Oil Revenues and Economic Policy in Cameroon

Results from a Computable General Equilibrium Model

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Abstract

This paper analyzes the impact of oil revenues on the agriculture-based economy of Cameroon, a significant (100,000 barrels per day) but temporary (20 years' of reserves) oil producer. It has been observed in other oil exporting countries that when oil revenues are spent domestically, an appreciation of the real exchange rate results, leading to a shift in the production mix away from tradable sectors in favor of nontradables. Using a multisectoral, general equilibrium model of Cameroon, we show that while this effect occurs in the aggregate, some tradable sectors actually expand. In particular some import-substituting industries, because they produce output which is only imperfectly substitutables with foreign goods, undergo an increase in demand despite the real exchange rate appreciation. The traditional export sectors -- coffee and cocoa in Cameroon's case -- do suffer, however, as a result of their decline in international competitiveness. Moreover, while real wages increase throughout the economy, the gap between rural and urban wages widens. Finally, efforts to protect the tradable sectors with tariffs have little effect on reversing the structural change induced by oil revenues.
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I. INTRODUCTION

The recent experience of several oil-exporting developing countries has shown that petroleum revenues can be a mixed blessing. Despite their potential for financing investment required for economic growth, these revenues can bring about structural changes in the economy that may be undesirable. Specifically, when income from the sale of crude oil is spent domestically, an appreciation of the real exchange rate results, lowering the prices of imports vis-a-vis domestically produced goods, and making exports less competitive. At the same time, demand for nontradables like construction and services grows, raising output and prices in these sectors. The result, often called the "Dutch disease", is a dramatic shift in the production mix of the economy, away from the import-substituting and exporting sectors (except oil) and towards the nontradable sectors.¹ In the short-run, the dislocations caused by this shift can be severe. Moreover, the new structure may not suit an economy whose oil revenues are temporary and therefore will have to return to the traditional traded goods sectors for its foreign exchange in the near future.

The purpose of this paper is to analyze, in some detail, the effects of an "oil boom" on the Republic of Cameroon. With an economy traditionally based on agricultural exports, Cameroon -- which has had oil revenues since 1978 -- appears likely to undergo the structural changes described above.

¹ The phenomenon was first observed for Australia by Gregory [1976]. For a survey of recent work in the area, see Corden [1982]. The term "Dutch disease" comes from the decline in the Netherlands' export competitiveness as a result of the exploitation of natural gas fields in the 1970's. For a detailed treatment of the Dutch disease in a developing country, see Benjamin, Devarajan and Weiner [1984].
Since it has no more than twenty years' worth of oil reserves, some of these changes may be unwelcome. If so, Government policies will be necessary to arrest them and assure that the temporary oil revenues contribute to the long-term growth of the Cameroonian economy.

In this paper, we present a model of the economy and simulate the impact of oil revenues on sectoral outputs, prices and wages. We then consider tariff policies to protect some of the non-oil traded goods sectors, and assess their direct and indirect effects.

An important conclusion of our paper is that, while the traded goods sectors taken together contract relative to the non-traded sectors, some traded sectors grow significantly as a result of the influx of oil revenues. This is due to a particular feature of our model that assumes that imports and domestically-produced goods in the same sector are not perfect substitutes -- an assumption that is realistic in the case of Cameroon. In addition, the multisectoral nature of our model and the pattern of final demand cause our results to deviate from those predicted by the classical theory of international trade. A second result of our analysis is that, although the income from oil exports leads to overall growth of the economy, the distribution of these benefits across different classes of workers can be quite skewed. Again, we show how this result stems from aspects of the model that were chosen to reflect the Cameroonian economy. Finally, the impact of tariff policies varies across sectors and, for the most part, these policies have little effect on reversing the structural change induced by oil revenues.

The plan of the paper is as follows. Section II is a thumbnail sketch of the Cameroonian economy and the policy issues surrounding the advent of revenues from crude oil. In Section III, we present a description of the model. Section IV is a discussion of the experiments that simulate oil
revenues and associated tariff policies as well as of sensitivity tests on the model's crucial parameters and assumptions. In Section V, we summarize the main points and present our conclusions.
II. THE CAMEROONIAN ECONOMY AND POLICY ISSUES

In the twenty-four years since independence, Cameroon has enjoyed modest but steady economic growth, with an average annual growth rate of GDP of over five percent. In 1981, its per capita GNP of $880 was one of the highest in sub-Saharan Africa. Agriculture is the most important sector, accounting for 32 percent of GDP and employing 80 percent of the labor force.\(^1\) In addition, of the $1.1 billion in export earnings (20 percent of GDP), over 72 percent came from cash crops — mainly coffee and cocoa. The industrial sector has been growing rapidly and now accounts for 24 percent of GDP. This sector produces a variety of exports and import-substitutes, including aluminum, pulp and consumer goods. Although the nontradable sectors — construction, services and public administration — have grown rapidly, poor infrastructure and low-levels of education remain the most-often cited obstacles to the country's development.

The discovery of offshore oil in the early Seventies, and its subsequent production beginning in 1978, heralded a new era in Cameroon's economic development. No longer would the country be totally dependent on coffee and cocoa exports — whose prices fluctuated wildly — for its foreign exchange. Moreover, the oil revenues represented an additional source of savings to the economy. The savings, in turn, could be used to finance capital investment, releasing capacity bottlenecks and increasing productivity.

However, for several reasons, the oil revenues are being viewed with caution. The oil sector is somewhat of an enclave in the economy. It uses

\(^1\) All statistics in this section refer to 1981 data.
imported materials and employs foreign labor (mainly highly skilled technicians), so that the effects of oil production on the rest of the economy, in terms of generating employment and backward linkages, are miniscule. The real impact of this sector, therefore, is the expenditure of net oil revenues. The latter are estimated to be about $1 billion in 1982 or about fifteen percent of GDP. While not all of this is patriated, even the fraction that is can create the "Dutch disease"-type effects described in Section I. Specifically, the appreciation of the real exchange rate resulting from oil revenue expenditures will make Cameroon's coffee and cocoa less competitive in world markets, and its import-substituting industries less competitive in domestic markets. The nontraded goods sectors, which have been plagued with capacity constraints, will face an increase in demand. It is important to note that these effects will occur although Cameroon's official exchange rate is fixed (at 50 CFA Francs to the French Franc). The injection of oil revenues will serve to raise domestic prices, making foreign goods more attractive. In short, the real exchange rate -- the relative price of traded to nontraded goods -- appreciates. Finally, Cameroon's oil reserves are limited. If no more than twenty years' production are forecast, allowing the non-oil traded goods sectors to contract is probably not the best preparation for the economy to enter the post-oil era.

The advent of oil revenues, therefore, raises a host of policy issues for the government. In the medium-term, the questions are: how much of the oil revenues should be expatriated, how should they be spent, and what will

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1/ For a more detailed analysis of Cameroon's oil sector and its relationship to the rest of the economy, see Benjamin and Devarajan [1985].

2/ van Wijnbergen [1984] shows that protecting the non-oil traded goods sector may be desirable if there is "learning-by-doing."
the effects of this expenditure be? If, as is suspected, the effects are those predicted by the Dutch disease literature, the next question is, how can the undesirable outcome be mitigated?

In the Cameroonian context, these questions translate to the impact of oil revenues on agricultural exports, import-substituting manufactures and the nontradable sectors. As for policies to mitigate the shift in output mix, protective tariffs are typically suggested. In particular, the government may consider protecting the food crops sector to prevent its demise in the wake of cheaper food imports. This policy is important for two other reasons. First, self-sufficiency in food is one of the country's goals in the future. Second, given the intensity of rural-urban migration in Cameroon, a pro-agricultural policy may be necessary to stem this flow as well as to maintain food output in the face of declining rural employment. Among manufacturing industries, intermediate goods in general, and construction materials and base metals in particular, have been singled out as potential candidates for protection.

Now, it is well-known that tariff policies have effects which go beyond the sector being protected. For example, a tariff on intermediate goods will raise costs for the purchasers of these goods, which, in turn, will alter prices elsewhere in the economy. For our purposes, the interesting question is how the direct and indirect effects of tariffs behave in the face of an injection of, say, half a billion dollars in oil revenues.

Lastly, there is the question of how the oil revenues are spent and the impact of this expenditure on the evolution of the economy. A major priority of the government's is education and manpower training. Investment in this sector will presumably increase labor productivity and thereby reduce some of the inflationary effects -- particularly in the nontradables sectors -- arising from the oil boom. Investment to increase productivity in
agriculture is also under consideration, the motivation being the goals of food self-sufficiency and lower rural-urban migration mentioned earlier.

