price adjustments take place since both P_X and P_N remain unchanged. The increase in exports is relatively minor because the reduction in the tariff reduces wages, so there is a source of cost reduction in the production of the exportable, but production of the exportable is not very labor intensive.

Flexibility in the price of the nontraded good provides an additional channel through which an expansion in exports can take place. As the demand for imports is price elastic, tariff reduction causes expenditure on imports to increase. For a given level of income, expenditure on other goods must fall, including the nontraded good, so the price of the nontraded good falls. Also, as imports and the nontraded good are substitutes in demand, tariff reduction contributes further to the reduction in P_N by inducing a reduction in the demand for the nontraded good. This reduction in P_N provides an incentive for exports to increase further, as both (P_X/P_M) and (P_X/P_N) rise, making the production of exports more profitable and providing an incentive for resources to move into the exportable sector. 4/ As a

---

1/ Consumer welfare is measured by the equivalent variation, which is described in the result tables.

2/ This result is also consistent with the conclusions reached in Mussa (1974) and Jones (1971).

3/ Alam and Rajapatirana (1993) stress that trade reform should be preceded or accompanied by a real depreciation, a reduction in the price of nontraded goods relative to traded goods.

4/ Exports expand as a result of reducing the tariff on imports because a tariff reduction increases the relative price of exportables to importables, as noted by Lerner (1936). A tax on imports is symmetrical to a tax on exports, so import liberalization increases exports.

result, the increase in exports that occurs when P_N is flexible is much larger than in the case where P_N is fixed. This is the reason why the trade deficit increases substantially when P_N is fixed, compared to the case where P_N is flexible and the trade balance is unchanged.

In the case where P_N remains fixed (column two in Table 2), the increase in welfare that results from trade liberalization is much larger than in the case where P_N is flexible (column 3 in Table 2). This result occurs because when P_N is fixed, the balance of trade worsens as consumption of imports rises dramatically and the real exchange rate appreciates. The welfare gain that results when P_N is rigid is unrealistic, as it assumes that there is no limit to the amount that the economy can borrow from the rest of the world, so welfare increases dramatically as consumption increases. The implications that belie the large welfare gain are that the deficit will have to be repaid in the future and this is likely to require that the economy run trade surpluses just to meet the interest payments alone. The results from this case also suggest the need for a nominal exchange rate adjustment as part of the trade reform program. The large increase in the trade deficit is likely to be unsustainable and unrealistic to finance, so a nominal exchange rate adjustment may be necessary. In the case where P_N is flexible, the economy faces an external borrowing constraint and P_N adjusts to ensure that this constraint is satisfied. Therefore, the welfare gain from trade liberalization is much smaller when P_N is flexible, compared to the case where P_N is fixed, as the economy's ability to borrow from abroad is limited.

As shown in Table 2, the changes in relative prices that result from trade reform have important effects on the performance of the economy. For example, trade reform leads to an increase in exports because the price of the exportable good rises relative to the price of the nontraded good. If P_N is flexible, this adjustment in relative prices will occur automatically through a reduction in the nominal price of the nontraded good, however, if the price of the nontraded good is rigid downward, then the necessary adjustment in relative prices will not occur. 1/ If the price of the nontraded good is rigid, then there is scope for a nominal devaluation, as a nominal devaluation would help facilitate the required adjustment in relative prices by increasing the prices of traded goods. Thus, as a matter of policy, a nominal devaluation would be a useful complement to a policy of trade liberalization when the price of the nontraded good is inflexible.

