

**TERMS OF TRADE AND THE REAL EXCHANGE RATE IN THE CFA ZONE:
IMPLICATIONS FOR INCOME DISTRIBUTION IN NIGER**

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1. INTRODUCTION

Dependence on primary commodity exports characterizes the economies of a number of countries in sub-Saharan Africa. During most of the 1970s, when commodity prices reached historic highs, real incomes rose along with exports in Cote d'Ivoire (cocoa and coffee), Cameroon (petroleum), and Guinea (bauxite). Subsequent reversals in the terms of trade contributed to balance of payments crises and led to the adoption of stabilization and structural adjustment measures. For Niger, a sharp increase in both the volume and price of uranium exports in the 1970s spurred an economic boom. Subsequent declines in uranium earnings in the early 1980s combined with drought and macroeconomic reforms in Niger's large neighbor to the south, Nigeria, to reduce foreign exchange earnings, real incomes and the stock of wealth.

Structural adjustment measures in Niger in the 1980s involved a combination of efforts to reduce government budget deficits, limit bank credits to the domestic economy, decontrol prices and liberalize agricultural markets. Exchange rate devaluation, a central aspect of the adjustment process in most countries of sub-Saharan Africa, was not an option in Niger, a member of the CFA (Communauté Financière Africaine) zone.¹ Nevertheless, movements in the real exchange rate, both vis à vis Niger's trading partners in officially recorded trade as well as vis à vis Nigeria, played an important part in determining economic incentives throughout the economy and the distribution of income.

In this chapter, we analyze the impacts of changes in external conditions and government policies on real incomes of various household groups in Niger using a computable general equilibrium (CGE) model. After a brief overview of major developments in Niger's economy in the 1970s and 1980s, we describe the CGE model and the data base. A set of six simulations follow, focusing on the effects of the decline in uranium revenues that occurred between 1987 and 1990, the impacts of government policy and the role of real exchange rate movements in influencing income distribution in Niger. The concluding section discusses implications of real exchange rate movements in the light of the debate surrounding a possible devaluation of the CFA franc.

¹ The value of the CFA franc is fixed at 50 FCFA per French franc under rules of the franc zone.

2. STRUCTURAL ADJUSTMENT IN NIGER

Niger is one of the poorest members of the CFA zone, having a per capita income of only 300 dollars (1991) per person (World Bank 1993). More than two-thirds of the country is located in the Sahara desert of West Africa. Ninety percent of its population of 7.25 million live in a narrow band along the Niger river in the southwest corner of the country or within 150 kilometers of the country's southern border with Nigeria.

Although the country has important mineral resources, in particular uranium, the economy remains dominated by agricultural and livestock activities, which produced 35 percent of GDP in 1987. Millet and sorghum are the major food staples, accounting for 80 percent of area cultivated in 1989. Livestock, cowpeas and onions are exported (mainly to Nigeria). The share of the mining and industrial sector is small — only 15 percent (Table 1).²

Formal sector enterprises (those registered for tax purposes by completing a *declaration statistique et fiscale* [DSF]) dominate the mining, energy, industry, modern construction, transport and communications sectors. Informal sector activities (mainly agriculture, livestock, trade) account for more than two-thirds of GDP.

During the eighties, Niger experienced an economic crisis largely as a result of four external shocks: a fall in uranium export revenues, reduced foreign capital inflows, drought, and adverse effects of economic fluctuations in neighboring Nigeria.

The expansion of world demand for uranium in the seventies, linked to the steep rise in petroleum prices in these years, boosted uranium prices and exports for Niger. The value of Niger's uranium exports increased from 2.0 billion FCFA in 1971 to 100.8 billion FCFA in 1980, when they accounted for 74 percent of Niger's export revenues. With additional uranium revenues as collateral, the government of Niger (and parastatals) were able to borrow heavily on world markets, greatly increasing foreign capital inflows into Niger and spurring domestic investment. From 1978 to 1980, the modern sector's share of GDP rose rapidly from 15 to 25 percent.

During the 1980s, however, world supply of uranium grew faster than a stagnating demand. Niger's export receipts fell as quantities exported declined between 1981 and 1985. And beginning in 1987, Niger's contract price negotiated with French importers, also dropped from 38,800 FCFA per kilogram in 1987 to 25,000 in 1989 and 20,400 in 1990 (Hugon 1990). Niger's uranium export earnings fell from a peak of 110.0 billion FCFA in 1983 to only 50.3 billion FCFA in 1992, a decline equivalent to 9.0 percent of GDP in 1992 (Figure 1).