To analyze the implications of oil revenues and of policies to counteract Dutch disease effects, it is clear that we need a model of the Cameroonian economy. The model should be multisectoral, to show the differential response between tradables and nontradables. Moreover, it should be price-endogenous, since the crux of the expenditure effect lies in its impact on relative prices. Also, the indirect effects of tariff policies are price effects. In addition, the model should allow for substitution between domestically produced and imported goods, since this substitutability is what underlies both the Dutch disease and the levying of protective tariffs to prevent it.

In the following sections of this paper, we present such a model and use it to simulate the policies described above. It goes without saying, however, that the model is not capable of answering all the questions raised by Cameroon's oil boom. In particular, the questions, "how much of the oil revenues should be repatriated?", requires an intertemporal optimizing model which, due to computational limits, would force us to sacrifice the sectoral richness of the present model. Instead, we will postulate a level of oil revenues to be absorbed and simulate its effects on the rest of the economy.

As this paper is concerned with comparative statics experiments only, the long-term effects of oil revenues are also left out. That is, questions about the allocation of investment to education or to increase agricultural productivity, since the impact of these investments will be felt several years into the future, will not be addressed in the simulations that follow. Rather, we will look at short- to medium-term issues, namely, the shift in the sectoral mix and the effects of tariff policies aimed at reversing this trend.
III. THE MODEL

A. A One-Sector Version of the Model

Before proceeding to a complete statement of the model, we consider a one-sector version that captures most of the essential features of its multi-sector counterpart. In this way, the underlying macroeconomic forces in the model can be seen in sharp relief. In addition, by reducing our model to one sector, we are able to portray the shift from one equilibrium to another in a simple diagram. Finally, as the one-sector can be solved analytically, it highlights the crucial parameters and specifications of the multi-sector model (which is solved numerically).

Consider an economy that produces one good, whose output is fixed (in the short run) at $X$. This output is either consumed domestically or exported:

$$X = C + E.$$  

Consumers also buy imports, which are imperfectly substitutable with the domestically produced output. If consumers have CES utility functions over the two goods, with the elasticity of substitution being $\sigma$, then demand is determined by their relative price:

$$\frac{C}{M} = k \left( \frac{P_m}{P} \right)^{\sigma}$$  

1/ With full employment and fixed factor supplies, total output is essentially fixed in the multisectoral model as well. Output of individual sectors, however, is not fixed as labor -- the only mobile factor -- moves between sectors in response to demand pressures.
where \( P_m \) is the import price in domestic currency, \( P \) the price of the domestic good and \( k \) a constant.

If the world price in dollars is parametrically given at \( P_w \) (the small country assumption), then

\[
P = e^P_{m w}
\]

where \( e \) is the exchange rate between dollars and CFA francs.

In specifying the demand for exports, we depart from the small country assumption and assume the demand curve for Cameroon's exports is downward-sloping in its domestic price relative to the world market price.\(^2\)

\[
E = E_0 P^{-\eta}
\]

where \( \eta \) is the elasticity of demand, assumed greater than one and \( E_0 \) a constant.

The last equation relates income with expenditure. In this case, we include in national income not just the value of output (\( P_X \)), but also inflows of foreign exchange (converted to local currency). It is these

\(^2\) It can be shown that this is the demand curve the country faces if Cameroon's export is imperfectly substitutable with the same commodity in the world market, and Cameroon's share in the world market is infinitesimal.
inflows that we vary to simulate the impact of oil revenues. If $F$ is the level of inflows in foreign currency, then:

$$eF + \bar{P}X = PC + P_m M.$$  \hspace{1cm} (A4)

Despite its stark simplicity, this system of four equations allows us to anticipate most of the results obtained from the more complex, multisectoral model.

First, observe that the system is homogeneous of degree zero in the vector of prices $(e,P)$. Since the exchange rate is fixed, it is the numeraire in the system. All other prices are expressed in terms of the numeraire good, which is foreign currency. Movements in the price $P$ can then be interpreted as movements in the real exchange rate with one modification. Traditionally, the real exchange rate is defined as the relative price of traded to nontraded goods. As there is no pure nontraded good in this model, the appropriate real exchange rate is the relative price of foreign goods to domestic goods.

Second, the four-equation system above has five unknowns namely, $C,E,M,P$ and $F$. To make the system determinate, we have to fix one of its unknowns. We choose $F$, which is our proxy for oil revenues. Having fixed $F$, we change it parametrically to examine how the other variables adjust.

We now show how the basic result can be portrayed in a diagram. Assume initially that $F = 0$. Since output is fixed, for a given price $P$ consumers' budget sets are fixed too. The consumer's problem is to find the optimal mix of imports and domestic goods in this budget set. Consumers' indifference curves are determined by the elasticity of substitution in their CES utility functions. By varying $P$ we can trace the consumer's offer curve of consumer goods and imports.
Since what is not consumed is exported (recall that output is fixed), this offer curve also defines the export supply curve. That is, for each price $P$ there is a level of exports $E$ which is consistent with consumers' decision about $C$ and $M$. We can plot this export supply curve below the original curve.

Equilibrium is determined by the intersection of the export supply curve with the export demand curve (A3). The equilibrium price and quantities are denoted by an asterisk in the following diagram:
We can now perform comparative statistics experiments on this model by varying $F$ and solving for the new equilibrium. From the diagram it is plain that an increase in $F$ will lead to a higher $P$ (real exchange rate appreciation), higher $M$ and $C$ and lower $E$. In other words, this simple model can reproduce the "Dutch disease."
While the diagrammatic treatment shows us the directions of change as a result of an inflow of foreign income, it tells us little about the magnitude of those changes. To get an idea of the latter, we need to solve the system analytically. First, we logarithmically differentiate the system to obtain four linear equations:

\[ 0 = \xi \hat{C} + (1 - \xi)\hat{E} \]
\[ \hat{C} - \hat{M} = -\sigma \hat{P} \]
\[ \delta \hat{F} + (1-\delta)\hat{P} = \theta (\hat{P} + \hat{C}) + (1-\theta)\hat{M} \]

where

\[ \xi = \frac{C}{X}, \]
\[ \delta = \frac{F}{F + PX}, \]
\[ \theta = \frac{PC}{PC + P_M M} \]

and \( z \) denotes \( \frac{dz}{z} \).

Next, we solve for \( \hat{P} \), the percentage change in price, in terms of \( \hat{F} \), the percentage change in foreign inflow:

\[ \hat{P} = \frac{\gamma}{\frac{\xi}{\xi} + \sigma (1-\theta) + \theta - (1-\gamma) \hat{F}} \]

(A5)
Several observations can be made about this expression. First note that as 
\( \sigma \rightarrow \infty, \hat{P} \rightarrow 0. \) That is, if the imported and domestically produced goods were
perfect substitutes, there will be no real exchange rate appreciation. This
is, of course, intuitive since if \( \sigma = \infty, \) there are no nontraded goods in the
system, and all the increased income is spent on imports. To show the latter
we first solve for \( \hat{M}: \)

\[
\hat{M} = \frac{\gamma}{1 + (1-\sigma)\theta - (1-\delta)\frac{\eta(1-\xi)}{\xi} + \sigma} \hat{F}
\]

With some manipulation, it can be shown that as \( \sigma \rightarrow \infty, \hat{M} + \frac{\gamma\hat{F}}{1-\delta}, \) or all the
extra income is spent on imports.

Second, it can be shown that if \( \eta > 1, \) the coefficient relating
\( \hat{P} \) with \( \hat{F} \) in (A5) is positive. That is, an export elasticity of demand
greater than one is sufficient for there to be a rise in \( P \) as a result of
increased \( F. \) Again, this squares with intuition. By Walras Law, or by
multiplying (A1) by \( P \) and subtracting (A4), we get:

\[
P_m M - PE = eF.
\]

In other words, the foreign inflow finances the trade deficit. As \( F \)
increases therefore, export revenues have to fall. If export demand is
elastic, this will only happen with an increase in \( P. \)

Third, notice that in (A5) the influence of \( \sigma, \) the elasticity of
substitution, is dampened by \( (1-\theta) \) the share of imports in the consumption
basket. Thus, even if \( \sigma \) is high, if the share of imports is small, the effect
is as if the substitutability were low. It turns out that this point is significant in interpreting our results from the multisectoral model. For example, the food sector in Cameroon, even though it faces stiff competition with imports, is only mildly affected by the injection of oil revenues, because the share of food imports in the budget was low in the model's base year.