Concerning the effects on the fiscal position, trade reform generates an increase in the government deficit, a finding which is consistent with Feltenstein (1989), but does not coincide with that of Tanzi (1989). Trade liberalization results in lower government revenue directly from a fall in tariff revenue and indirectly through a fall in revenue from the value-added tax and the labor income tax. The reduction in import protection results in

---

1/ If the price of the nontraded good is inflexible, then trade liberalization is likely to result in unemployment as import-competing sectors contract.

a contraction in output of the importable sector and an increase in import volume, but total value-added tax revenue falls as output of the nontraded declines and the exportable sector is exempt from the value-added tax. Since production of the importable good is labor intensive, the reduction in protection lowers real wages, and as a result, revenue from the taxation of labor income falls. The only positive effect on revenue comes from taxation of profits in the petroleum sector. As explained earlier, the reduction in the import tariff reduces P_N, so the relative price of the exportable to the nontraded good (P_X/P_N) rises. 1/ Since the reduction in the import tariff induces a real exchange rate depreciation, exports expand and revenue generated from taxation of profits in the exportable sector increases. Nominal government expenditure falls somewhat, due to the reduction in the price of the nontraded good, but the loss in revenue exceeds the reduction in expenditure, so the budget deficit increases as result of trade reform.

As noted by Blejer and Cheasty (1988), the effect of trade liberalization on the fiscal position of the government depends on many factors, including the price elasticity of demand for imports. If the demand for imports is price elastic, a reduction in protection would increase import tax revenue, *ceteris paribus*. But as there are many other factors to consider, it is necessary to determine the effect of trade liberalization using a fully specified general equilibrium model which captures important interactions in the economy, especially the cross-price effects that arise from changes in the price of the nontraded good on the demand for imports. This is one aspect of the issue that is demonstrated by the results in Table 2. When the price of the nontraded good is flexible, the reduction in total tariff revenue is greater than in the case where P_N is fixed. This result occurs because trade liberalization reduces the price of the nontraded good (a real exchange rate depreciation), which reduces the demand for imports, since imports and the nontraded good are substitutes in demand.

As part of the trade liberalization experiments, the model was used to explore the public finance aspects of trade reform. In these experiments, the question is: how must other taxes be changed as a result of trade liberalization in order to hold the fiscal deficit fixed in real terms? Two other types of taxes are considered as replacement taxes: a change in the value-added tax rate or the introduction of a tax on the production of the exportable good. As is well known from the theory of public finance, a lump-sum tax has no distortionary cost. However, the analysis in this paper assumes that lump-sum taxes are not possible to administer. Therefore, the choice for a replacement tax is between two distorting taxes. Each of these two alternatives represents a differential incidence type experiment, as used in Ballard (1990), Shoven and Whalley (1977), and applied to the case of petroleum taxation in the United States by de Melo, Stanton, and Tarr (1989) and import tariffs in the United States by Rousslang and Tokarick (forthcoming), where a tax is changed in order to keep the real budget

---

1/ See Jones (1974) and Dornbusch (1974) for a further discussion of this result.

position of the government constant in response to a policy change. The efficiency effects from these experiments are presented in Table 3.

As indicated in Table 2, trade liberalization worsens the fiscal position of the government. If the revenue lost from trade liberalization is replaced by increasing the value-added tax rate, so as to keep the deficit of the central government constant in real terms, there would be a welfare gain of TT$346.5 million, which is less than the welfare gain from trade liberalization alone. This result occurs because an increase in the value-added tax rate intensifies the distortion in consumption of the importable and the nontraded good. The introduction of a tax on the production of the exportable good, at a rate of 32.6 percent, would replace the revenue lost from trade liberalization, however, a welfare gain of only TT$162.7 would result. The tax on the production of the exportable good reduces the volume of exports; thus the effects of this tax are similar to the effects of a trade restriction, such as an import tariff. The reduction in the volume of exports leads to a corresponding reduction in the volume of imports, which lowers welfare, because consumption of the imported good is already distorted by both the import tariff and the value-added tax. When the revenue lost from trade liberalization is replaced by a tax on the production of the exportable good, the resulting welfare gain is TT$162.7 million. These results show that a tax on the production of the exportable good is a more efficient means of raising revenue than an import tariff, since an aggregate welfare gain results from a reduction in the import tariff combined with an increase in the tax on the production of the exportable. Comparing the two types of replacement taxes (an increase in the value-added tax rate or a tax on the production of the exportable good), an increase in the value-added tax rate is a more efficient means of replacing the revenue lost from trade liberalization.

