

# Working Paper

---

INTERNATIONAL MONETARY FUND

**IMF WORKING PAPER**

© 1994 International Monetary Fund

This is a Working Paper and the author would welcome any comments on the present text. Citations should refer to a Working Paper of the International Monetary Fund, mentioning the author, and the date of issuance. The views expressed are those of the author and do not necessarily represent those of the Fund.

WP/94/115

INTERNATIONAL MONETARY FUND

Policy Development and Review Department

**Macroeconomic Policies and Smuggling: An Analysis  
of Illegal Oil Trade in Nigeria**

---

Prepared by Jian-Ye Wang 1/

September 1994

Authorized for distribution by Benedicte Vibe Christensen

**Abstract**

Based on a simple model, the paper provides an explanation for illegal oil trade between Nigeria and its neighboring countries. The analysis focuses on the linkages between the level of smuggling and changes in the Government's fiscal, monetary, and domestic pricing policies. It is shown that smuggling has implications for inflation and currency depreciation. A vicious circle emerges when financial policies are expansionary and policy makers attempt to hold the domestic sale price of oil constant. Macroeconomic indicators of Nigeria over the period 1986-1993 appear to support the predictions of the model. Policy implications of the analysis are also noted.

**JEL classification number:**

E65, F41, O55

---

1/ I am particularly grateful to Anupam Basu, Benedicte Vibe Christensen, and Reinold van Til for helpful comments and suggestions. The paper has also benefitted from comments from Robin Kibuka, Soukang Lin, Kazi Matin, and Joseph Nana.

<u>Table Contents</u>	<u>Page</u>
Summary	iii
I. Introduction	1
II. Unrecorded Cross-Border Trade in Oil Products, 1986-1993	2
III. The Model	4
IV. Government Policies and Smuggling	8
1. Fixing the domestic oil price and fiscal policy	8
2. Adjusting the domestic oil price	9
3. Fixing the official exchange rate	10
4. Currency devaluation in the neighboring countries	11
V. Concluding Remarks	12
Figures	
1. Nigeria and Neighboring Countries: Petroleum Price Differentials, 1986-93	4a
2. Fixing the Oil Price and Fiscal Policy	8a
3. Changing Oil Subsidy and Oil Price Differential	10a
Tables	
1. Nigeria and Neighboring Countries: Consumer Prices of Premium Gasoline, 1986-93	13
2. Benin: Oil Consumption and Unrecorded Oil Imports, 1986-91	14
3. Nigeria: Selected Macroeconomic Indicators, 1986-93	15
References	16

### Summary

This paper examines the relations between macroeconomic policies and smuggling. The study is based on observations of unofficial cross-border trade in petroleum products between Nigeria and neighboring countries in West Africa. Such trade has long been noted to have adverse effects on price and output structures, exchange rates, and public finances in the region.

Available statistical evidence indicates that despite the periodic upward adjustment in the domestic sale prices of petroleum products and substantial trade liberalization in Nigeria under the country's Structural Adjustment Program, the main incentive for smuggling--the price differentials of petroleum products between Nigeria and its neighbors--rose in 1986-93. Oil smuggling from Nigeria to neighboring countries persisted or even grew over the period.

To explain this pattern, the paper develops a simple model focusing on the links among smuggling, public finances, and the Government's monetary, exchange rate, and oil pricing policies. The model shows that a vicious circle emerges. Inappropriate domestic oil pricing policy gives rise to implicit oil subsidies, which provide the incentive for smuggling. The smuggling worsens the Government's financial position, and monetary financing of the fiscal deficit accelerates domestic inflation and currency depreciation. The Government's attempt to fix the prices of petroleum products is tantamount to indexing the implicit oil subsidy to the exchange rate, which pushes up the cross-border oil price differentials. Smuggling then increases, exacerbating the fiscal imbalances. This process eventually forces the Government to abandon the previous oil prices. In the absence of a fundamental fiscal correction and reform of the oil pricing policy, the vicious circle continues. Macroeconomic indicators of Nigeria in 1986-93 support this analysis.

The model is also used to shed light on the impact of the devaluation of the CFA franc on cross-border oil trade. The paper concludes with policy implications for financial stabilization and adjustment in Nigeria.

*This page intentionally left blank*

## I. Introduction

Following the seminal paper by Bhagwati and Hansen (1973), illegal foreign trade has been mostly associated with evasion of tariffs or other trade and exchange restrictions in the economic literature. A series of articles have examined effects of smuggling on domestic prices and national welfare under different market structures [Sheikh (1974), Pitt (1981), Martin and Panagariya (1984), and Thursby, Jensen and Thursby (1991)]. Norton (1988) incorporated transportation cost into a model for smuggling of agricultural goods. Macedo (1987) and Johnson (1987) looked into smuggling in response to the convertibility of currencies. However, illegal trade has seldom been related to fiscal and monetary policies, and the macroeconomic implications of smuggling, if any, have not been explored.

It has long been noted in West Africa that cross-border trade, particularly in petroleum products, between Nigeria and her neighbors, most of which are members of the CFA franc zone, have had adverse effects on price and output structures, exchange rates, and public finances in these countries. <sup>1/</sup> The recent deterioration in Nigeria's economic and financial situation has further highlighted one of the key factors behind the illegal oil trade--the country's implicit subsidies on domestic sales of petroleum products, which was equivalent to an estimated 9 percent of GDP in 1992.