While the single-sector model just described anticipates many of our results in the large, it leaves out the intersectoral flows which are crucial to our conclusions about the influence of oil revenues in Cameroon. Hence, we turn now to a presentation of multisectoral CGE model which will be used for the simulations in section IV.

B. The Multisector CGE Model

The computable general equilibrium (CGE) model to be described is a descendant of Johansen's [1960] pioneering work on the Norwegian economy. It follows more closely the applications of CGE models to developing countries by, among others, Adelman and Robinson [1978], Taylor et al. [1980], and Dervis, de Melo and Robinson [1982]. Specifically, the present model is a variant of that developed by Dervis, de Melo and Robinson [1982].

All CGE models attempt to simulate a market economy where prices and quantities for goods and factors adjust to equate supply and demand. The model can be used to simulate the effects of a change in government policy or in the external environment by introducing the change and solving for the new supply-demand equilibrium. The equations which govern supply and demand in

\[1/\] For other variants, see Lewis and Urata (1984), Michel and Noel (1984), Condon, Corbo and de Melo (1985), and Robinson and Tyson (1983).
the model, in turn, are based on individual optimizing behavior by agents in the economy: producers maximize profits, consumers maximize utility, etc.

In the multisector version of the CGE model, the material balance condition of the previous section must be satisfied for every sector. Moreover, the components of supply and demand are more general. Supply consists of domestic production and imports. The different components of demand are intermediate demand, consumer demand, investment demand, government demand and export demand. Since equilibrium is achieved by adjustment of prices, it is important to specify how each of the components of supply and demand depends on prices. We begin with imports.

**Import Demand**

In the classical theory of international trade, a traded good is assumed to be one for which (i) the country is a price-taker in the world market and (ii) the domestically produced good is a perfect substitute for that sold in world markets. This specification leads to the result that the domestic price of a traded good is equal to its world price. Now, for a country like Cameroon, the second assumption is particularly troublesome. First, quality differences are frequently observed between imports and domestic substitutes. Second, at a level of aggregation of eleven sectors, each sector represents a bundle of different goods. For example, the capital goods sector includes some goods (like machine tools) produced in Cameroon and others (like heavy machinery) which are not. Clearly, these two types of goods are not perfect substitutes. In our model, we resolve this problem by relaxing assumption (ii) for imported goods. Instead, we postulate that for any traded good, imports, $M_i$, and domestically produced goods, $D_i$, are imperfect substitutes. Domestic consumers are assumed to demand a "composite
commodity" $Q_i$ which is a CES (Constant Elasticity of Substitution) aggregation of $M_i$ and $D_i$:

$$Q_i = b_i \left[ \delta_i M_i^{-\rho_i} + (1 - \delta_i)D_i^{-\rho_i} \right]^{-\frac{1}{\rho_i}}$$

(B1)

where $b_i$, $\delta_i$ are constants and $\sigma_i$, the elasticity of substitution, is given by $\sigma_i = \frac{1}{1 + \rho_i}$.

This formulation implies that consumers will choose a mix of $M_i$ and $D_i$, depending on their relative prices. The dependence can be derived from (B1) as:

$$\frac{M_i}{D_i} = \left( \frac{P_i}{P_i^{\text{W}}} \right)^{\sigma_i} \left( \frac{1}{1 - \delta_i} \right)$$

(B2)

where $P_i$ and $P_i^{\text{W}}$ are the prices of the domestic and imported goods respectively. In classical trade theory, $\sigma_i$ is infinity, so that $P_i = P_i^{\text{W}}$, since if $P_i$ ever exceeded $P_i^{\text{W}}$, $D_i$ would have to be zero. Note that equation (B2) allows for a richer set of responses, but as $\sigma_i$ gets larger, the sensitivity of $\frac{M_i}{D_i}$ to changes in $\frac{P_i}{P_i^{\text{W}}}$ rises. Also, as a result of this specification, $P_i$ is no longer equal to $P_i^{\text{W}}$; rather it is endogenously determined in the model. The variable $P_i^{\text{W}}$, however, is fixed exogenously (we retain the price-taker assumption of classical trade theory), and is linked to the world price in dollars, $P_i^{\text{W}}$, by:

$$P_i^{\text{W}} = P_i^{\text{W}}(1 + tm_i)ER$$

(B3)
where ER is the exchange rate between US dollars and CFA Francs (fixed parametrically in the model) and τm_i is the tariff rate on sector i.

Finally, it should be noted that the CES aggregation (B1) implies the price $P_i$ of the composite good is given by

$$P_i = \frac{1}{B_i} \left[ \delta_i^{\sigma_i} P_{M_i}^{1-\sigma_i} + (1-\delta_i)^{\sigma_i} P_{D_i}^{1-\sigma_i} \right]^{\frac{1}{1-\sigma_i}}$$  \hspace{1cm} (B4)

**Exports**

Classical trade theory assumes that a small country faces a perfectly elastic demand for its exports. Again, this assumption may not be realistic for many developing countries. While they may not be able to affect the world market price with their exports, such countries may register a declining market share as, say, their domestic prices rise. To reflect this, we specify Cameroon's exports as facing a constant elasticity demand function:

$$E_i = \Pi_i \frac{ER(1+te_i)}{PD_i}^{\eta_i}$$  \hspace{1cm} (B5)

where $\Pi_i$ is a weighted average of world prices for good i, and $te_i$ is the export tariff rate. (If there is an export subsidy, $te_i$ will be negative.) Notice that as $PD_i$ rises relative to $\Pi_i$, export demand will fall although the country is still a price-taker.

Furthermore, export supply may exhibit an excessively strong response to changes in domestic prices. As a domestic price rises, producers are induced to increase supply and domestic consumers to reduce their demand. The net result is a dramatic increase in exports (the difference between supply and domestic demand). However, in reality, exports may not rise this fast, for the domestically consumed and exported commodities in the same sector may
be quite different. For example, "intermediate goods" includes both electricity (which is not traded) and wood pulp (which is). To get around this problem, we approximate an "export supply function" with a logistic curve which relates the export share of production $\frac{E_i}{X_i}$ to the price ratio $\frac{PE_i}{PD_i}$.

$$\frac{E_i}{X_i} = \frac{\bar{A}_i}{1 + \exp \left[ B_i (r_i - \bar{r}_i) \right]} + \bar{C}_i$$

where $r_i = \frac{PE_i}{PD_i}$.

The price $PE_i$ is the price the exporter of good $i$ receives and is another endogenous variable in the system. It is determined by equating the supply of and demand for exports. We employ this formulation for all exporting sectors except cash crops, where the "bundling" problem mentioned above does not occur.

**Domestic Supply of Goods and Demand for Labor**

Domestic supply of sector $i$ is given by a constant-returns Cobb-Douglas production function, with three types of labor ($L_{1i}, L_{2i}, L_{3i}$) and sector-specific capital, $K_i$, which is fixed in the short run $1/$:

$$X_i = \bar{A}_i \alpha_{1i} L_{1i} \alpha_{2i} L_{2i} \alpha_{3i} L_{3i} \alpha_{4i} K_i$$

where $\alpha_{4i} = 1 - \sum_k \alpha_{k1}$ and $\bar{A}_i$ is a constant.

$1/$ It is also possible to have CES production functions, with the elasticity of substitution estimated separately.
At this point, we must specify the labor market so that the dependence of $X_i$ on prices can be seen. Before we show how the demand for labor is determined, however, we must define the "net price" of sector $i$:

$$ P_{N_i} = P_{D_i} - \sum_j P_j a_{ji} - t_{d_i} $$  \hspace{1cm} \text{(B8)}

where $a_{ji}$ is the $(j, i)$ input-output coefficient and $t_{d_i}$ is the indirect tax rate in this sector.

With perfect competition, profit maximization requires that the wage of each factor equal the value of its marginal product:

$$ P_{N_i} \frac{\partial X_i}{\partial L_{ki}} = w_k \quad k = 1, 2, 3 $$  \hspace{1cm} \text{(B9)}

This equation implicitly defines labor demand. Hence the dependence of commodity supply, $X_i$, on prices and wages is established through equations (B7), (B8) and (B9).

The labor market clears when total labor demand (across sectors) for each category $k$ is equal to the (inelastic) supply of labor in that category, $L_k$

$$ \sum_i L_{ki} = L_k $$  \hspace{1cm} \text{(B10)}

**Intermediate Demand**

As a result of the fixed-coefficient assumption, intermediate demand for material inputs $W_i$ is derived as follows:

$$ W_i = \sum_j a_{ij} X_j $$  \hspace{1cm} \text{(B11)}
E. Consumer Demand

We assume there is only one representative household in this economy, which buys consumer goods according to fixed expenditure shares. If $C_i$ is consumption demand for good $i$, then,

$$C_i = \frac{\beta_i C}{P_i} \quad (B12)$$

where $C$ is total consumption and $\beta_i$ is the share spent on good $i$.