² For more detailed discussion of the Nigerien economy, see Dorosh (forthcoming), Jabara (1991), SEDES (1987, 1988), and Horowitz et al. (1983).

Table 1 – Niger: Production Activities in the Niger SAM

SAM Subsector	National Accounts Subsector	Production	Value Added	Value Added
		FCFA billions	FCFA billions	Percentage
Grains	11	70,932	64,211	9.8
Export crops	11	23,821	18,314	2.8
Other crops	11	56,835	53,157	8.1
Livestock	12	84,772	83,441	12.7
Forestry, fish	13	23,384	22,319	3.4
Mining ^a	21	91,194	43,948	6.7
Meat processing	31	63,935	9,487	1.4
Food processing	31	17,189	7,048	1.1
Formal		10,279	3,573	0.5
Informal		6,910	3,475	0.5
Manufacturing	32-39, 41-42	84,553	41,413	6.3
Formal		56,880	22,262	3.4
Informal		27,673	19,151	2.9
Construction	51, 52	55,835	20,674	3.2
Formal		37,303	14,583	2.2
Informal		18,532	6,091	0.9
Trade	61	165,827	123,781	18.9
Formal		31,179	18,926	2.9
Informal		134,648	104,855	16.0
Transportation/communication	63, 71, 72	56,602	34,169	5.2
Formal		25,099	16,392	2.5
Informal		31,503	17,777	2.7
Private services	81, 83, 94, 95	76,920	58,928	9.0
Formal		16,576	10,745	1.6
Informal		60,344	48,183	7.4
Public services	91, 96	106,291	73,962	11.3
Total		968,089	654,852	100.0
Primary sectors		259,744	241,443	36.9
Formal industry ^b		158,353	69,783	10.7
Informal industry ^c		88,518	32,113	4.9
Formal services		110,157	60,646	9.3
Informal services		245,026	176,905	27.0
Public services		106,291	73,962	11.3
Total		968,089	654,852	100.0

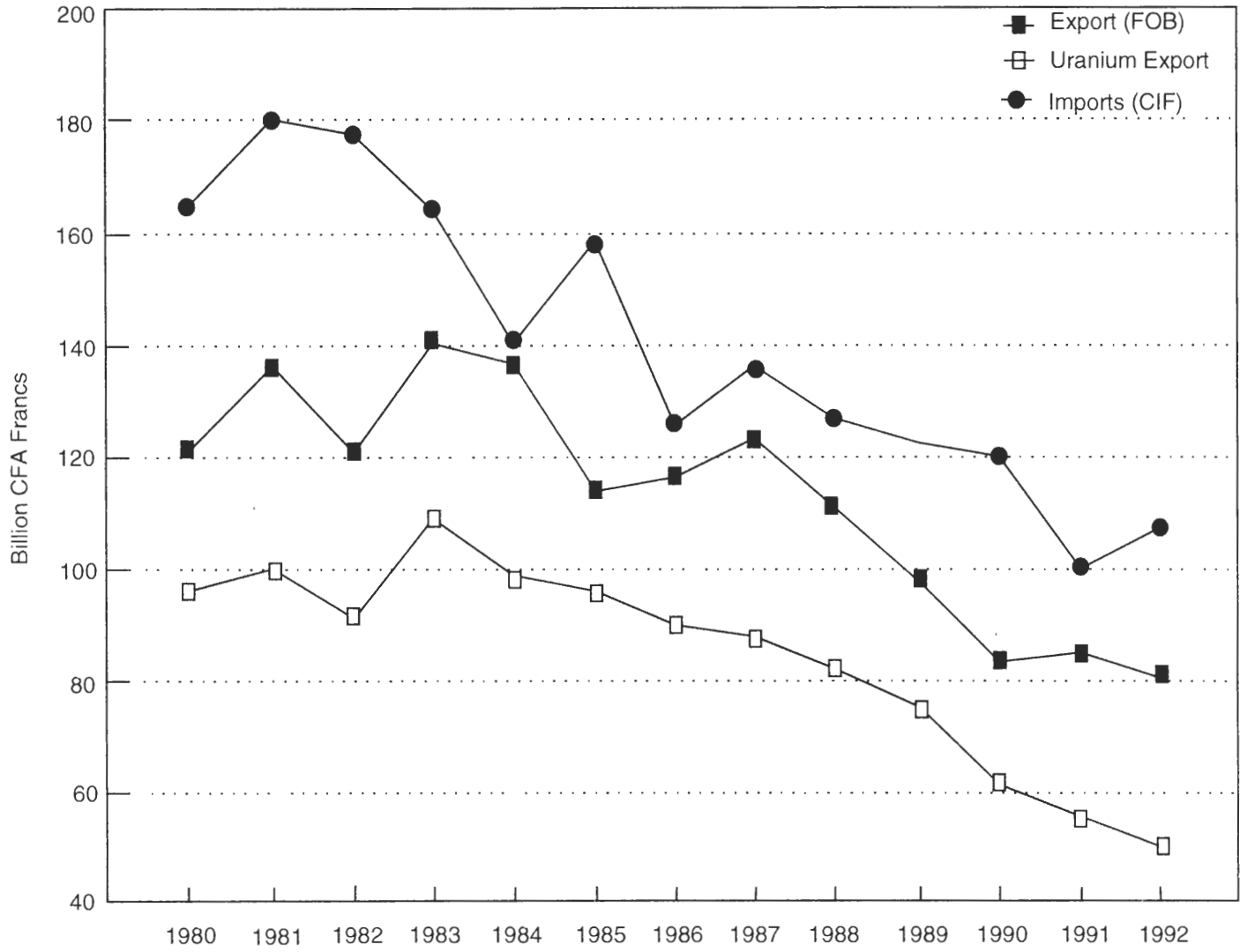
Source: Dorosh and Essama Nssah (1991).