The purpose of this paper is twofold. First, the available statistical evidence on cross-border trade in oil products between Nigeria and its neighboring countries is reviewed. Second, based on the observations in the region, a simple model is developed to illustrate the interactions between smuggling, domestic oil pricing, public finances, and the Government's monetary and exchange rate policies. It is found that the price differentials of petroleum products between Nigeria and her neighbors (Benin, Cameroon, Chad, and Niger)--the main incentive for smuggling--had been steadily rising in 1986-1993 (except in 1991 when Cameroon unilaterally lowered its domestic oil prices by more than 30 percent). Oil smuggling from Nigeria to neighboring countries had been persistent or even growing over the period despite the substantial trade liberalization in Nigeria under the Structural Adjustment Program since September 1986, including the removal of prohibition on petroleum exports to West African countries in 1988. This observed pattern could be explained by a vicious circle of oil subsidies, smuggling, fiscal imbalances, monetary expansion and currency depreciation. Inappropriate domestic oil pricing policy gives rise to implicit oil subsidies, which provide the incentive for smuggling. The magnitude of the oil subsidy was significant enough to affect the

---

<sup>1/</sup> Stolper and Deardorff (1990) provide an informative discussion of smuggling in Africa. Johnson's theoretical analysis (1987) was explicitly based on border trading in the ECOWAS (Economic Community of West Africa States) region. However, macroeconomic factors do not feature prominently in these studies.

Government's financial position. Monetary finance of the fiscal deficit leads to rapid rise of domestic inflation and currency depreciation. The Government's attempt to fix the prices of petroleum products is tantamount to indexing the implicit oil subsidy to the exchange rate. This endogeneity of oil subsidy pushes up the cross-border oil price differentials and hence smuggling, which in turn aggravates the fiscal imbalances. This process eventually forces the Government to adjust domestic petroleum prices. Without a fundamental correction of the fiscal imbalances, however, another cycle begins. Macroeconomic indicators of Nigeria over the period 1986-1993 appear to support the predictions of the model. This analysis highlights the inherent inconsistency of price fixing and expansionary financial policies and in general is applicable to other commodities which are both exported and domestically consumed and upon which fiscal revenues depend importantly. The analysis also sheds light on the impact of a devaluation of the currency in the neighboring countries on the cross-border oil trade.

The remainder of this paper is divided into four parts. Section II reviews some stylized facts pertinent to the key determinants of oil price differentials between Nigeria and the neighboring countries. Section III presents a simple analytical framework, which is used in Section IV to illustrate the impact of oil pricing and fiscal policies, fixing the official exchange rate, and changes in world petroleum prices. The last section summarizes the policy implications of the analysis.

## II. Unrecorded Cross-Border Trade in Oil Products, 1986-1993

There is no reliable data on the illegal exports of Nigeria's petroleum products. However, the similar output and endowment structure in the region (especially between Nigeria, Cameroon, and Benin) suggests that the differentials in petroleum retail prices across countries should be an important measure of the magnitude and the trend of smuggling. <sup>1/</sup>

Table 1 presents consumer prices of premium gasoline in Nigeria, Benin, Cameroon, Chad, and Niger between 1986 and 1993. During the period under review, the local currency prices of gasoline were adjusted upward several times in Nigeria while being kept constant in neighboring countries. However, gasoline prices in neighboring countries (including a tax component, ranging between 40-60 percent of the retail prices in 1991) were substantially higher than the world price, while retail prices in Nigeria were consistently below world market prices, implying a subsidy element throughout the period. Relative to the world market prices, premium

---

<sup>1/</sup> Petroleum is the most important export commodity in both Nigeria and Cameroon. Benin also exports crude oil. Recorded bilateral trade in the region has been small. Nigeria accounted for less than 2 percent of imports in Benin, Cameroon, Chad, and Niger in the early 1990s (see Direction of Trade Statistics, 1992). As mentioned previously, Nigeria lifted prohibition on petroleum exports to West African countries in 1988.

gasoline price in Nigeria (at the parallel exchange rate) fell from about 80 percent of the world price in 1986 to below 20 percent in 1992-93. In comparison, gasoline prices in the neighboring countries were relatively stable but far above world market prices, ranging from 4 to 6 times of the world prices. The price differentials with all the neighboring countries in CFA franc terms at the parallel exchange rates were increasing, except for Cameroon which lowered retail prices for gasoline in 1991 (Figure 1). Calculations based on data in Table 1 indicate that price differentials in terms of U.S. dollar and naira, at both official and parallel exchange rates, exhibited a similar rising trend. Given the relatively small spread between the official and parallel market exchange rates of the naira during the 1987-92 period, the price differentials calculated at both these rates were broadly similar. 1/ During 1987-93, the naira depreciated considerably from CFA 197.3 per naira in 1986 to CFA 12.8 per naira in 1993. After adjusting for the low inflation in the CFA countries, the real bilateral exchange rate of the naira against the CFA franc depreciated markedly.

The above discussion suggests that petroleum taxation in neighboring countries, exchange rate movements, and oil subsidies in Nigeria were important determinants of the cross-border price differentials. To illustrate this, let  $P_t^N$  and  $P_t^B$  be the local currency prices of petroleum products in Nigeria and a neighboring country (e.g., Benin) in period  $t$ ,  $s_t$  and  $\tau_t^*$  be a specific subsidy in Nigeria and tax on petroleum products in the neighboring country, respectively. 2/ Using  $e_t$  to denote the naira/U.S. dollar exchange rate and  $e_t^*$  the CFA franc/U.S. dollar exchange rate, the CFA franc/naira rate can be written as  $e_t^*/e_t$ . Then,  $P_t^N = e_t P_t^W - s_t$ , and  $P_t^B = e_t^* P_t^W + \tau_t^*$ , where  $P_t^W$  = World oil price in U.S. dollar terms. The oil price differential in CFA francs in period  $t$  thus is:

$$P_t^B - \left( \frac{e_t^*}{e_t} \right) P_t^N = \tau_t^* + \left( \frac{e_t^*}{e_t} \right) s_t. \quad (1)$$

Clearly the price differential in CFA franc term can be decomposed into tax in the CFA countries and subsidy in Nigeria, valued at the ongoing exchange rate. The price differential is positively related to  $\tau_t^*$  and  $s_t$ , and negatively related to  $e_t$ , given the relative stability of  $e_t^*$  (neighboring CFA countries operate a fixed exchange rate system). It is also clear from equation (1) that the world oil prices would have no impact on the price differential unless it affects the determination of  $\tau_t^*$  and  $s_t$ . Using the information in Table 1, both the  $\tau_t^*$  and  $s_t$  over the period of

---

1/ The official and parallel exchange rates were unified in March 1992 in the context of an inter-bank market system.