Total consumption $C$, in turn, is taken to be a fixed fraction of disposable income $Y$:

$$C = (1 - s)Y \quad (B13)$$

Recalling that we have only one household type, we see that disposable income $Y$ is simply total factor earnings less direct taxes:

$$Y = (1 - t) \sum \pi_i X_i \quad (B14)$$

where $t$ is the direct tax rate (assumed zero in Cameroon).

Government Demand

We assume the government keeps the nominal level of expenditure on each commodity fixed. Hence, government demand for commodity $i$ is

$$G_i = \frac{\beta_i^G GC}{P_i} \quad (B15)$$
where \( GC \) is the fixed level of expenditure and \( \beta^G_i \) is sector \( i \)'s share. In our model \( \beta^G_i \) is zero for all sectors except public administration, for which \( \beta^G_1 = 1 \).

**Investment Demand**

In our comparative statics experiments, capital stocks are fixed. Therefore, investment does not add to the capital stock. However, for accounting purposes, it is necessary to specify the size and composition of investment demand.

We assume that the level of investment is determined by the level of savings in the economy. The latter is the sum of private, public and foreign savings:

\[
S = s \sum_i P_i N_i X_i + G - GC
\]

\[\text{(B16)}\]

where

\[
G = \sum_i \left( t_{di} N_i X_i + t_{mi} P_{i1} + t_{ei} D_{1i} + \frac{t}{1-t} Y + \bar{F} \right) \cdot ER
\]

\[\text{(B17)}\]

and \( \bar{F} \) is the (exogenous) level of foreign savings (expressed in dollars).

Having determined the level of savings (and hence investment) from (B16) and (B17), we must specify how the composition of investment is determined. First, we assume that the investible funds available to sector \( j \) are a fixed fraction \( H_j \) of \( S \). Next, these funds are deflated by the price of a unit of capital in that sector, \( P_i h_{ij} \) where \( h_{ij} \) is the \((i,j)\) element of the capital coefficients matrix. Finally, investment by sector of origin is given by

\[
z_i = \sum_j \frac{h_{ij} S}{\sum P_i h_{ij}}
\]

\[\text{(B18)}\]
Increased demand for investment translates to demand for capital goods. From equation \((B16)\), it follows that an increase in foreign savings \((F)\) will, through the agency of equation \((B18)\), bring about an increase in demand with respect to the capital-goods-producing sectors. By applying Walras' law to this system (including the investment-savings identity represented by \((18)\)), we obtain:

\[
\sum_i \frac{P_{D_i} E_i}{ER (1+\tau_i)} - F = 0 \tag{B19}
\]

This can be viewed as an additional equation, defining the trade deficit as being equal to the level of foreign savings. \(^1/\)

Supply-Demand Equilibrium

Having shown how the different components of supply and demand depend on prices and wages, we now state the equilibrium conditions necessary to solve the model.

Recall that all the components of demand (save exports) are assumed to be for the composite commodity \(Q_i\) at prices \(P_i\). Yet, supply comes from either the domestically produced good \(D_i\) or imports \(M_i\). We assume that, for each sector, the proportion of demand satisfied by the domestically produced good is the same for each component of demand. This proportion \(d_i\), in turn, can be derived from \((B1)\) and

\(^1/\) In other versions of the Dervis-de Melo-Robinson model, either the level of foreign savings \((F)\) or the exchange rate \((ER)\) is an endogenous variable. Also, these versions include an equation which fixes the absolute level of prices. In our model, we fix both \(F\) and \(ER\), but allow the price level to adjust endogenously. (See section A).
Thus, the supply-demand equilibrium conditions for the economy are

\[ X_i = d_i W_i + C_i + Z_i + G_i + E_i \quad i = 1, \ldots, N \]  
(B21)

Note that we assume all export demand is for the domestically produced good rather than for the composite commodity.

Equations (B1)-(B19) represent the model we use to simulate the impacts of oil revenues and tariffs. The result of the simulations can be explained by the assumptions underlying (B1)-(B19). First, by equation (B17) we assume that oil revenues accrue to the government which saves all its additional income.\(^1\) By equation (B16), this influx of savings gets translated to an increase in demand for investment goods, mainly capital goods and construction materials. It is not surprising, therefore, that the latter sectors benefit most from an oil boom.

Second, equation (B9) is essentially an assumption of full employment in the economy. Moreover, with fixed capital stocks, labor inputs determine output in each sector [equation (B7)]. Now, if the nontradable sectors expand as a result of the increased demand (from oil revenues), labor is drawn to these sectors and away from the traded goods sectors. In this way, the traded goods sectors as a whole must contract, although some individual sectors may expand.

---

\(^1\) This assumption is relaxed for some simulations.
Third, equation (B1) states that imports and domestically produced goods in the same sector may not be perfectly substitutable. As a result, when the real exchange rate appreciates in the wake of an oil boom, consumers do not instantly switch all their purchases to imports. Rather, some of this additional demand is satisfied by domestic production. If the demand is significant, the import-substituting sector's output will have to increase. Also because of equation (B1), an import tariff will have a milder effect on the domestic economy than classical trade theory would predict. Since the domestically produced good is only an imperfect substitute, it does not register as strong an increase in demand, and hence in output, when a tariff is levied on the import.
IV. SIMULATION RESULTS

The model described in the previous section was estimated for the Cameroonian economy for 1979-80. Of the model's eleven sectors (see Table 1), only two—construction and public services—are "pure" nontradables. Of the remaining nine, five are net exporters (mainly primary goods and private services) while four manufacturing sectors are net importers. In general, the substitution elasticities between foreign and home goods are higher for primary and consumer goods than for intermediate and capital goods.

Table 1

<table>
<thead>
<tr>
<th>Sectors</th>
<th>1979-80 Net Trade (billions of CFA Francs)</th>
<th>Export/Production Ratio</th>
<th>Imports/Domestically Produced Supply Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Food Crops</td>
<td>2.133</td>
<td>1.39</td>
<td>0.76</td>
</tr>
<tr>
<td>2  Cash Crops</td>
<td>117.026</td>
<td>95.14</td>
<td>125.88</td>
</tr>
<tr>
<td>3  Forestry</td>
<td>22.314</td>
<td>75.71</td>
<td>0.32</td>
</tr>
<tr>
<td>4  Food Processing</td>
<td>5.49</td>
<td>32.56</td>
<td>36.98</td>
</tr>
<tr>
<td>5  Consumer Goods</td>
<td>-31.198</td>
<td>4.95</td>
<td>32.98</td>
</tr>
<tr>
<td>6  Intermediate Goods</td>
<td>-37.241</td>
<td>35.63</td>
<td>75.70</td>
</tr>
<tr>
<td>7  Cement &amp; Base Metals</td>
<td>-39.115</td>
<td>30.73</td>
<td>209.63</td>
</tr>
<tr>
<td>8  Capital Goods</td>
<td>-130.881</td>
<td>37.27</td>
<td>209.63</td>
</tr>
<tr>
<td>9  Construction</td>
<td>0</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>7.187</td>
<td>13.26</td>
<td>13.94</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>19.27</td>
<td>29.19</td>
<td></td>
</tr>
</tbody>
</table>

1/ For details of the estimation procedure, see Bejamín and Devarajan [1984].
The assumption of imperfect substitutability between home and foreign goods is an important one. For example, if the prices of domestic goods rise relative to the prices of foreign goods, consumers do not instantly switch all their purchases to imports. Rather, some of this additional demand is satisfied by domestic production. If the demand is significant, the import-substituting sector's output will have to increase. Also because of equation (1), an import tariff will have a milder effect on the domestic economy than classical trade theory would predict. Since the domestically produced good is only an imperfect substitute, it does not register as strong an increase in demand, and hence in output, when a tariff is levied on the import.