^a Mining and meat processing subsectors include both formal and informal activities

^b Formal industry figures include informal mining activities.

^c Informal industry includes formal meat processing activities.

Figure 1 - Niger Trade Balance, 1980-1992



A stabilization program beginning in 1984 succeeded in sharply reducing imports, so that with the exception of the drought year of 1984/85, Niger's merchandise trade deficit averaged only 1.4 percent of GDP from 1984 to 1987. Between 1987 and 1992, however, export earnings fell more rapidly than imports and the merchandise trade deficit reached 5.0 percent of GDP (Table 2).

The poor performance of the uranium sector also contributed to Niger's fiscal problems, through reductions in royalties, income taxes and export duty. Fiscal revenues from the uranium sector declined from 9.8 billion FCFA in 1987 to 6.2 billion FCFA in 1990. The major explanation for the 23.6 billion FCFA increase in the government deficit between 1987 and 1990, however, was a 27.6 percent (17.2 billion FCFA) increase in government expenditures (Figure 2). More recently, political turmoil limited tax collection in 1991, and with Central Bank credit to the government near the statutory limits on borrowing, the government resorted to arrears on both domestic payments to government workers and suppliers, and on external obligations.

Related to the drop in uranium revenues and the drop in world uranium prices, was a decline in foreign capital inflows in the 1980s. Until 1975, Niger's foreign debt was fairly small although from 1970 to 1975 public and publicly guaranteed debt increased from 5 to 12 percent of GNP. Beginning in 1976, Niger used rising export revenues as collateral to greatly increase foreign borrowing, much of it from commercial banks. After 1981, Niger's ability to obtain credit on world markets declined together with the large fall in world uranium prices, and net transfers fell. Counting foreign grants, net transfers declined from 10.6 percent of GDP in 1981 to 0.3 percent in 1982. The grant component of these transfers fell as well, from 50.2 percent to 20.9 percent of budgetary receipts.

Climatic conditions were also disastrous. During the decade of the eighties, rainfall was satisfactory only in the years 1986 and 1990. 1984 and 1987 were both drought years. The drought in 1984 was especially severe, causing large declines in the livestock herd and crop production. Food production per capita fell 22 percent in 1984, but recovered in subsequent years of higher rainfall. The effects on livestock were more long-lasting: the cattle population fell 40 percent in 1984 and continued to decline until 1986 when it was 59 percent below 1983 levels.