2/  $\tau_t^*$  in this paper is defined as the difference between world price and domestic price. In CFA franc countries, oil taxation is a major part of this difference.



1986-93 can be calculated. While  $r^*$  had been relatively stable,  $s$  (for premium gasoline) had increased rapidly from ₦ 0.1 per liter in 1986 to about ₦ 4.5 in 1993.

An inference can be made about the trend of oil smuggling from Nigeria to neighboring countries by looking at the evolution of the oil price differential. Assuming that the quantity of smuggling is an increasing function of the price differential, we would expect smuggling to have increased during this period. Estimates for Benin confirm this conjecture. Unrecorded oil imports from Nigeria to Benin are estimated to have increased from about 33,900 metric tons (20 percent of total oil consumption in Benin) in 1986 to some 133,200 metric tons (68 percent of total consumption) in 1991 (Table 2). 1/ In Cameroon, it is also estimated that up to 17 percent of the domestic oil consumption consisted of illegal imports from Nigeria in the early 1990s. 2/

The empirical evidence reviewed in this section begs further questions. How do the more basic economic factors, especially fiscal policies, interact with each other, and under what conditions to generate the observed pattern of oil price differentials in the region? To answer these questions, a model is outlined in the next section, which provides the analytical framework for discussing the relationship between macroeconomic policies and oil smuggling.

### III. The Model

Consider an economy consisting of a household and a government sector. In each period, the household sector is endowed with a fixed quantity of oil,  $y$ , which is exported at the prevailing world market price,  $P^W$ . The government sector gets a fraction of the export receipts,  $T = \alpha P^W y$ , through taxation (at tax rate  $\alpha$ ), and imports oil for domestic sale. It sets the domestic sale price,  $P^N$ , and cannot distinguish between purchases for genuine domestic consumption and for smuggling. 3/ To simplify the

---

1/ Retail prices of petroleum products in Benin are among the lowest in CFA countries (see Table 1). Unrecorded oil imports in Table 2 thus can be safely attributed to smuggling from Nigeria.

2/ Estimates from Cameroon's Ministry of Industrial Development and Commerce.

3/ Alternatively, the government runs an oil company. The household sells  $y$  to the oil company in each period at the world price,  $P^W$ , and pays an income tax to the government. The oil company sells oil at home at  $P^N$  and exports the remaining oil to the world market. Both paradigms are equivalent. As in Johnson (1987), there are three countries in the model: the home country, a neighboring country, and the rest of the world. The largest share of trade of both the home and neighboring country is with the rest of the world.

Figure 1. Nigeria and Neighboring Countries  
Petroleum Price Differentials, 1986-93 1/



Source: Table 1.

— Benin-Nigeria    ■ Cameroon-Nigeria    ■ Chad-Nigeria    — Niger-Nigeria

1/ In CFA franc terms, at parallel exchange rate (interbank rate before January 1989 and bureaux rate in 1989-93).

notation, it is assumed that the world price prevails in the neighboring countries. Noting  $P^N = eP^W - s$ , the price differential in foreign currency terms,  $q$ , thus is:

$$q = P^W - \frac{P^N}{e} = \frac{s}{e}. \quad (2)$$

Clearly,  $q$  in (2) captures the home country component of the price differential as described in equation (1). Over time, the change of  $q$  depends on the rate at which oil subsidy changes,  $\omega$ , and the rate of depreciation of the home currency,  $\epsilon$ .

$$\dot{q} = (\omega - \epsilon)q, \quad \omega = \frac{\dot{s}}{s}, \quad \epsilon = \frac{\dot{e}}{e}, \quad (3)$$

where a dot over a variable represents the time derivative of the variable. The quantity of smuggling,  $x$ , can be postulated as a function of the price differential,  $q$ . 1/

$$x = x(q), \quad x' > 0, \quad x'' < 0. \quad (4)$$

The Government's budget constraint can be written as follows:

$$\dot{M} = G - \alpha e P^W y + e P^W [x(q) + c] - P^N [x(q) + c]. \quad (5)$$

where  $\dot{M}$  is the change in the monetary base,  $G$  is public expenditure and  $c$  represents the volume of domestic oil consumption. The first two terms in (5) are the underlying fiscal balance excluding the Government's domestic oil operation. The third and fourth terms represent the cost of and revenue from domestic oil sale, respectively. Oil subsidy, implicit in (5), appears as the loss of revenue to the Government. These two terms vanish when  $P^N = eP^W$ . Note that total domestic sale comprises the amount for

1/ The smuggling function can be derived as follows. Let  $\pi$  and  $h(\cdot)$  be the profit and transaction cost (other than the cost of buying oil at the official gas pump in the home country) schedule of smuggling.  $h$  is increasing and convex in  $x$ ,  $h_x > 0$ ,  $h_{xx} > 0$ . Solving the smuggler's profit maximization problem

$$\text{Max } \pi = qx - h(x)$$

yields equation (3). Note that a tightening of border controls would shift up the cost schedule.