Table 3. Efficiency Effects of Alternative Tax Policies Designed to Replace the Revenue Lost From Trade Liberalization

(All values are in millions of 1991 TT dollars unless otherwise noted)

	Trade Liberalization	Replace Revenue with Change in: VAT tax rate	Production tax
Tax rates (in percent)			
Value-added tax	5.7	10.5	5.7
Production tax	0.0	0.0	32.6
Percent change in real wage	-2.5	-6.4	-9.8
Export volume	7478.1	7455.2	6937.7
Import volume			
Final goods	2012.4	1986.3	1461.8
Intermediate	3832.0	3835.2	3842.2
Equivalent variation	353.1	346.5	162.7
Real exchange rate index (Percentage change)	24.8	20.3	38.5

1/ The equivalent variation is computed by: $EV = E(P^0, U^1) - E(P^0, U^0)$, where $E(P, U)$ is the expenditure function, U^0 is the initial level of utility, U^1 is the new level of utility, P^0 is the vector of initial prices, and P^1 if the vector of prices after the policy change.

2/ The real exchange rate index is computed by dividing a weighted average of traded goods prices (inclusive of tariffs) by the price of nontraded goods. A positive value indicates a real depreciation. The formula for the real exchange rate is:

$$RER = \frac{(0.09PW_M\ (1 + t_M) + 0.57PW_X + 0.34PWI)}{P_N}$$

Results of Experiment 2: Terms-of-Trade Deterioration

Given the dependence of the economy on trade, especially exports of petroleum, changes in the terms of trade have profound effects on the behavior of exports and the fiscal position of the government. This experiment examines the effect of a 5 percent deterioration in the terms of trade on the overall performance of the economy, concentrating on the trade and fiscal implications. 1/

Given the choice of the world price of imports as the numeraire, the deterioration in the terms of trade takes the form of a reduction in the world price of exportables, PW_X. This deterioration induces a contraction of the exportable sector, so output and employment both fall. Some of the labor released by the exportable sector is absorbed by the importable sector, so production of the importable good rises. This increase in the production of the importable good, coupled with a decrease in domestic demand, results in a reduction in import volume. The lower price of the nontraded good and the lower price of the exportable reinforce the reduction in domestic demand for the importable good and the corresponding fall in import volume. The contraction of the exportable sector also exerts downward pressure on the wage, which contributes further to the increase in output of the importable good, as production of the importable is labor intensive.

Of greater quantitative importance is the income effect of the terms-of-trade deterioration. As Table 1 shows, the percentage changes in the quantities demanded of both the importable and nontraded good with respect to a change in the price of the exportable is quite small, as the consumption share of petroleum is very small. The major effect of the reduction in the price of the exportable, however, comes through the income effect. The deterioration in the terms of trade reduces the value of exports, and with it, the value of production or GDP. This income effect serves to reduce the demand for all three goods, as they are all normal goods.

In this experiment, the relative price of the exportable to the importable is not constant, so it is not possible to form a composite good called a "traded good." 2/ It is possible, however, to calculate an "exportables real exchange rate" (the relative price of the exportable to the nontraded good) and an "importables real exchange rate" (the relative price of the importable to the nontraded good). The reduction in the price of the exportable reduces the demand for the nontraded good (the substitution effect) and the negative income effect of the terms-of-trade deterioration reinforces this substitution effect. As a result, the deterioration in the terms of trade causes the price of the nontraded good to fall, but the exportables real exchange rate remains virtually unchanged

---

1/ A 5 percent deterioration is approximately the average deterioration over the period 1991-1993.

2/ See Edwards (1989) for a discussion of this point.

as the reduction in the price of the nontraded good is roughly equal to the reduction in the price of the exportable. The terms-of-trade deterioration does result in a depreciation of the importables real exchange rate and this result is consistent with the theoretical findings of Edwards and van Wijnbergen (1987), Neary (1988), and Khan and Ostry (1991). In addition, as Edwards and van Wijnbergen (1987) point out, this possibility becomes more likely the more distorted the economy is to start with. In the case of Trinidad and Tobago, the economy is subject to many distortions, with the high level of nominal protection applied to imports representing a major bias against exports.