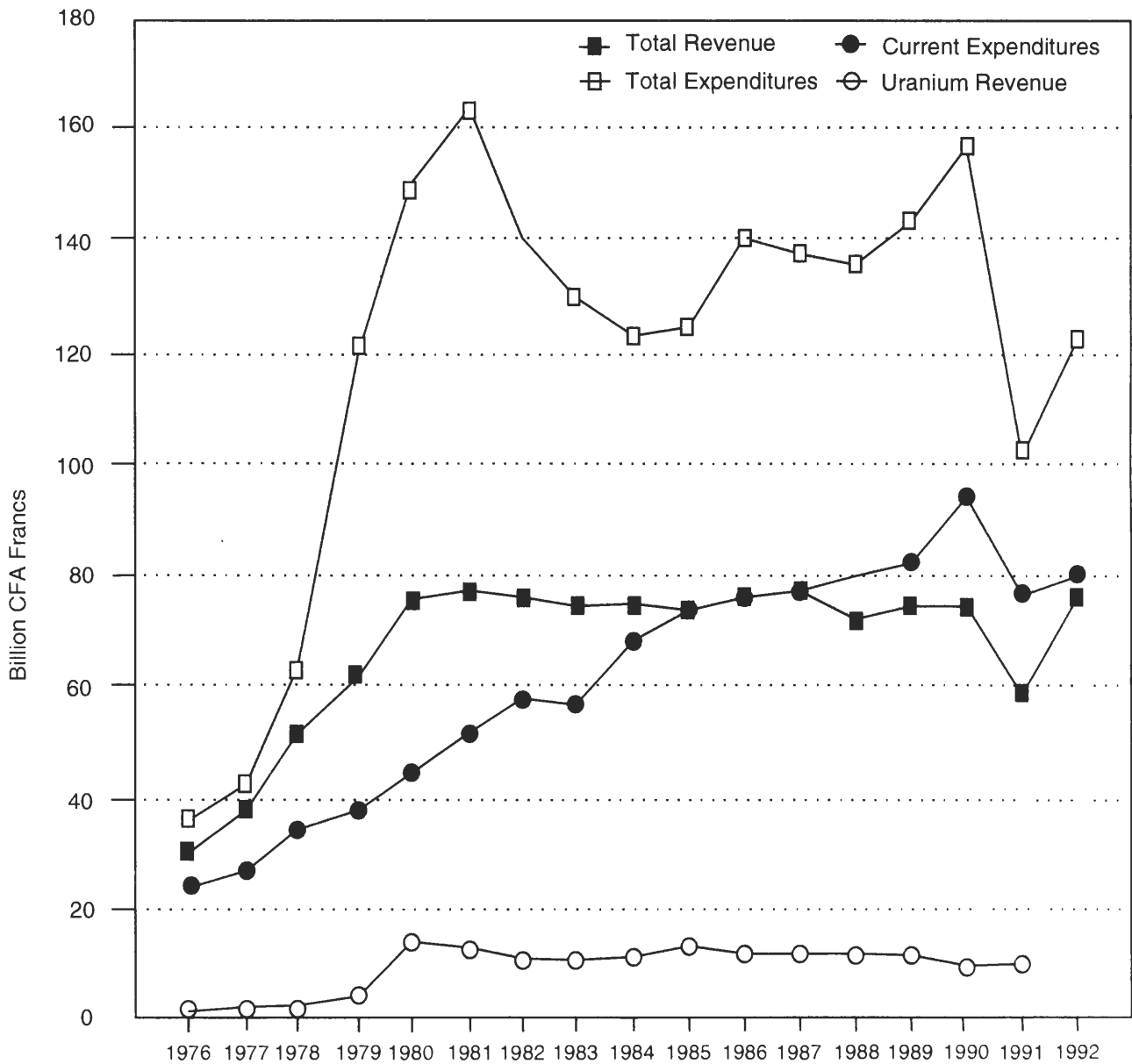
Finally, economic policies and economic conditions in Nigeria, Niger's neighbor to the south with an economy is nearly ten times as large, had large negative impacts on Niger. Niger's overall real exchange vis à vis its major trading partners, as calculated by the IMF, actually *depreciated* by 41.5 percent between 1980 and 1990, in part due to Niger's very low rate of price inflation over the period. Yet, the CFA franc *appreciated* by 113.9 percent relative to the Nigerian Naira on the parallel market during the eighties as Nigeria undertook macroeconomic reforms and devalued its currency. This movement in the bilateral real exchange rate with Nigeria diminished profitability of Niger's exports to Nigeria and encouraged imports from Nigeria, to the detriment of Niger's domestic industries and rural producers of livestock, cowpeas and onions. Declining real