There are three categories of labor in the model, and their employment pattern in the various sectors is given in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Sector</th>
<th>Rural</th>
<th>Urban Unskilled</th>
<th>Skilled</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Crops</td>
<td>.91</td>
<td>.09</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2 Cash Crops</td>
<td>.89</td>
<td>.10</td>
<td>.01</td>
<td>1</td>
</tr>
<tr>
<td>3 Forestry</td>
<td>.76</td>
<td>.18</td>
<td>.06</td>
<td>1</td>
</tr>
<tr>
<td>4 Food Processing</td>
<td>.52</td>
<td>.38</td>
<td>.10</td>
<td>1</td>
</tr>
<tr>
<td>5 Consumer Goods</td>
<td>.36</td>
<td>.48</td>
<td>.16</td>
<td>1</td>
</tr>
<tr>
<td>6 Intermediate Goods</td>
<td>.42</td>
<td>.38</td>
<td>.19</td>
<td>1</td>
</tr>
<tr>
<td>7 Cement &amp; Base Metals</td>
<td>.42</td>
<td>.38</td>
<td>.19</td>
<td>1</td>
</tr>
<tr>
<td>8 Capital Goods</td>
<td>.44</td>
<td>.39</td>
<td>.17</td>
<td>1</td>
</tr>
<tr>
<td>9 Construction</td>
<td>.39</td>
<td>.49</td>
<td>.12</td>
<td>1</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>.39</td>
<td>.41</td>
<td>.20</td>
<td>1</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>---</td>
<td>.72</td>
<td>.28</td>
<td>1</td>
</tr>
</tbody>
</table>

Finally, the intermediate flows and the structure of demand are given in Table 3.
Table 3

INTERMEDIATE FLOWS
(in billions of CFA francs)

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>10.07</td>
<td>0.00</td>
<td>0.00</td>
<td>21.80</td>
<td>0.24</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>25.37</td>
<td>0.00</td>
<td>57.48</td>
</tr>
<tr>
<td>2.</td>
<td>0.00</td>
<td>2.00</td>
<td>0.00</td>
<td>1.47</td>
<td>1.33</td>
<td>1.90</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>6.70</td>
</tr>
<tr>
<td>3.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.18</td>
<td>0.00</td>
<td>5.99</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>6.16</td>
</tr>
<tr>
<td>4.</td>
<td>1.13</td>
<td>0.83</td>
<td>0.00</td>
<td>2.33</td>
<td>1.46</td>
<td>1.43</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.57</td>
<td>2.51</td>
<td>10.26</td>
</tr>
<tr>
<td>5.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.08</td>
<td>6.38</td>
<td>1.24</td>
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<td>0.00</td>
<td>0.64</td>
<td>0.55</td>
<td>8.88</td>
</tr>
<tr>
<td>6.</td>
<td>2.23</td>
<td>16.28</td>
<td>0.62</td>
<td>2.73</td>
<td>9.84</td>
<td>66.72</td>
<td>6.25</td>
<td>0.16</td>
<td>25.53</td>
<td>5.72</td>
<td>13.88</td>
<td>149.97</td>
</tr>
<tr>
<td>7.</td>
<td>0.01</td>
<td>0.03</td>
<td>0.01</td>
<td>8.09</td>
<td>6.03</td>
<td>15.91</td>
<td>4.43</td>
<td>1.21</td>
<td>32.46</td>
<td>0.11</td>
<td>0.00</td>
<td>73.29</td>
</tr>
<tr>
<td>8.</td>
<td>0.14</td>
<td>1.28</td>
<td>0.72</td>
<td>0.67</td>
<td>1.46</td>
<td>14.95</td>
<td>0.70</td>
<td>0.52</td>
<td>4.57</td>
<td>2.40</td>
<td>0.00</td>
<td>27.39</td>
</tr>
<tr>
<td>9.</td>
<td>1.56</td>
<td>0.15</td>
<td>0.09</td>
<td>7.53</td>
<td>2.17</td>
<td>15.08</td>
<td>0.06</td>
<td>0.00</td>
<td>2.54</td>
<td>2.37</td>
<td>0.65</td>
<td>32.20</td>
</tr>
<tr>
<td>10.</td>
<td>1.24</td>
<td>40.29</td>
<td>7.87</td>
<td>7.27</td>
<td>30.88</td>
<td>65.42</td>
<td>4.03</td>
<td>1.02</td>
<td>23.84</td>
<td>84.54</td>
<td>39.59</td>
<td>305.99</td>
</tr>
<tr>
<td>11.</td>
<td>0.07</td>
<td>0.39</td>
<td>0.10</td>
<td>0.39</td>
<td>0.64</td>
<td>2.72</td>
<td>0.17</td>
<td>0.01</td>
<td>0.78</td>
<td>1.35</td>
<td>0.00</td>
<td>6.60</td>
</tr>
<tr>
<td>Total</td>
<td>16.44</td>
<td>61.23</td>
<td>9.40</td>
<td>52.54</td>
<td>60.43</td>
<td>191.36</td>
<td>20.64</td>
<td>2.92</td>
<td>89.72</td>
<td>123.06</td>
<td>57.19</td>
<td>684.92</td>
</tr>
</tbody>
</table>

STRUCTURE OF DEMAND

<table>
<thead>
<tr>
<th>SECTOR</th>
<th>INTERM.</th>
<th>CONS.</th>
<th>GOVT.</th>
<th>INV.</th>
<th>STOCK CHANGE</th>
<th>EXPORTS</th>
<th>IMPORTS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>57.48</td>
<td>260.13</td>
<td>0.00</td>
<td>6.71</td>
<td>4.03</td>
<td>4.59</td>
<td>2.46</td>
<td>330.48</td>
</tr>
<tr>
<td>2.</td>
<td>6.70</td>
<td>4.22</td>
<td>0.00</td>
<td>0.00</td>
<td>3.51</td>
<td>125.07</td>
<td>8.04</td>
<td>131.45</td>
</tr>
<tr>
<td>3.</td>
<td>6.16</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>1.02</td>
<td>22.34</td>
<td>0.02</td>
<td>29.50</td>
</tr>
<tr>
<td>4.</td>
<td>10.26</td>
<td>53.08</td>
<td>0.00</td>
<td>0.00</td>
<td>3.19</td>
<td>23.45</td>
<td>17.96</td>
<td>72.02</td>
</tr>
<tr>
<td>5.</td>
<td>8.88</td>
<td>133.65</td>
<td>0.00</td>
<td>0.00</td>
<td>7.10</td>
<td>5.86</td>
<td>37.06</td>
<td>118.43</td>
</tr>
<tr>
<td>6.</td>
<td>149.97</td>
<td>168.15</td>
<td>0.00</td>
<td>0.00</td>
<td>3.49</td>
<td>101.33</td>
<td>138.57</td>
<td>284.38</td>
</tr>
<tr>
<td>7.</td>
<td>73.29</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>10.50</td>
<td>49.62</td>
<td>34.17</td>
<td>34.17</td>
</tr>
<tr>
<td>8.</td>
<td>27.39</td>
<td>0.00</td>
<td>113.36</td>
<td>0.43</td>
<td>3.84</td>
<td>134.72</td>
<td>10.30</td>
<td>34.17</td>
</tr>
<tr>
<td>9.</td>
<td>32.20</td>
<td>3.79</td>
<td>0.00</td>
<td>138.13</td>
<td>0.00</td>
<td>0.00</td>
<td>174.12</td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>305.99</td>
<td>302.61</td>
<td>135.03</td>
<td>258.20</td>
<td>22.78</td>
<td>378.61</td>
<td>462.89</td>
<td>1964.62</td>
</tr>
<tr>
<td>11.</td>
<td>6.60</td>
<td>22.35</td>
<td>135.03</td>
<td>258.20</td>
<td>22.78</td>
<td>378.61</td>
<td>462.89</td>
<td>1964.62</td>
</tr>
<tr>
<td>12.</td>
<td>684.92</td>
<td>917.98</td>
<td>135.03</td>
<td>258.20</td>
<td>22.78</td>
<td>378.61</td>
<td>462.89</td>
<td>1964.62</td>
</tr>
</tbody>
</table>
We present first the results of some comparative static experiments where, from the base year, the model is driven to a new equilibrium by changes in some exogenous or policy variables. In these experiments, the capital stock and labor supply are held constant, whereas in the dynamic experiments they are updated in each period. We use the comparative statics experiments to explore the effects of three exogenous changes: (1) an increase in oil export revenues (this could also represent the patriation of other types of foreign earnings or a sudden injection of foreign exchange from any source); (2) the pursuit of food self-sufficiency through increased tariffs on food imports; and (3) the institution of an industrial policy which increases import tariff protection for intermediate goods and construction materials, to avoid deindustrialization.

Since oil revenues were very small during the base year of the model, it provides a base case against which comparative statics experiments with high oil revenues can be evaluated. We simulate increased earnings from oil exports by injecting a specific amount of foreign earnings into the economy. This amount can be varied in order to reflect different levels of patriated foreign earnings. In testing this model for possible "Dutch disease"-type effects, we experiment with $500 million or 105 billion CFA Francs of oil revenues. This need not by any means be either a realistic or likely figure. Rather, it is easiest to experiment with an extreme level in order to illustrate how certain features of the model and characteristics of the Cameroonian economy influence the structure of the new equilibrium which accommodates the new high level of patriated foreign exchange earnings.