domestic consumption,  $c$ , and that for smuggling,  $x$ . In the rest of the paper,  $c$  is assumed to be constant and independent of the oil smuggling. 1/ Using the definition of  $P^N$  and  $T$ , (5) can be rewritten as

$$\dot{M} = G + s[x(q) + c] - T. \quad (5')$$

Equation (5') indicates that the implicit oil subsidy in (5) is equivalent to an explicit expenditure item. To simplify the analysis, equation (5) abstracts from debt financing of the fiscal deficit, which is assumed to be covered entirely by money creation,  $\dot{M}$ . We also assume that the monetary authorities do not intervene in the foreign exchange market, and there is a unified floating exchange rate. 2/ The right hand side of (5') solely determines money supply in the economy. 3/

We make simplifying assumption a la cash-in-advance constraint, i.e. money serves only as a medium of exchange, the income velocity of circulation is unitary. 4/ We further assume national output,  $y$ , to be constant over time. Together these assumptions imply that the demand for real monetary balances,  $\bar{L}(y)$ , will be constant over time. 1/ The money market equilibrium condition is:

$$\frac{M}{P} = \bar{L} \left( \frac{1}{y} \right). \quad (6)$$

Note that this condition implies that the rate of inflation,  $\dot{P}/P$ , is equal to the growth rate of money,  $\dot{M}/M$ . The exchange rate of the home currency,  $e$ , thus can be expressed in terms of the general price levels at home,  $P$ , and abroad,  $P^*$ :

Equation (7) states that the money market equilibrium condition (6) holds at home and in the neighboring country. It shows that the equilibrium exchange rate depends on nominal money supplies and demand for real balances

1/ In a more satisfactory treatment, domestic consumption of oil should be derived from more basic assumptions and could be affected by the relative prices between oil and other goods that enter the consumer's utility function. This paper abstracts from these complications because added complexities would not alter the basic results of the paper.

2/ The implications of relaxing this assumption is discussed in Section IV.

3/ For extensive discussion of the monetary implication of the government's budget constraint, see, for instance, Frenkel and Razin (1987); Bruno and Fisher (1990) discusses the role of expectation and multiple equilibria.

4/ See Clower (1967). Svensson (1985) reviews earlier papers that have used such an assumption.

$$e = \frac{P}{P^*} = \frac{M}{M^*} \left( \frac{\frac{*}{L}}{\frac{L}{L}} \right). \quad (7)$$

at home and abroad. <sup>1/</sup> To further simplify the analysis, we assume that the foreign price,  $P^*$ , is constant and equal to one. Equation (7) therefore implies  $e=P$  and the home currency depreciation equation rate,  $\epsilon$ , is equal to the growth in money:

$$\epsilon = \frac{\dot{M}}{M}. \quad (8)$$

Equations (2)-(8) indicate that over time, changes in the oil price differential,  $\dot{q}$ , depend on, among other things, the Government's policy on oil subsidies,  $\omega$ , real tax revenue,  $\tau$ , real public expenditure (excluding oil subsidies),  $g$ , and the oil price differential,  $q$ .

$$\dot{q} = [\omega - \phi(q; g, \tau, c, m)]q, \quad \phi(.) = \frac{g+q[x(q)+c]-\tau}{m}, \quad (9a)$$

where  $g=G/P$ ,  $\tau=T/P$ ,  $m=M/P$ . The function  $\phi(.)$ , which is from equation (5), represents the growth rate of money. From equations (6)-(8), it is also equal to the inflation rate and the depreciation rate of the home currency. It can be noted that seigniorage,  $\dot{M}/P$ , is equal to  $\phi m$ . It can be verified that  $\phi(.)$  has the following properties:

$$\frac{\partial \phi}{\partial q} > 0, \quad \frac{\partial \phi}{\partial g} > 0, \quad \frac{\partial \phi}{\partial \tau} < 0, \quad \frac{\partial \phi}{\partial c} > 0, \quad \frac{\partial \phi}{\partial m} < 0. \quad (9b)$$

Equation (9) relates the evolution of the oil price differential to government policies and implicitly exogenous variables such as world oil price and the transaction cost of smuggling. As is evident, fiscal policy plays a central role in the system. How the system operates and its stability depend on the Government's policies, particularly with respect to the subsidization and pricing of oil. Once the equilibrium oil price

---

<sup>1/</sup> Implicitly we make the assumption of purchasing power parity (PPP). If one believes PPP only holds for the tradable goods, then the equilibrium exchange rate will also depend on the relative price structure in both home and foreign countries (see Dornbusch (1988), Chapter 8). In such a case, equation (7) implicitly assumes a stable relative price structure in both home and foreign countries.

differential is determined in the system, oil smuggling can be derived according to equation (4). The evolution of prices and exchange rates can be readily obtained.

#### IV. Government Policies and Smuggling

##### 1. Fixing the domestic oil price and fiscal policy

The model developed in the previous section can be closed by specifying the Government's policy on oil subsidies. Under a policy of fixing the retail prices of petroleum products, an oil subsidy is implicit, and its rate of change,  $\omega$ , is essentially endogenous. Recall that the oil price  $P^N$  is equal to the difference between world oil prices in home currency terms,  $eP^W$ , and the oil price subsidy,  $s$ . Differentiating  $P^N$  with respect to time gives

$$\omega = \left( \frac{P^W}{q} \right) \left[ \epsilon + \frac{\dot{P}^W}{P^W} - \frac{\dot{P}^N}{eP^W} \right]. \quad (10)$$

Strictly fixing  $P^N$  and assuming a stable  $P^W$ , equation (11) thus implies indexing the oil subsidy on the exchange rate with the oil subsidy increases faster than the rate at which the exchange rate depreciates.

$$\omega = \left( \frac{P^W}{q} \right) \epsilon, \quad \left( \frac{P^W}{q} \right) > 1 \quad \text{for } P^N > 0, s > 0. \quad (11)$$