Table 2 — Niger: Macroeconomic Trends, 1985-1991

	1985	1986	1987	1988	1989	1990	1991
Uranium exports							
Unit value (mn CFA/MT)	30.0	30.0	29.3	27.6	25.0	20.4	19.0
Quantity (MT)	3042	3026	2948	2966	2967	2964	2960
Value (bn CFA francs)	91.3	90.8	86.4	81.9	74.2	60.5	56.2
Uranium fiscal revenues (bn FCFA)	10.8	9.3	9.8	9.4	8.3	6.2	7.2
Total exports G&NFS (bn CFA)	135.7	130.9	139.1	140.5	129.1	114.5	114.5
Total imports G&NFS (bn CFA)	195	166.5	156.4	148.6	151.1	142.4	119.2
Trade deficit (bn CFA)	59.3	35.6	17.3	8.1	22	27.9	4.7
Trade deficit/GDP (percent)	9.2	5.4	2.6	1.2	3.2	4.1	0.7
Real GDP (bn 1987 CFA francs)	665.5	695.9	671.1	708.7	709.7	696.9	710.2
Consumer price index (1985=100)	100	96.8	90.3	89	86.5	85.8	79.1
Nominal exchange rate (FCFA/\$)	449.26	346.3	300.54	297.85	319.01	272.26	282.11
Real exchange rate index (1980=100)	83.9	79	71.8	67.7	62.8	62.1	54.2
Naira index (1980=100)	135.9	184.8	187.1	205.2	183.8	213.9	251.8

Source: IMF 1992a, Dorosh (forthcoming), IMF 1992b.

Figure 2 - Niger: Government Budget, 1976-1992



incomes in Nigeria during the eighties also reduced demand for Niger's export products. Niger's parallel market exports of textiles to Nigeria fell by an estimated 60 percent between the early 1980s and 1989 (Ministère du Plan 1991).

3. MODEL SPECIFICATIONS

The CGE model for Niger (Dorosh and Nssah 1993) is a standard neo-classical CGE model following Dervis, de Melo, and Robinson (1982). The basic structure of the CGE model is reflected in the underlying data base, a social accounting matrix (SAM), derived from the 1987 national accounts and household survey data.³

Twenty activities producing fourteen commodities are modeled (see Table 1). This level of disaggregation reflects important differences in technologies between the formal and informal sectors and the importance of certain traded goods in the economy (e.g., uranium and cowpeas). For a number of industrial goods and various services, two separate production technologies (for formal and informal sectors) are modeled, each producing the same commodity output. Thus, for these commodities, the output of the corresponding formal sector activity is treated as a perfect substitute for the production of that same commodity by the informal sector.

The model includes eight primary factors of production: skilled and unskilled labor, formal and informal capital, and four types of agricultural capital corresponding to the total value of the land, livestock, and implements of each of four rural household groups — rural north poor and nonpoor, and rural south poor and nonpoor. Ownership of cattle is used to distinguish poor and nonpoor households in rural areas and the 400 mm rainfall isohyet demarcates north and south. Three urban household types (urban nonpoor, urban poor, and semiurban)⁴ and three other institutions (formal enterprises, informal enterprises, and the government) are also included in the model. Per capita income of urban nonpoor households is 2.6 times that of the urban poor (Table 3). In all, the rural poor account for 51.4 percent of total population; the urban poor comprise only 6.4 percent.

Domestic production (value added) of each good is modeled as a constant elasticity of substitution (CES) function of land, labor and capital; quantities of intermediate inputs are assumed to be fixed shares of the quantity of output produced. Profit maximization determines demand for skilled and unskilled labor⁵ by each activity and real wages adjust to clear the labor market. In the

³ Details of the construction of the SAM are found in Dorosh and Essama Nssah (1991).

⁴ Semi-urban households are defined as those residing in cities with a 1988 population less than 50,000.

⁵ Skilled labor is defined as urban workers employed as military personnel, administrative staff, specialists, scientific personnel and office employees, using data from the population census of 1987 (see Dorosh and Nssah 1991).