In the Cameroon model, oil revenues are channelled directly into the total savings pool available for investment. In the first experiment,
investment increases across sectors by an average of 41 percent; domestic prices rise 23 percent and nominal wages 26 percent (see Table 4).

Table 4

<table>
<thead>
<tr>
<th>Percentage change in:</th>
<th>Oil revenues channelled to investment</th>
<th>Oil revenues channelled to consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>40.7</td>
<td>14.1</td>
</tr>
<tr>
<td>Domestic prices</td>
<td>23.2</td>
<td>31.5</td>
</tr>
<tr>
<td>Composite prices</td>
<td>18.4</td>
<td>24.8</td>
</tr>
<tr>
<td>Nominal wages</td>
<td>26.2</td>
<td>36.4</td>
</tr>
</tbody>
</table>

It may be of interest to see how these aggregate figures change if instead oil revenues are distributed directly to consumers. Consumer demand for labor-intensive goods drives nominal wages up 36 percent and domestic prices increase by 32 percent. Investment grows by only 14 percent as compared with 41 percent in the case where new revenues are channelled into investment. This latter specification is the one used in all the experiments presented below. It provides a benchmark ideal scenario where the first-round use of oil revenues is for improvement in the capital stock as opposed to expansion of consumption.
This aggregate picture of the investment boom in the first experiment, with rising prices and wages, coincides with a general worsening of the trade position. However, evidence of the Dutch disease is best indicated in the sectoral breakdown of price, output, and trade changes.

Table 5
Base Foreign Earnings Experiment

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage change in domestic goods price</th>
<th>Percentage change in composite goods price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>24.8</td>
<td>24.6</td>
</tr>
<tr>
<td>2</td>
<td>15.2</td>
<td>6.5</td>
</tr>
<tr>
<td>3</td>
<td>11.3</td>
<td>11.3</td>
</tr>
<tr>
<td>4</td>
<td>24.6</td>
<td>17.3</td>
</tr>
<tr>
<td>5</td>
<td>21.4</td>
<td>15.6</td>
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<td>6</td>
<td>22.9</td>
<td>12.7</td>
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<td>32.1</td>
<td>1.4</td>
</tr>
<tr>
<td>9</td>
<td>32.4</td>
<td>33.4</td>
</tr>
<tr>
<td>10</td>
<td>23.8</td>
<td>20.8</td>
</tr>
<tr>
<td>11</td>
<td>17.9</td>
<td>17.9</td>
</tr>
<tr>
<td>Total</td>
<td>23.2</td>
<td>18.4</td>
</tr>
</tbody>
</table>

The rise of domestic goods prices in relation to foreign goods prices is most apparent in the prices of composite goods (see Table 5). Traded sectors show the smallest increase because the traded component holds constant at the world price while only the price of the domestically produced and sold portion responds to rising domestic demand. Thus the increases in domestic prices and wages worsen the trade position of the country both because productive resources move to more profitable nontraded sectors (where prices
are increasing faster) and because domestic traded goods face some price competition from foreign goods, depending on how substitutable they are, in both domestic and export markets. The investment boom generated in this experiment causes imports to grow by 23 percent and exports to fall by 12 percent.

Some parallel results occur in changes in the structure of production (see Table 6). Production grows most significantly in construction—both a nontraded and investment good—while it declines severely in cash crops, the traditional export sector, which loses competitiveness as domestic costs rise. But the expected pattern of output changes is broken by other tradable sectors, notably capital goods, which shows a high growth rate. This is due to the structure of demand for the capital goods sector as it supplies investment goods to the large investment boom. Another tradable sector, construction materials, does not suffer as much as might be expected given the importance of foreign competition, since the booming construction sector demands a large share of its output. The small expansion in two other tradable sectors, food crops and consumer goods, occurs because trade is so small in these sectors that they behave more like nontradables.
Table 6
Base Foreign Earnings Experiment

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage Change in Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Crops</td>
<td>2.8</td>
</tr>
<tr>
<td>2 Cash Crops</td>
<td>-12.9</td>
</tr>
<tr>
<td>3 Forestry</td>
<td>-6.6</td>
</tr>
<tr>
<td>4 Food Processing</td>
<td>-5.7</td>
</tr>
<tr>
<td>5 Consumer Goods</td>
<td>3.1</td>
</tr>
<tr>
<td>6 Intermediate Goods</td>
<td>-1.5</td>
</tr>
<tr>
<td>7 Cement &amp; Base Metals</td>
<td>-1.6</td>
</tr>
<tr>
<td>8 Capital Goods</td>
<td>12.2</td>
</tr>
<tr>
<td>9 Construction</td>
<td>27.7</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>0.1</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>-11.5</td>
</tr>
<tr>
<td>12 Total</td>
<td>0.8</td>
</tr>
</tbody>
</table>

Finally, the production of public services falls only because nominal government consumption has been fixed while prices are rising, and government purchases the vast majority of the sector's output. A different experiment fixing real government consumption would solve this problem but would also alter the amount of new investment from a given level of oil revenue expenditures. Such an experiment conducted with this model and with the same $500 million oil revenue inflow shows that investment increases only 29 percent (as opposed to 41 percent) while domestic prices rise by 28 percent and wages by 30 percent (see Table 7). Nominal government consumption must increase more than 27 percent to make up for inflation caused by the rising demand. And maintaining

1/ Given our assumptions of fixed capital stock and a fully employed fixed labor supply, the total change in real output is insignificant in these comparative static experiments; only the intersectoral structure of output changes is relevant. These assumptions are relaxed in the dynamic experiments.
the size of government causes large increases in real wages for skilled and urban workers since the public services sector relies on them heavily.

Table 7
Base Foreign Earnings Experiment

<table>
<thead>
<tr>
<th>Change in:</th>
<th>Constant nominal government consumption</th>
<th>Constant real government consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment</td>
<td>40.7%</td>
<td>29.2%</td>
</tr>
<tr>
<td>Domestic prices</td>
<td>23.2%</td>
<td>28.0%</td>
</tr>
<tr>
<td>Composite prices</td>
<td>18.4%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Nominal wages</td>
<td>26.2%</td>
<td>30.4%</td>
</tr>
<tr>
<td>Level of government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>consumption (billions of CFA Francs)</td>
<td>135.2</td>
<td>171.9</td>
</tr>
</tbody>
</table>

The effect of oil revenues on foreign trade is as could be expected (see Table 8). Imports rise in all traded sectors and exports decline, both because productive resources are drawn into nontraded sectors and also because domestic traded goods prices, not perfectly tied to international prices, are allowed to rise.
Table 8
Base Foreign Earnings Experiment

<table>
<thead>
<tr>
<th>Sector</th>
<th>Exports</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Crops</td>
<td>-6.29</td>
<td>43.53</td>
</tr>
<tr>
<td>Cash Crops</td>
<td>-13.22</td>
<td>6.41</td>
</tr>
<tr>
<td>Forestry</td>
<td>-7.94</td>
<td>1.99</td>
</tr>
<tr>
<td>Food Processing</td>
<td>-15.73</td>
<td>30.56</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>-7.50</td>
<td>32.10</td>
</tr>
<tr>
<td>Intermediate Goods</td>
<td>-11.81</td>
<td>15.56</td>
</tr>
<tr>
<td>Cement &amp; Base Metals</td>
<td>-10.27</td>
<td>16.36</td>
</tr>
<tr>
<td>Capital Goods</td>
<td>-6.16</td>
<td>37.55</td>
</tr>
<tr>
<td>Construction</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Private Services</td>
<td>-10.96</td>
<td>10.83</td>
</tr>
<tr>
<td>Public Services</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>-11.87</td>
<td>23.18</td>
</tr>
</tbody>
</table>

Turning to the impact of oil revenues on the labor market, we find labor in general leaving the traded for the nontraded sectors. Those sectors diverging from this expected pattern are the ones experiencing exceptional growth rates for reasons explained above. With the assumptions of a constant labor supply and flexible wages, the reallocation of workers is as follows:

Table 9
Base Foreign Earnings Experiment

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage change in labor force</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Crops</td>
<td>4.35</td>
</tr>
<tr>
<td>Cash Crops</td>
<td>-20.69</td>
</tr>
<tr>
<td>Forestry</td>
<td>-20.71</td>
</tr>
<tr>
<td>Food Processing</td>
<td>13.08</td>
</tr>
<tr>
<td>Consumer Goods</td>
<td>5.24</td>
</tr>
<tr>
<td>Intermediate Goods</td>
<td>-4.04</td>
</tr>
<tr>
<td>Cement &amp; Base Metals</td>
<td>-4.08</td>
</tr>
<tr>
<td>Capital Goods</td>
<td>16.70</td>
</tr>
<tr>
<td>Construction</td>
<td>61.64</td>
</tr>
<tr>
<td>Private Services</td>
<td>-0.76</td>
</tr>
<tr>
<td>Public Services</td>
<td>-15.06</td>
</tr>
<tr>
<td>Total</td>
<td>0.00</td>
</tr>
</tbody>
</table>
Real wages increase by 5.7 percent in the economy overall, but there is variation in the distribution across skill categories:

<table>
<thead>
<tr>
<th>Change in Real Wage Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural unskilled</td>
</tr>
<tr>
<td>Urban unskilled</td>
</tr>
<tr>
<td>Urban skilled</td>
</tr>
</tbody>
</table>

While the wages for skilled urban workers rise at less than the average rate, it should be remembered that they are paid ten times as much as the other two labor groups at the outset. Also, the wage differential developing between urban and rural unskilled workers has serious implications for the effect of oil revenues on rural-urban migration and productivity in agriculture. Any differences in rural and urban household consumption patterns will multiply the effects of this shifting income distribution.

In this first experiment we have seen how the structure of the Cameroonian economy and the features of the CGE model which express this structure have complicated the spending effect of an oil boom. Of particular importance is the assumption of imperfect substitutability among foreign and domestic traded goods which allows domestic prices of these goods to rise above world levels while they maintain a share in total supply. In view of the importance of this assumption, we examine here the elasticities of substitution and the sensitivity of the model to them.

All of the experiments presented so far use relatively low elasticities of substitution between home and foreign goods – near the minimum of 0.4 for intermediate and capital goods and higher though still relatively low for primary and consumer goods. This restricts the rate at which imports can replace domestic production as local prices and wages rise during the investment boom. As a comparison, we repeat the base foreign earnings
experiment changing only the elasticities of home/foreign good substitution for the food crops, intermediate goods, construction materials and capital goods sectors. In each case this elasticity is raised to near the maximum of the possible range (about 4.0). The "high elasticity" case creates the same amount of new investment as the base foreign earnings experiment but generates a different kind of boom.

In this the pattern of price increases is similar to that of the base (low elasticity) experiment but the magnitude is smaller (13 percent versus 23 percent) because of the greater competition from foreign goods imported at constant world prices. Those sectors whose home/foreign goods substitution elasticity has been raised show the most significantly smaller price increases. In the same way, the structure of output changes in the "high elasticity" experiment echoes that of the base foreign earnings case, but instead of the surprising expansion of capital goods we find a contraction, and the previously mild declines in intermediate goods and construction materials have become more severe. The pattern of changes in imports shows how foreign goods more easily replace domestic producers in these sectors as suppliers to the domestic investment boom. The declines in intermediate goods and construction materials contribute to the contraction in capital goods (which is actually quite small in nominal terms) since the one is the major purchaser of intermediate goods from this sector and they both rely heavily on this sector for investment goods.

In the food crops sector, with its low nominal level of imports, output grows slightly less than before. However, the food processing sector suffers less of a decline as its major input, food crops, has a much lower price increase. Several sectors show a smaller drop in their exports as the price of their inputs and their own prices diverge less from world levels.
Table 10

Model Results Under Assumptions of Low and High Elasticities of Substitution between Home and Foreign Goods (percentage change from base year)

<table>
<thead>
<tr>
<th>Sector</th>
<th>Low Elasticity</th>
<th>High Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domestic Prices</td>
<td></td>
</tr>
<tr>
<td>1  Food Crops</td>
<td>24.81</td>
<td>15.14</td>
</tr>
<tr>
<td>2  Cash Crops</td>
<td>15.24</td>
<td>8.79</td>
</tr>
<tr>
<td>3  Forestry</td>
<td>11.31</td>
<td>2.10</td>
</tr>
<tr>
<td>4  Food Processing</td>
<td>24.58</td>
<td>15.11</td>
</tr>
<tr>
<td>5  Consumer Goods</td>
<td>21.38</td>
<td>12.69</td>
</tr>
<tr>
<td>6  Intermediate Goods</td>
<td>22.91</td>
<td>8.27</td>
</tr>
<tr>
<td>7  Cement &amp; Base Metals</td>
<td>18.79</td>
<td>6.13</td>
</tr>
<tr>
<td>8  Capital Goods</td>
<td>32.12</td>
<td>11.38</td>
</tr>
<tr>
<td>9  Construction</td>
<td>32.42</td>
<td>24.31</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>23.85</td>
<td>13.86</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>17.93</td>
<td>10.63</td>
</tr>
<tr>
<td>12 Total</td>
<td>23.21</td>
<td>13.24</td>
</tr>
</tbody>
</table>

<p>|                     | Output         |                 |
| 1  Food Crops       | 2.81           | 1.71            |
| 2  Cash Crops       | -12.89         | -7.92           |
| 3  Forestry         | -6.57          | -5.58           |
| 4  Food Processing  | -5.66          | -3.97           |
| 5  Consumer Goods   | -3.13          | 2.35            |
| 6  Intermediate Goods | -1.48       | -8.59           |
| 7  Cement &amp; Base Metals | 1.59       | -6.46           |
| 8  Capital Goods    | 12.16          | -6.77           |
| 9  Construction     | 27.71          | 28.43           |
| 10 Private Services | 0.06           | -0.19           |
| 11 Public Services  | -11.51         | -7.28           |
| 12 Total            | 1.28           | 0.13            |</p>
<table>
<thead>
<tr>
<th>Sector</th>
<th>Low Elasticity</th>
<th>High Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Imports</td>
<td>Exports</td>
</tr>
<tr>
<td>1  Food Crops</td>
<td>43.53</td>
<td>-6.29</td>
</tr>
<tr>
<td>2  Cash Crops</td>
<td>6.41</td>
<td>-13.22</td>
</tr>
<tr>
<td>3  Forestry</td>
<td>1.99</td>
<td>-7.94</td>
</tr>
<tr>
<td>4  Food Processing</td>
<td>30.56</td>
<td>-15.73</td>
</tr>
<tr>
<td>5  Consumer Goods</td>
<td>32.10</td>
<td>-7.50</td>
</tr>
<tr>
<td>6  Intermediate Goods</td>
<td>15.56</td>
<td>-11.81</td>
</tr>
<tr>
<td>7  Cement &amp; Base Metals</td>
<td>16.36</td>
<td>-10.27</td>
</tr>
<tr>
<td>8  Capital Goods</td>
<td>37.55</td>
<td>-6.16</td>
</tr>
<tr>
<td>9  Construction</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>10.83</td>
<td>-10.96</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>12 Total</td>
<td>23.18</td>
<td>-11.87</td>
</tr>
</tbody>
</table>
The reallocation of labor among sectors reflects the pattern of output changes, and nominal wages rise only 16 percent as compared to 26 percent in the first experiment.

Thus the elasticity of substitution between foreign and domestic goods has a significant impact on the character of an investment boom generated by $500 million of newly patriated foreign earnings. It affects price and wage inflation, the relative structure of output changes, and the magnitude of trade changes.

In this first series of experiments on the impact of new foreign exchange inflows we find that, while the model produces Dutch disease-type results in aggregate, the detailed sectoral results show some cases which differ from the predicted pattern. Of key importance is the assumption of imperfect substitutability between home and foreign goods. This enhances the role of the direct and indirect demand in the economy and leads to some traded sectors expanding in the course of the oil-generated investment boom, despite the real exchange rate appreciation. The pattern of output changes in those sectors associated with investment goods seems most affected. Two tradable sectors showing positive growth rates—food crops and consumption goods—sell mostly to growing private consumption. Yet the buoyancy of these sectors is aided more by their insulation from foreign competition by means of their very low levels of imports and exports. Thus they are less affected by changes in the relative prices between domestic and foreign goods. This insularity in the case of food crops governs the results of comparative static experiments relating to food self-sufficiency.

One common technique for achieving food self-sufficiency is to increase food import tariffs to restrict imports, support domestic prices, and thus encourage local production. But again, the semi-complementarity between
home goods and imports incorporated in the model constrains the transfer of demand from imports to domestic goods. Indeed, the near self-sufficiency in food crops in the base year makes it not surprising that an experiment doubling the level of the import tariff on food crops produces virtually no effect. The tiny drop in food imports is insignificant in nominal terms. Domestic food crops output remains unchanged. Output and trade in other sectors also show virtually no effect, and increase in tariff revenues is very slight. Thus the stability of output in the food crops sector can only be tested in the dynamic context where several years' enactment of different investment plans, population growth, and migration may affect that sector's productivity and draw people toward or away from the production of food crops.