The deterioration in the terms of trade worsens the overall deficit of the government. This result occurs mainly because the terms-of-trade deterioration reduces tax revenue, principally oil tax revenue, since exports fall. Furthermore, the large reduction in imports results in a sharp fall in tariff revenue. Taken together, these two revenue sources account for the major share of the fall in tax revenue. The results from this experiment are presented in column 2 of Table 4.

Results of Experiment 3: Terms-of-Trade Deterioration and Trade Liberalization

In this experiment, the model quantifies the effects of the program of trade reform as a policy response to the deterioration in the terms of trade. The results from this experiment are presented in column 3 of Table 4.

As a policy response, trade liberalization mitigates many of the detrimental effects of the terms-of-trade deterioration alone. Compared to experiment 2, trade reform provides a major impetus toward export expansion, as it offsets the negative effects of the terms-of-trade deterioration on exports and the reduction in consumer welfare is mitigated. Trade reform induces a major real devaluation, a reduction in the relative price of the nontraded good to the price of the exportable, which provides an incentive for export expansion. Both the importable and the nontraded sector contract to free inputs (labor) to the exportable sector. Thus, the flexibility of the real exchange rate--the price of the nontraded good--is very important in facilitating the adjustment of the economy to the new set of international prices.

When trade reform is superimposed on the terms-of-trade deterioration, the fiscal position of the central government worsens, over and above the increase in the fiscal deficit from the terms-of-trade deterioration alone. Trade reform reduces value added in the importable and nontraded sectors, as well as wages, so revenue from value-added taxes and taxes on labor income is reduced substantially.

Table 4 Effects of A 5 Percent Terms-of-Trade Deterioration With and Without Trade Reform

(*All values are in millions of 1991 TT Dollars unless otherwise noted*)

	Base Case	Without Reform	With Trade Reform
Real output			
Importables	2130.2	2225.9	1628.5
Exportables	8607.7	8575.0	9171.8
Nontraded	13568.2	13494.2	13491.9
Government revenue	6673.4	6131.5	5914.1
Oil tax	2504.9	2323.6	2614.7
Tariff			
Final goods	544.8	335.7	168.4
intermediate	0.0	0.0	193.9
VAT	1051.7	978.4	772.8
Labor income tax	1474.0	1395.8	1066.3
Other	1098.0	1098.0	1098.0
Government expenditure	6761.1	6742.7	6674.2
Government balance	-87.7	-611.2	-760.1
Export volume	6702.7	6682.3	7473.8
Import volume			
Final goods	1033.8	636.9	1588.6
Intermediate	4035.2	4411.7	4251.5
Trade balance	1633.7	1633.7	1633.7
Percent change in real wage	NA	-1.2	-4.1
Equivalent variation	NA	-583.6	-229.4
(Percent of base-year GDP)	NA	-2.5	-1.0
Relative prices (ratio)			
Exportables real exchange rate (P_X/P_N)	1.00	1.01	1.29
Importables real exchange rate (P_M/P_N)	1.53	1.62	1.50

1/ The equivalent variation is computed by: $EV = E(P^0, U^1) - E(P^0, U^0)$, where $E(P, U)$ is the expenditure function, U^0 is the initial level of utility, U^1 is the new level of utility, P^0 is the vector of initial prices, and P^1 if the vector of prices after the policy change.

Although trade reform results in an expansion of exports and an increase in revenue from the taxation of profits on petroleum, the reduction in value-added tax revenue and labor income tax revenue is much greater, so total revenue falls. Nominal government expenditure falls somewhat, but by less than the fall in revenue, so the deficit increases. Thus, while trade reform ameliorates many of the adverse effects of the terms-of-trade deterioration, such as the effect on exports, it worsens the budget deficit of the government.

Results of Experiment 4: Terms-of-Trade Effects and an Export Subsidy

This experiment examines the effects of an alternative policy response to the deterioration in the terms of trade, namely, an export subsidy which restores the domestic price of the exportable to the level before the terms-of-trade deterioration. The effects of introducing an export subsidy, together with a deterioration in the terms of trade, are presented in column 3 of Table 5.