Table 3 - Niger: Revenue Shares by Household, 1987

Factor income shares	Urban	Urban	Semi-	Rural	Rural	Rural	Rural	Rural
	Monpoor	Poor	urban	North Monpoor	North Poor	South Monpoor	South Poor	South Poor
Skilled labor	0.769	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	0.057	0.499	0.746	0.375	0.884	0.639	0.881	0.881
Informal capital	0.174	0.481	0.218	0.458	0.057	0.229	0.031	0.031
Land: North nonpoor	0.000	0.007	0.012	0.167	0.000	0.000	0.000	0.000
Land: North poor	0.000	0.003	0.006	0.000	0.059	0.000	0.000	0.000
Land: South nonpoor	0.000	0.007	0.013	0.000	0.000	0.131	0.000	0.000
Land: South poor	0.000	0.003	0.005	0.000	0.000	0.000	0.088	0.088
Total	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Population								
(thousands)	228.0	451.5	344.3	729.6	2188.8	1660.1	1414.2	1414.2
(percent of total)	3.2	6.4	4.9	10.4	31.2	23.7	20.2	20.2
Total income								
(million FCFA)	94.5	72.2	20.6	84.3	107.3	112.6	69.6	69.6
(percent of total)	16.8	12.9	3.7	15.0	19.1	20.1	12.4	12.4
Per Capita Income (FCFA/person)	414.5	159.9	59.8	115.5	49	67.8	49.2	49.2

Source: Dorosh and Nssah (1991).

comparative static simulations presented, labor supply is fixed.⁶ Elasticities of substitution between capital and labor are chosen to correspond with guesstimates of magnitudes for elasticities of supply, equal to 1.0 for agricultural activities, 0.1 for mining, and 0.5 for most other sectors of the economy.⁷

Both imports and exports are assumed to be less than perfect substitutes for domestic goods. For each imported commodity, we use a constant elasticity of substitution (CES) aggregation function to define the composite of imports and domestically produced goods (Armington 1969). For export commodities, a constant elasticity of transformation (CET) aggregation is used to define a composite commodity of export goods and goods produced for domestic consumption. Appendix Table 1 gives elasticities of substitution and levels of trade and domestic production for the commodities in the model. Niger is assumed to be a price taker for imports. For exports, the price elasticity of world demand (in large part from Nigeria, is 4.0).

Household incomes are determined as the sum of earnings from factors of production owned by the household (Table 3). In simulation 2, where foreign exchange is rationed, rents accrue to urban nonpoor households and consumers pay an implicit tariff on imported goods. By definition, earnings of skilled labor accrue solely to urban nonpoor households. Formal enterprises receive returns to formal sector capital. Incomes of the poor derive from unskilled labor, informal sector capital and land; by definition, the rural poor own no livestock. Consumption of each commodity is a fixed share of total expenditures for each household group (Appendix Table 2). Savings is a linear function of income.

Government recurrent and investment expenditures are fixed in real terms. Savings determines the level of private investment. The value of private (public) investment by sector of destination j is assumed to be a fixed share of total fixed private (public) investment and the composition of capital by activity is likewise fixed.

In all commodity markets, prices adjust to equate supply and demand. Labor markets also clear through adjustment in real wages. Savings determines private investment given fixed values of real government investment and government expenditure. With the nominal exchange rate and foreign savings fixed exogenously, changes in the aggregate price index bring about movements in the real exchange rate and equilibrium in the Rest of World accounts.

⁶ This differs from Dorosh and Nssah (1993) where labor supply is a positive function of the real wage.

⁷ The livestock sector is modeled with an elasticity of substitution of 1.0 to allow greater flexibility in simulating reduction of capital stock due to drought (see Dorosh and Nssah 1993).

The model solves for a sequence of solutions to the static model by updating capital stock according to the previous period's net investment by sector. Labor supply is also increased exogenously by a constant population growth rate.

4. SIMULATION RESULTS

Six simulations, analyzing various aspects of real exchange rate adjustment and fiscal policy, are presented. In each simulation, revenues from uranium exports are lowered by 25.9 billion FCFA, (equal to 3.9 percent of GDP in 1987), reflecting the fall in uranium export revenues from 1987 to 1990. Given that the quantity of uranium exports remained essentially unchanged over this period, we model the loss in revenues as an exogenous decline in capital inflows. Real government expenditures are held fixed, unless otherwise noted. Total investment in the economy (private and government) is determined by the level of total savings (private, public, and foreign). With no changes in trade or fiscal policy, adjustment in the real exchange rate restores the external balance to its initial level.⁸

The first three simulations focus on the size and consequences of a real exchange rate depreciation to restore external equilibrium. Simulation 1 models the effects of the real exchange rate depreciation required with no changes in fiscal or trade policies. The major policy alternative to real exchange rate depreciation, rationing of foreign exchange, is modeled in simulation 2.⁹ Simulation 3 highlights the role of Nigeria's economic policies for real exchange rate adjustment in Niger. Here it is assumed that exchange rate policy in Nigeria keeps the real exchange rate between the CFA franc and the Naira unchanged from its base level; changes in the real exchange rate between Niger and its other trading partners equilibrate the external accounts.