Substituting (11) into (9a), the dynamic system (9) becomes

$$\dot{q} = (P^W - q) \phi(q; g, \tau, c, m). \quad (12)$$

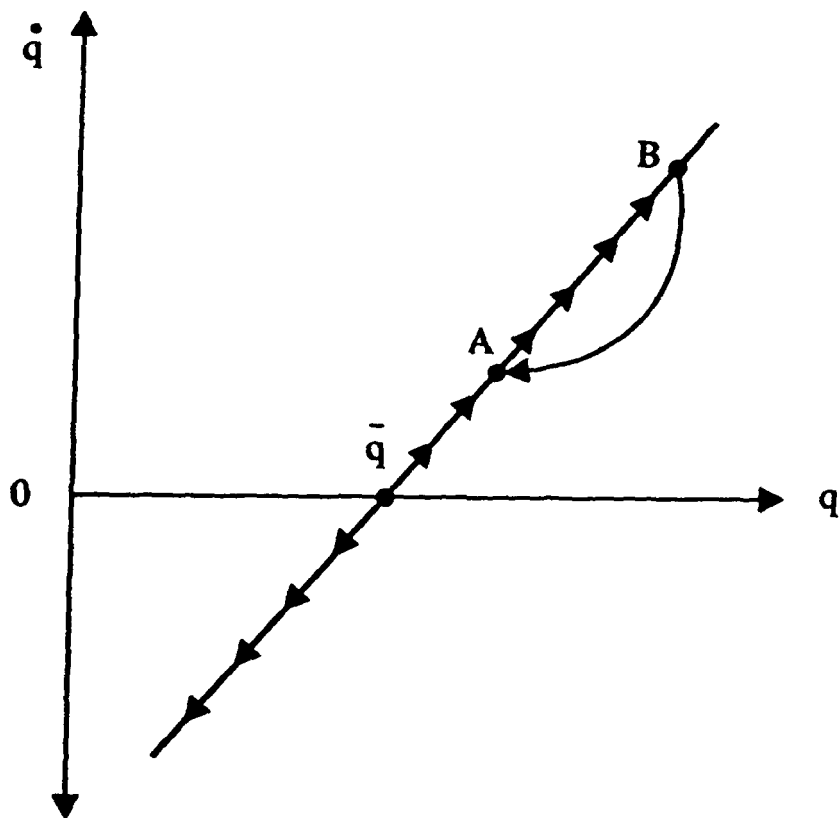
The system (12), depicted in Figure 2, is inherently unstable because

$$\left. \frac{\partial \dot{q}}{\partial q} \right|_{q=\bar{q}} = (P^W - \bar{q}) \frac{\partial \phi}{\partial q} > 0. \quad (13)$$

The derivatives in (13) are evaluated at the steady state  $\bar{q}$ . Since the oil price  $P^N$  cannot be zero and assuming a non-negative oil subsidy,  $(P^W - q) > 0$ ,  $\partial \phi / \partial q > 0$  follows from (9b).

Assuming initially,  $P^N = eP^W$ , which implies no implicit subsidy and no smuggling, several observations follow:

Figure 2  
Fixing the Oil Price and Fiscal Policy



(1) If the underlying fiscal stance is expansionary,  $G-T > 0$ ,  $\phi > 0$ , the exchange rate would depreciate. Under a policy of fixing  $P^N$ , a subsidy emerges, so does smuggling;

(2) The implicit subsidy and smuggling can be kept from increasing only when the fiscal position is in balance, i.e., when  $G+s[x(\bar{q})+c]=T$ , and hence  $\phi=0$ . The economy is at the stationary point  $\bar{q}$  in Figure 2.

(3) The magnitude of smuggling affects the fiscal position negatively. The larger the smuggling, the larger the subsidy expenditure or revenue loss [recall equation (5)].

(4) Expansionary financial policies combined with strictly fixing  $P^N$  produce a vicious circle: monetary financing of the fiscal deficit leads to inflation and currency depreciation, which results in a even higher rate of increase of the oil subsidy, more smuggling, and a larger fiscal deficit. The economy moves from point A to B in Figure 2.

(5) The widening of macroeconomic imbalances eventually may force the Government to adjust the oil price upward so that the implicit oil subsidy will be reduced [recall equation (10)], moving the economy from point B back to A. Without a fundamental fiscal correction and reform of the oil pricing policy, however, a new cycle begins.

These observations may explain to a large extent what has happened in Nigeria in the past several years. Between 1986 and 1988, domestic sale prices of petroleum products in Nigeria were held broadly unchanged. As the fiscal deficit widened from the equivalent of 4 percent of GDP to 13 percent of GDP during this period, broad money growth accelerated from 3 percent in 1986 to an annual rate of 43 percent in 1988 (Table 3). By the end of 1988, inflation rose to 65 percent and the rate of depreciation of the naira against the U.S. dollar reached an annual rate of 46 percent in the interbank market. This led to an upward adjustment of retail prices of petroleum products in 1989. A similar experience was repeated in 1989-1990 and 1991-1993 (oil price adjustment in November 1993), although tempered by other factors, especially the improvement of the terms of trade in 1989-1990.

## 2. Adjusting the domestic oil price

An upward adjustment of  $P^N$  reduces the implicit oil subsidy. Increasing the rate at which  $P^N$  is raised, according to equation (10), reduces the growth rate of subsidy,  $\omega$ . To the extent that  $\omega$  depends on the Government's oil pricing policy,  $\omega$  could be treated as exogenous, we thus have a stable system as depicted in Figure 3.

Over the period 1986-1992, retail prices of premium gasoline in Nigeria moved up in a step-wise fashion (Table 1). The price doubled from N 0.2 per liter in 1985 to N 0.4 in 1986. The price was adjusted upward again by 50 percent in 1989 and by about 20 percent in 1991. As the rate at which  $P^N$



$$\frac{\partial q}{\partial \bar{q}} \bigg|_{q=\bar{q}} = -\frac{\partial \phi}{\partial q} < 0. \quad (14)$$

was adjusted decelerated,  $\omega$  increased. Increasing  $\omega$  shifts the curve DD in Figure 3 to the right to D'D'. The new steady state is  $\bar{q}'$ ,  $\bar{q}' > \bar{q}$ . The oil price differential shows an increasing trend. The pattern of oil price adjustment thus may contribute to the enlargement of the oil price differential over the period.