Export Subsidy

An export subsidy offsets the reduction in exports that results from a deterioration in the terms of trade, since the subsidy expands output in the exportable sector. Both the nontraded and the importable sector contract to free labor to the exportable sector. The reduction in output of the importable good, together with an increase in domestic demand for the importable, leads to an increase in the volume of imports of final goods. The most notable effect of the subsidy is on the fiscal position of the government. A policy of export promotion, through subsidizing exports in response to a terms-of-trade deterioration, leaves the deficit of the central government almost unchanged, even though the cost of the subsidy is TT$340.7 million. The reason for this is that the export subsidy increases exports, and with it, revenue from taxation of profits in the exportable (petroleum) sector. Furthermore, the export subsidy increases imports of final goods, which generates additional tariff revenue and additional revenue from the value-added tax. Thus, even though the export subsidy increases government expenditure, the subsidy offsets almost all of this cost by generating additional revenue from taxation of oil profits and additional revenue from higher consumption of imports. Even more interesting is the fact that the export subsidy lessens the welfare loss from a deterioration in the terms of trade. The welfare loss from the terms-of-trade deterioration alone is TT$583.6 million while the welfare loss from the terms-of-trade deterioration and the export subsidy is TT$511.6 million. This result occurs because the export subsidy offsets the bias against exports introduced by the import tariff; this smaller reduction in welfare is a "second best" effect. As is well known, the first-best policy would be to eliminate the tariff on imports.

Table 5. Effects of a 5 Percent Terms-of-Trade Deterioration With and Without an Export Subsidy

(All values are in millions of 1991 TT dollars unless otherwise noted)

	Base Case	TOT Shock	TOT Shock with Export Subsidy
Real output			
Importables	2130.2	2225.9	2179.3
Exportables	8607.7	8575.0	8677.3
Nontraded	13568.2	13494.2	13459.6
Government Revenue	6673.4	6131.5	6139.8
Oil tax	2504.9	2323.6	2545.6
Tariff			
Final goods	544.8	335.7	403.8
intermediate	0.0	0.0	0.0
VAT	1051.7	978.4	1000.0
Labor income tax	1474.0	1395.8	1433.2
Other	1098.0	1098.0	1098.0
Government expenditure	6761.1	6742.7	6749.6
Government balance	-87.7	-611.2	-609.8
Export volume	6702.7	6682.3	6813.5
Import volume			
Final goods	1033.8	636.9	766.3
Intermediate	4035.2	4411.7	4413.5
Trade balance	1633.7	1633.7	1633.7
Percent change in real wage	NA	-1.2	-0.5
Equivalent variation	NA	-583.6	-511.6
(Percent of base-year GDP)	NA	-2.5	-2.2
Relative Prices (ratio)			
Exportables real exchange rate (P_X/P_N)	1.00	1.01	1.04
Importables real Exchange rate (P_M/P_N)	1.53	1.62	1.58

1/ The equivalent variation is computed by: $EV = E(P^0, U^1) - E(P^0, U^0)$, where $E(P, U)$ is the expenditure function, U^0 is the initial level of utility, U^1 is the new level of utility, and P^0 is the vector of initial prices.

Results of Experiment 5: Public Finance Aspects of a Terms-of-Trade Shock

As shown from the results of experiment two, a terms-of-trade deterioration worsens the budget deficit of the central government. In this experiment, the model is used to investigate the following issue: suppose the government wants to ameliorate the increase in the budget deficit from the terms-of-trade deterioration. What is the "best" means of reducing the budget deficit through a manipulation of tax policy? In this context, the term "best" refers to the most efficient means of reducing the deficit, that is, the tax policy which has the lowest deadweight loss per dollar of revenue raised. This experiment repeats the terms-of-trade deterioration of experiment two and considers two ways to hold the real budget deficit constant: a change in the vale-added tax rate, or a combination of an increase in the value-added tax rate and the introduction of a tax on the production of the exportable good. In the first part, the value-added tax rate is altered and in the second, the value-added tax rate is increased to 8 percent along with the introduction of a tax on the production of the exportable good to keep the real deficit constant. The results from all three experiments are presented in Table 6.