Another sectoral policy experiment, one that doubles import tariffs for intermediate goods and construction materials, has a more significant impact on the structure of output, relative prices, and trade. Doubling the tariffs is one possible industrial policy that would seek to protect and encourage output in these two manufacturing sectors. While this policy succeeds in the case of construction materials, it fails for intermediate goods (see Table 11).
Table 11
Double Import Tariffs Sectors 6 and 7

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage Change in Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Crops</td>
<td>0.07</td>
</tr>
<tr>
<td>2 Cash Crops</td>
<td>-0.35</td>
</tr>
<tr>
<td>3 Forestry</td>
<td>0.29</td>
</tr>
<tr>
<td>4 Food Processing</td>
<td>-3.00</td>
</tr>
<tr>
<td>5 Consumer Goods</td>
<td>-1.50</td>
</tr>
<tr>
<td>6 Intermediate Goods</td>
<td>-2.29</td>
</tr>
<tr>
<td>7 Cement &amp; Base Metals</td>
<td>3.98</td>
</tr>
<tr>
<td>8 Capital Goods</td>
<td>2.49</td>
</tr>
<tr>
<td>9 Construction</td>
<td>4.76</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>0.24</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>0.24</td>
</tr>
</tbody>
</table>

The pattern of output is mostly explained by the structure of demand for the two sectors targeted by this policy. About half of the composite good in sector 6 is sold to final consumption, while in sector 7, all of the composite good is sold to intermediate consumption. In the model, intermediate demand does not respond to price changes since it behaves according to fixed technological coefficients; price changes merely alter the cost of production. As the increased tariffs in sectors 6 and 7 raise the price of those composite goods, the intermediate demand for construction materials remains inflexible to this change while the consumption demand for intermediate goods falls in response to the price increase.

It is also worth noting that sector 6 is a major purchaser of its own output, absorbing nearly half of the total supplied to intermediate demand. Thus, raising the tariff on intermediate goods acts to increase the cost of producing them. This situation arises in part because of the diversity of the items which have been aggregated into sector 6. In contrast, the major consumer of sector 7's output, buying nearly half of its total supply, is construction, a sector which grows significantly in this experiment. The
higher tariffs cause government tariff revenues to increase 38 percent, and with government consumption fixed, this contributes to higher total savings and fuels an increase in total investment of 7 percent. This investment boom keeps demand for construction strong, so its output grows despite the fact that the sector must pay more for one of its inputs. The price changes reported in Table 12 reflect the influence of the new tariffs on the imported components of goods in sectors 6 and 7 and the pattern of direct and indirect demands in the economy.

Table 12
Double Import Tariffs Sectors 6 and 7

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage change in domestic goods price</th>
<th>Percentage change in composite goods price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Food Crops</td>
<td>-1.02</td>
<td>-1.0</td>
</tr>
<tr>
<td>2 Cash Crops</td>
<td>0.29</td>
<td>0.1</td>
</tr>
<tr>
<td>3 Forestry</td>
<td>-0.77</td>
<td>-0.8</td>
</tr>
<tr>
<td>4 Food Processing</td>
<td>1.84</td>
<td>1.3</td>
</tr>
<tr>
<td>5 Consumer Goods</td>
<td>0.51</td>
<td>0.4</td>
</tr>
<tr>
<td>6 Intermediate Goods</td>
<td>2.49</td>
<td>7.8</td>
</tr>
<tr>
<td>7 Cement &amp; Base Metals</td>
<td>9.94</td>
<td>17.2</td>
</tr>
<tr>
<td>8 Capital Goods</td>
<td>3.77</td>
<td>0.2</td>
</tr>
<tr>
<td>9 Construction</td>
<td>6.15</td>
<td>6.2</td>
</tr>
<tr>
<td>10 Private Services</td>
<td>-1.05</td>
<td>-1.1</td>
</tr>
<tr>
<td>11 Public Services</td>
<td>-0.20</td>
<td>-0.2</td>
</tr>
<tr>
<td>12 Total</td>
<td>0.69</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The impact of the tariff increases on the pattern of trade shows that imports of construction materials are hardly affected, dropping less than one percent, while imports of intermediate goods fall by 7.3 percent.

Those sectors which must pay more for intermediate inputs because of the higher tariffs, have less value added to distribute to factors of production. In the course of this experiment, total value added falls and therefore household income and consumption decline as well. Real wages in
particular fall by 1.8 percent on average. The distribution of wage changes across sectors is as follows:

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural unskilled</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Urban unskilled</td>
<td>-1.4%</td>
</tr>
<tr>
<td>Urban skilled</td>
<td>-1.7%</td>
</tr>
</tbody>
</table>

In general, this policy is not particularly favorable to primary sectors nor to the rural unskilled workers whom they employ.
V. SUMMARY AND CONCLUSIONS

This paper presents a computable general equilibrium model designed to examine the effects of expanding oil export earnings on the agriculture-based economy of Cameroon. The recent experience of other countries has shown that such a sudden increase in foreign exchange earnings can initiate a "Dutch disease" syndrome: appreciation of the real exchange rate, declining international competitiveness, and the contraction of tradable sectors (aside from oil) in favor of nontradable goods. The model estimated for Cameroon produces these types of results in the aggregate despite the fact that Cameroon's nominal exchange rate is fixed. Appreciation of the real exchange rate occurs because, with fixed factor supplies, domestic prices adjust in response to the investment expenditure of oil revenues. Since no foreign substitutes exist for nontraded goods, prices and output expand in these sectors while production of traded goods as a whole contracts.

Although the model produces these expected results in the large, the detailed sectoral results show some cases which differ from the predicted pattern. This occurs mainly because the model incorporates some semi-complementarity between foreign and domestic goods. This assumption of imperfect substitutability between home goods and imports enhances the role of the direct and indirect demand in the economy and leads to some traded sectors -- particularly those associated with investment goods -- in the course of the oil-generated investment boom.

Changes in the structure of output have a further effect on the distribution of income since expanding and declining sectors vary in their
reliance on different types of labor, mainly to the benefit of skilled and urban workers.

The results described thus far are those of a "best-use" scenario where all oil revenues are all channeled into investment. An alternative scenario allocating new revenues to consumers leads in aggregate to higher real exchange rate appreciation with a smaller investment boom.

The base experiment results are also compared to those produced under different assumptions about the degree of substitutability between imports and domestic goods thus testing the sensitivity of the model to this parameter. This test shows that significant increases in this elasticity of substitution affects the magnitude, relative structure, and (in a few cases) the direction of changes in output and trade as imports undermine erstwhile expanding sectors and hold down their prices.

In contrast, the imposition of higher import tariffs has almost no impact on the structure of output. Imports decline in the fact of higher protection, but the imperfect substitutability of home and foreign goods constrain the transfer of demand from imports to domestic goods.

It should be pointed out that the experiments presented in this paper do more to analyze structural shifts arising from an oil boom than they do to measure the benefits of increased oil revenues. In particular, the results are silent on the long run benefits of new investments in the capital stock and of increasing output and productivity. The paper also says nothing about optimal sectoral allocation. Answering such questions requires explicitly modelling the evolution of the economy overtime. While the CGE model presented here may be extended to do this, the comparative statics framework of this paper makes it unsuitable.
Yet the multisectoral, price endogenous model presented here is a powerful tool for analyzing the direct and indirect effects of both an oil boom and policy responses in a consistent way. It can provide statistical evidence of results which are normally discussed only in theoretical terms. And the model's sectoral richness allows us to derive results which are not apparent in the two sector model used in classical trade theory. In this way the model can aid in formulating a strategy for managing the significant opportunities and problems attendant upon a sizeable but temporary export boom in a developing country.
REFERENCES


World Bank Publications of Related Interest

Decentralized Renewable Energy Development in China: The State of the Art
Robert P. Taylor
Describes China's achievements in the development of biogas, small-scale hydroelectric plants, and other decentralized renewable energy systems. Discusses the Chinese approach to decentralized energy development during the 1970s, and the advantages and disadvantages of the Chinese methods.


The Economics of Power System Reliability and Planning: Theory and Case Studies
Mohan Munasinghe
A completely integrated treatment of system reliability. Indicates that application of the reliability optimization methodology could help realize considerable savings in the electric power sector, which is especially important for developing countries with limited foreign exchange reserves.

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