In the special case in which the oil price is adjusted so that the growth rate of subsidy,  $\omega$ , is always equal to the exchange rate depreciation,  $\epsilon$ , an increase in real government expenditure,  $g$ , and/or an erosion in real tax revenue,  $\tau$ , owing for instance, to a decline in the world oil price, would enlarge the fiscal imbalance, pushing up inflation and currency depreciation. Assuming initially  $q > 0$ , and hence smuggling  $x > 0$ , repeated increases in  $g$  and/or reduction in  $\tau$  bring the economy to a higher inflationary path, while smuggling persists.

Before concluding this section, it would be useful to point out the implications of relaxing some of the assumptions of the analysis. It has implicitly been assumed so far in this paper that transaction cost schedule for smuggling,  $h(x)$ , is stable. An upward shift in the cost schedule, owing perhaps to tighter border controls, could lead to a rising price differential because a higher  $q$  is needed for the same level of smuggling. If the demand for real monetary balances in the economy,  $L(\cdot)$ , is not constant and depends on inflation expectation, the higher the inflation, the smaller the real balances,  $L(\cdot) = m$ . Recall that seigniorage is equal to  $\phi m$ . As the "base" for inflation tax,  $m$ , shrinks, the "tax rate",  $\phi$ , has to increase to finance the same level of real fiscal deficit. Under the policy of fixing the oil price, the system depicted in Figure 2 becomes more unstable. The analysis in section IV.1. thus is reinforced.

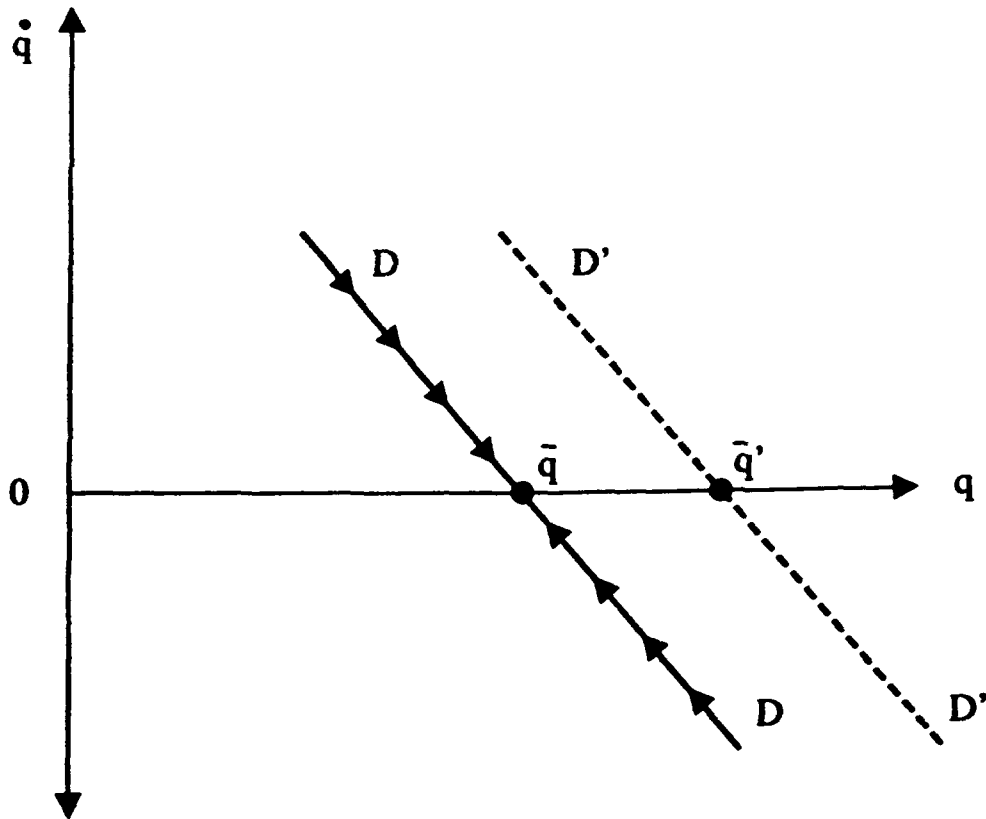
### 3. Fixing the official exchange rate

So far, we have assumed that there is a unified floating exchange rate in the country. Relaxing this assumption may imply a dual or multiple exchange rate regime. Assume that the Government introduces a fixed exchange rate and defends it through exchange restrictions and rationing. <sup>1/</sup> In this case, the official foreign exchange reserves would not change and domestic money supply would still be determined by equation (5). Let  $e$  and  $\theta$  denote the parallel and official exchange rate

---

<sup>1/</sup> Typically, an economy experiencing financial imbalances may not have adequate official reserves to meet the demand for foreign exchange at a fixed (overvalued) exchange rate. As a result of exchange restrictions imposed by the government in response to such a situation, a parallel market for foreign exchange develops.

Figure 3  
Changing  $\omega$  and Oil Price Differential



respectively, and maintain the assumption that PPP holds for goods in each market and foreign prices are constant and normalized to be one. The aggregate price level,  $P$ , can be expressed as expenditure-weighted function of the prices in the free and official markets,  $P=P(e,\theta)$ . Assuming the expenditure share of the free market is  $\beta$ ,  $\beta < 1$ . Then  $P=e\beta\theta^{1-\beta}$ . The parallel exchange rate thus is related to the domestic inflation and the money supply in the following way:

$$\beta\epsilon = \frac{\dot{P}}{P} = \frac{\dot{M}}{M}. \quad (15)$$

When  $\beta=1$ , equation (15) reduces to (8). Using (15), system (9) becomes

$$\dot{q} = [\omega - \phi(q; g, \tau, c, m)(\beta^{-1})]q \quad (16)$$

It is clear that (14) and (9) behave in essentially the same way and our analysis on the effects of fixing the oil price and fiscal policy would remain the same. The narrower the parallel market (for a smaller  $\beta$ ), the faster the parallel exchange rate depreciates, given the underlying financial and oil pricing policies, and sooner the Government has to abandon the previous oil prices (recall section IV.1). Fixing the official exchange rate thus would not reduce smuggling.