Change in the Value-Added Tax Rate

As noted in Table 6, the value-added tax rate must rise from 5.7 percent to 9.3 percent in order to leave the real budget deficit unchanged. Also, the reduction in welfare from a terms-of-trade deterioration and an increase in the value-added tax rate is only slightly larger than the reduction in welfare that occurs from just the deterioration in the terms of trade. The increase in the value-added tax rate discourages the consumption of imports, and this acts to lower welfare since consumption of the importable good is already distorted by the import tariff.

Combined Increase in the Value-Added Tax and a Tax on the Production of the Exportable Good

As shown in Table 6, the value-added tax rate is increased to 8 percent and the tax on production of the exportable good must rise to 19.9 percent in order to keep the real government deficit unchanged. The combination of these two tax increases results in a larger welfare loss compared to the welfare loss from just an increase in the value-added tax rate. The increase in the value-added tax rate intensifies the distortion in consumption of the importable and the nontraded good. Furthermore, the introduction of a tax on the production of the exportable good is an additional source of welfare loss as this tax acts to reduce the volume of exports beyond the reduction that occurs as a result of the terms-of-trade deterioration. The reduction in the volume of exports leads to a reduction in import volume, which lowers tariff revenue and leads to a greater welfare loss as the consumption of imports is already subject to a tariff. Thus, of these two alternative tax policies designed to reduce the budget deficit from a terms-of-trade deterioration, an increase in the value-added tax rate alone produces a smaller welfare loss, since the value-added tax applies to larger base than the tax on the production of the exportable good.

Table 6. Efficiency Effects of Alternative Tax Policies Designed to Replace the Revenue Lost from a Terms-of-Trade Shock

(All values are in millions of 1991 TT dollars unless otherwise noted)

	Terms-of-Trade Shock	Replace Revenue with change in VAT tax rate	Replace Revenue with change in Production tax and VAT tax rate
Tax rates (in percent)			
Value-added tax	5.7	9.3	8.0
Production tax	0.0	0.0	19.9
Percent change in real wage	-1.2	-4.2	-7.0
Export volume	6682.3	6662.2	6277.7
Import volume			
Final Goods	636.9	614.6	257.9
Intermediate	4411.7	4413.9	4386.1
Real output			
Importables	2225.9	2230.2	2379.1
Exportables	8575.0	8581.1	8143.7
Nontraded	13494.2	13484.6	13641.2
Equivalent variation	-583.6	-598.5	-844.5

1/ The equivalent variation is computed by: $EV = E(P^0, U^1) - E(P^0, U^0)$, where $E(P, U)$ is the expenditure function, U^0 is the initial level of utility, U^1 is the new level of utility, and P^0 is the vector of initial prices.

VI. Conclusion

This paper used a general equilibrium model, applied to the economy of Trinidad and Tobago, to quantify the effects of trade reform on the real exchange rate, exports, imports, and the fiscal position of the government. The effects of trade reform on overall fiscal performance are of particular importance as there are clear limits on the government's ability to borrow.

A policy of trade reform by itself raises economic welfare in the aggregate, but the real wage falls in the case where P_N is flexible. In theory, it is possible to design redistribution schemes so that those injured by trade reform could be fully compensated. Trade reform increases the volume of exports and imports since the reform program induces a real exchange rate depreciation. Flexibility in the price of the nontraded good is important for the full effects to be realized, as it is the fall in P_N that provides the incentive for exports to expand. The results show that if P_N is rigid, then trade reform will produce, at most, a modest expansion in exports. These results also suggest the need for policymakers to pursue policies that promote price flexibility in conjunction with trade reform. In the case where the price of the nontraded good is inflexible, a nominal exchange rate depreciation would help bring about the change in relative prices that would result from trade liberalization by increasing the prices of traded goods. Thus, a nominal exchange rate depreciation would be a useful complement to a policy of trade liberalization when the prices of home goods are inflexible.

The result that trade liberalization will induce a real exchange rate depreciation is especially important for providing guidance on policy for the economy of Trinidad and Tobago. In the early 1980s, increases in the international price of petroleum squeezed other tradeable sectors, namely importables, as the economy began to suffer from the "Dutch Disease". The fall in output and employment in the importable sectors was a natural consequence of the expansion of the exportable sector, since the rise in the price of oil attracted resources away from the importable sector. Furthermore, the rise in the price of oil "threatened" the viability of import-competing sectors because of the real exchange rate appreciation induced by oil-price rise. The new-found wealth from the rise in the price of petroleum also increased the price of home goods, further strengthening the real exchange rate appreciation and the reduction in the output of importables. In response, the government expanded the number of imports on the "negative list" in an attempt to offset reductions in output and employment in the importable sectors and discourage consumption of imports. The result of this policy was to contribute to further appreciation of the real exchange rate and a greater reduction in exports of goods other than petroleum. As these experiments show, trade reform induces a real exchange rate depreciation and an expansion in export volume; conversely a policy of protection induces a real exchange rate appreciation. Furthermore, trade reform acts to worsen the deficit of the central government; however, the results show that it is possible to offset the increase in the deficit with increases in other taxes and still generate a aggregate welfare gain.

In the case of an adverse terms-of-trade shock, trade liberalization helps to mitigate many of the detrimental effects of the shock. Trade liberalization offsets, to some degree, the reduction in the volume of exports and imports from a terms-of-trade deterioration, but it worsens the budget deficit of the central government. Of the two options explored to reduce the deficit of the central government from a terms-of-trade deterioration, an increase in the value-added tax rate produces a smaller welfare loss compared to a combined increase in the value-added tax rate and the introduction of a tax on the production of the exportable good. A consideration of the revenue impacts of external shocks is important because the government's recourse to additional borrowing is limited.

References

Alam, Asad, and Sarath Rajapatirana, "Trade Policy Reform in Latin American and the Caribbean in the 1980s," The Word Bank, Working Paper WPS 1104 (1993).

Ballard, Charles, "Marginal Welfare Cost Calculations: Differential Analysis vs. Balanced Budget Analysis," Journal of Public Economics, Vol. 41 (1990), pp. 263-276.

Benjamin, Nancy, Shantayanan Deverajan, and Robert Weiner, "The 'Dutch Disease' in a Developing Country: Oil Reserves in Cameroon," Journal of Development Economics, Vol. 30, No. 1 (January 1989), pp. 71-92.

Blejer, Mario, and Adrienne Cheasty, "The Fiscal Implications of Trade Liberalization," Working Paper No. WP/88/102 (International Monetary Fund: Washington, 1988).

Clarete, Ramon, and John Roumasset, "A Shoven-Whalley Model of a Small Open Economy: An Illustration with Philippine Tariffs," Journal of Public Economics, Vol. 32 (1987), pp. 247-261.

_____, and John Whalley, "Interactions Between Trade Policies and Domestic Distortions in a Small Open Developing Economy," Journal of International Economics, Vol. 24 (1988), pp. 345-358.

Corden, W., "Booming Sector and Dutch Disease Economics: Survey and Consolidation," Oxford Economic Papers, Vol. 36 (1984), pp. 359-380.

_____, and J. Peter Neary, "Booming Sector and De-industrialization in a Small Open Economy," The Economic Journal, Vol. 92 (1982), pp. 825-848.

De Melo, Jaime, and David Tarr, A General Equilibrium Analysis of U.S. Trade Policy (Cambridge: Cambridge University Press, 1992).

Dervis, K., Jaime de Melo, and Sherman Robinson, General Equilibrium Models for Development Policy (Cambridge: Cambridge University Press, 1982).

Deverajan, Shantayanan, Jeffery Lewis, and Sherman Robinson, "External Shocks, Purchasing Power Parity, and the Equilibrium Real Exchange Rate," Working Paper No. 611 (University of California at Berkeley, 1991).

Dornbusch, Rudiger, "Tariffs and Nontraded Goods," Journal of International Economics, Vol. 4 (May 1974), pp. 177-186.

Edwards, Sebastian, "Exchange Rate Misalignment in Developing Countries," Occasional Paper Number 2, World Bank (1988).