#### 4. Currency devaluation in the neighboring countries

The model can be extended to take into account the impact of exchange rate and oil pricing in the neighboring countries. Recall  $P^B=e^*P^W+\tau^*$  [eq. (1)]. Given the retail prices of petroleum products in the neighboring countries, a devaluation of  $e^*$  would reduce the oil tax there. According to (1), the oil price differential would narrow, thereby reducing smuggling. A different and opposite effect is that a given oil subsidy in the home country would become larger in foreign currency terms as the foreign currency depreciates. Anecdotal evidence in Nigeria in early 1994 suggests that the former effect may be important. Over the longer term, in the absence of a fundamental change in the oil pricing policy and sufficient fiscal adjustment in the home country, domestic inflation and currency depreciation would continue, the home country component of the price differential,  $q$ , would rise and smuggling would increase. It should be noted that an upward adjustment of oil retail prices in the neighboring countries to pass through the effect of devaluation, according to our analysis, is equivalent to maintaining the oil tax. It would not help narrow the oil price differential and contain smuggling.

## V. Concluding Remarks

In this paper, a model has been developed linking macroeconomic policies to smuggling. The analysis complements the existing literature on smuggling by examining the phenomenon of unofficial border trade activities in the context of a macroeconomic model. The study is motivated by the observations on illegal oil trade between Nigeria and its neighboring countries in West Africa. A number of policy implications of the analysis could be noted. The analysis highlights that oil smuggling in Nigeria is closely related to the stance of fiscal policy and oil pricing policies.

Contrary to the belief that controlling domestic oil prices may help lower inflation, our analysis suggests that it actually contributes to higher inflation and faster currency depreciation, than if oil prices were at world market levels. Maintaining domestic oil prices below the export parity is an extremely inefficient way to subsidize the domestic consumption of oil. In addition to the waste associated with the low prices, it provides rent to the smugglers and worsen the country's financial imbalances. A one-time upward adjustment of the oil price, in the absence of sufficient fiscal adjustment, does not solve the smuggling and the attendant macroeconomic problems in the longer term. Adjusting the retail price of oil in line with domestic inflation and exchange depreciation would help contain the implicit oil subsidies.

On exchange rate policy, the analysis underscores the fundamental importance of fiscal adjustment in achieving exchange rate stability. Fixing the official exchange rate at an appreciated level, as the authorities in Nigeria recently did, would not reduce smuggling because the official exchange rate is not relevant for the smugglers' profit calculation, and it has a direct and adverse impact on exporters in the formal sector. Devaluation of the CFA franc would not have a lasting effect in reducing smuggling, so long as fundamental financial adjustment remains to be achieved in Nigeria. Finally, our analysis reveals the close linkages among financial, exchange rate, and pricing policies. Hence, a coordinated policy package, including particularly timely adjustment of oil prices supported by large reduction of fiscal imbalances and a market-based exchange rate, would enhance the effect of stabilization efforts in Nigeria.

Important questions such as the impact of oil subsidy/smuggling on national welfare and price and output structures are not addressed in this paper. A general equilibrium analysis, explicitly taking into account the interactions of economic structures and policies in both Nigeria and her neighbors thus would be relevant and interesting. The analysis in this paper is a step toward such an inquiry.

Table 1. Nigeria and Neighboring Countries: Consumer Prices of Premium Gasoline, 1986-1993

	1986	1987	1988	1989	1990	1991	1992	1993
(In local currency per liter)								
Nigeria	0.4	0.4	0.4	0.6	0.6	0.7	0.7	1.1
Benin	175.0	175.0	175.0	175.0	175.0	175.0	175.0	175.0
Cameroon	185.0	190.0	220.0	280.0	280.0	190.0	195.0	195.0
Chad	290.0	290.0	290.0	290.0	290.0	290.0	290.0	290.0
Niger	280.0	280.0	254.0	263.0	263.0	263.0	263.0	263.0
(In percent of world price)								
Nigeria								
At official exch. rate	173.8	63.1	68.4	48.5	34.0	38.5	22.5	32.4
At parallel exch. rate	84.0	60.7	51.4	34.0	28.4	28.5	19.1	19.7
Benin	390.1	373.7	434.2	326.6	292.5	338.0	372.6	391.9
Cameroon	412.4	405.8	545.8	522.6	468.0	367.0	415.2	436.7
Chad	646.5	619.3	719.5	541.3	484.7	560.1	617.4	649.4
Niger	624.2	598.0	630.1	490.9	439.6	508.0	559.9	588.9
(Price differential per liter, in CFA francs)								
At official exch. rate								
Benin-Nigeria	97.1	145.4	147.4	149.0	154.7	155.1	164.4	160.6
Cameroon-Nigeria	107.1	160.4	192.4	254.0	259.7	170.1	184.4	180.6
Chad-Nigeria	212.1	260.4	262.4	264.0	269.7	270.1	279.4	275.6
Niger-Nigeria	202.1	250.4	226.4	237.0	242.7	243.1	252.4	248.6
At parallel exch. rate								
Benin-Nigeria	79.2	102.7	125.3	144.1	146.0	153.2	161.3	166.0
Cameroon-Nigeria	89.2	117.7	170.3	249.1	251.0	168.2	181.3	186.0
Chad-Nigeria	194.2	217.7	240.3	259.1	261.0	268.2	276.3	281.0
Niger-Nigeria	184.2	207.7	204.3	232.1	234.0	241.2	249.3	254.0
Memorandum items:								
World price 1/								
CFAF per liter	44.9	46.8	40.3	53.6	59.8	51.8	47.0	44.7
US\$ per liter	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2
Exchange rates 2/								
Official								
Naira/US\$	1.8	4.0	4.5	7.4	8.0	9.9	17.3	22.1
CFAF/US\$	346.3	300.5	297.9	319.0	272.3	282.1	264.7	283.2
CFAF/Naira	197.3	74.8	65.6	43.3	33.9	28.5	15.3	12.8
Parallel 3/								
Naira/US\$	3.6	4.2	6.0	10.5	9.6	13.4	20.4	36.2
CFAF/Naira	95.4	72.0	49.3	30.3	28.4	21.1	13.0	7.8

Sources: International Financial Statistics, Petroleum Market Intelligence; various issues.

1/ This reference price is calculated based on the export price of Nigeria's crude oil, and the average ratio of US Gulf Coast gasoline to West Texas crude in 1991-1993.

2/ Period average.

3/ Parallel rate refers to interbank rate before January 1989 and bureaux rate in 1989-1993.

Table 2. Benin: Oil Consumption and Unrecorded Oil Imports  
1986-1991

	1986	1987	1988	1989	1990	1991
(In thousands of metric tons or unit indicated)						
Local Sales of petroleum products 1/	134.8	122.2	110.3	89.9	74.2	63.3
Estimated unrecorded petroleum imports	33.9	50.7	66.5	89.3	109.8	133.2
Estimated consumption of petroleum products 2/	168.7	172.9	176.8	179.2	184.0	196.5
Unrecorded imports in total consumption 3/	20.1	29.3	37.6	49.8	59.7	67.8
Memorandum items:	(In million of barrel)					
Production of crude oil	1.8	1.9	1.4	1.3	1.4	1.4
Exports of crude oil	1.8	1.9	1.7	1.4	1.3	1.4

Sources: Société Nationale de Commercialisation des Produits pétroliers (SONACOP), Société Beninoise d'Electricité et d'Eau (SBEE); and Seme oil project.

1/ Through official SONACOP distribution channels.

2/ IMF staff estimates.

3/ In percent.

Table 3. Nigeria: Selected Macroeconomic Indicators, 1986-1993

	1986	1987	1988	1989	1990	1991	1992	1993
(In percent of GDP)								
Government finance								
Overall fiscal balance	-4.3	-7.4	-13.1	-6.9	-2.9	-6.8	-8.0	-17.5
Domestic bank financing	-1.1	2.2	4.2	-4.1	1.1	4.0	8.5	12.7
(Annual percentage changes)								
Broad money	2.7	22.7	43.3	6.1	40.0	33.8	51.2	51.9
Consumer prices 1/	12.8	20.4	64.7	44.7	3.5	23.0	48.8	61.3
Exchange rate 2/								
Official	-0.7	-19.9	-22.6	-30.0	-15.0	-8.7	-49.8	-10.2
Parallel 3/	...	-26.5	-45.8	-12.8	-7.3	-34.1	-34.2	-49.0
Memorandum item:								
Retail price of premium gasoline (naira/liter)	0.4	0.4	0.4	0.6	0.6	0.7	0.7	1.1

Sources: International Financial Statistics, IMF occasional paper (forthcoming) "Nigeria: Experience with Economic Adjustment, 1981-1993."

1/ End of period.

2/ Naira/US dollar exchange rate; "--" represents depreciation, in local currency terms from December in the preceding year to December in the current year.

3/ Interbank rate before January 1989 and bureaux rate in 1989-1993.

### References

- Bhagwati, J. and B. Hansen, 1973, "A theoretical analysis of smuggling," Quarterly Journal of Economics 87, 172-87.
- Bruno, M. and S. Fisher, 1990, "Seigniorage, operating rules, and high inflation trap," Quarterly Journal of Economics 105, 353-374.
- Clower, R., 1967, "A reconsideration of the microeconomic foundation of monetary theory," Western Economic Journal 6, 1-8.
- Dornbusch, R., 1988, Exchange Rate and Inflation, The MIT Press, Cambridge, Massachusetts.
- Frenkel, J. and A. Razin, 1987, Fiscal Policies and World Economy, The MIT Press, Cambridge, Massachusetts.
- Johnson, O., 1987, "Trade tax and exchange rate coordination in the context of border trading: A theoretical analysis," IMF Staff Papers 34, 548-564.
- Macedo, J., 1987, "Currency inconvertibility, trade taxes and smuggling," Journal of Development Economics 27, 109-125.
- Martin, L. and A. Panagariya, 1984, "Smuggling, trade, and price disparity: a crime-theoretic approach," Journal of International Economics 17, 201-218.
- Norton, D.A.G., 1988, "On the economic theory of smuggling," Economica 55, 107-118.
- Lizondo, J., 1987, "Unification of dual exchange markets," Journal of International Economics 22, 57-77.
- Pitt, M., 1981, "Smuggling and price disparity," Journal of International Economics 11, 447-458.
- Sheikh, M., 1974, "Smuggling, production and welfare," Journal of International Economics 4, 355-364.
- Stolper, W. and A. Deardorff, 1990, "Effects of smuggling under African condition: A factual, institutional and analytic discussion," Weltwirtschaftliches Archiv 126, 116-141.
- Svensson, L., 1985, "Money and asset prices in a cash-in-advance economy," Journal of Political Economy 93, 919-944.
- Thursby, M., R. Jensen, and J. Thursby, 1991, "Smuggling, camouflaging, and market structure," Quarterly Journal of Economics 426, 789-814.