_____, "Tariffs, Capital Controls, and Equilibrium Exchange Rates," Canadian Journal of Economics, Vol. 22, No. 1 (1989), pp. 79-92.

_____, and Sweder van Wijnbergen, "Tariffs, The Real Exchange Rate, and The Terms of Trade: On Two Popular Propositions in International Economics," Oxford Economic Papers, Vol. 39 (1987), pp. 458-464.

Feltenstein, Andrew, "Tax Policy and Trade Liberalization: An Application to Mexico," Working Paper No. WP/92/108 (International Monetary Fund: Washington, 1992).

Ho, Mun, and Dale W. Jorgenson, "Trade Policy and U.S. Economic Growth," Harvard Institute of Economic Research, Discussion Paper No. 1634 (Cambridge, 1993).

Jones, Ronald W., "The Structure of Simple General Equilibrium Models," Journal of Political Economy, Vol. 73 (1965), pp. 557-572.

_____, "Trade With Nontraded Goods: The Anatomy of Interconnected Markets," Economica, Vol. 41 (May 1974), pp. 121-138.

_____, "A Three Factor Model in Theory, Trade, and History," in International Trade: Essays in Theory (New York: North Holland, 1979).

Khan, Mohsin, and Peter Montiel, "Real Exchange Rate Dynamics in a Small, Primary-Exporting Country," Staff Papers (International Monetary Fund: Washington), Vol. 34 (1987), pp. 681-710.

_____, and Jonathan Ostry, "Response of the Equilibrium Real Exchange Rate to Real Disturbances in Developing Countries" (International Monetary Fund: Washington), Working Paper No. WP/91/3 (1991).

Lee, Jong-Wha, "International Trade, Distortions, and Long-Run Economic Growth," Staff Papers (International Monetary Fund: Washington), Vol. 40, No. 2 (1993).

Lerner, Abba P., "The Symmetry Between Import and Export Taxes," Economica, Vol. 3 (1936), pp. 306-313.

Mansur, A.H., and John Whalley, "Numerical Specification of Applied General Equilibrium Models: Estimation, Calibration, and Data," in Applied General Equilibrium Analysis, eds. H. Scarf and J. Shoven (Cambridge: Cambridge University Press, 1984).

Maxwell Stamp, PLC, "Trinidad and Tobago Trade Policy Study: Final Report" (1992).

Melo, Jaime de, Julie Stanton, and David Tarr, "Revenue-Raising Taxes: General Equilibrium Evaluation of Alternative Taxation in U.S. Petroleum Industries," Journal of Policy Modeling, Vol. 11 (1989), pp. 425-449.

Mussa, Michael, "Tariffs and the Distribution of Income: The Importance of Factor Specificity, Substitutability, and Intensity in the Short and Long Run," Journal of Political Economy, Vol. 82 (1974), pp. 1191-1203.

Neary, J. Peter, "Determinants of the Equilibrium Real Exchange Rate," American Economic Review, Vol. 78 (1988), pp. 210-215.

Rousslang, Donald, and Stephen Tokarick, "Estimating the Welfare Cost of Tariffs: The Roles of Leisure and Domestic Taxes," forthcoming in Oxford Economic Papers.

Shoven, John, and John Whalley, "Equal Yield Tax Alternatives: General Equilibrium Computational Techniques," Journal of Public Economics, Vol. 8 (1977), pp. 221-224.

_____, and John Whalley, "Applied General Equilibrium Models of Taxation and International Trade," Journal of Economic Literature, Vol. 23, No. 3 (1984).

Singer, S. Fred, "The Price of World Oil," Annual Review of Energy, Vol. 8 (1983), pp. 451-508.

Stolper, Wolfgang, and Paul Samuelson, "Protection and Real Wages," Review of Economic Studies, Vol. 9 (1941), pp. 58-73.

Tanzi, Vito, "The Impact of Macroeconomic Policies on the Level of Taxation and the Fiscal Balance in Developing Countries," Staff Papers (International Monetary Fund: Washington), Vol. 36, No. 3 (September 1989).

U.S. Department of Energy, Monthly Energy Review (Washington: U.S. Government Printing Office, 1986).