Simulations 4 through 6 show the impacts of alternative fiscal policies. In simulation 4, government recurrent expenditures are reduced to offset the negative impact of the fall in uranium revenues on the government budget deficit. Simulation 5 models the effects of increased income taxes on urban households, again designed to restore the budget deficit to its original level. Finally, simulation 6 shows the effects of an increase in government recurrent expenditures, a scenario not unlike actual government policy in the late eighties.

⁸ Note that in this non-monetary model, only relative prices are determined. In the Niger model, we do not distinguish between a real exchange depreciation resulting from a devaluation with a fixed domestic price level and one resulting from a deflation of domestic prices with a fixed exchange rate. Fixing another price (such as the real wage rate) in addition to either the nominal exchange rate or the domestic price level, would permit a distinction between nominal exchange rate devaluation and real depreciation with a fixed exchange rate (see Devarajan and de Melo 1987b).

⁹ In the CFA zone, effective rationing of foreign exchange can take place through import licensing restrictions (Nash 1993) or through cutbacks in bank credit that fall largely on public enterprises with heavy propensities to import.

REAL EXCHANGE ADJUSTMENT TO A TERMS OF TRADE SHOCK

In the absence of any fiscal or trade policy interventions (Simulation 1), lower uranium export earnings lead to lower incomes and reduced spending on domestic goods, so that the price of nontradable goods falls relative to tradable goods (whose prices are linked to world market prices). The real exchange rate depreciates by 9.7 percent in year 1 of the simulation (the relative price of tradables vis à vis nontradables rises), helping to reduce import demand and spur nonuranium exports (Table 4).¹⁰ Imports decline by 9.9 percent and exports of cowpeas and livestock rise by 10.8 and 17.3 percent, respectively.

In addition to forcing a depreciation of the real exchange rate, the decline in uranium revenues also affects the macroeconomy by directly lowering incomes and total savings. Total investment falls by 23.2 percent because of the reduced pool of savings, lowering demand for construction services and investment goods. With government investment assumed fixed in real terms, private investment falls by 58.8 percent.

Urban households suffer most in this scenario. Wages for skilled labor fall by 5.4 percent as the construction sector, a large employer of skilled labor, declines by 8.9 percent. Since skilled labor accounts for 77 percent of nontransfer income for urban nonpoor households, the decline in wage payments reduces their incomes by 4.12 percent (Table 5). The impact of higher relative prices for tradable goods (which comprise a larger budget share for urban households than for rural households), raises the consumer price of index (CPI) for the urban nonpoor by 1.64 percent more than the national CPI, so that their total decline in real incomes is 6.52 percent. Similarly, a rise in consumer prices contributes to the 4.76 percent reduction in real incomes of the urban poor.

The depreciation of the real exchange rate helps mitigate the adverse effects of the decline in uranium revenues by raising real prices of agricultural tradables such as cowpeas, whose production increases by 6.6 percent. The rural poor experience the smallest percentage declines in real income (2.0 to 2.3 percent) since returns to agricultural land rise with the real exchange rate depreciation. Returns to livestock fall, however, as lower private investment demand for livestock partially offsets the benefits of higher real prices for livestock exports. As a result, returns to agricultural capital (including both land and livestock) decline or increase only slightly for owners of cattle (the rural nonpoor households).

Thus, although the effects of the decline in uranium prices are felt throughout the economy, urban households are most severely affected. Rural

¹⁰ Results from year 5 of each of the simulations are given in Appendix Table 3 and do not vary qualitatively from those discussed in the text. For simulation 1, the real exchange rate depreciation in year 5, relative to the reference run with no decline in uranium revenues, is 10.1 percent.

Table 4 – Effects of a Terms of Trade Shock: Niger Simulation Results

	(1)	(2)	(3)	(4)	(5)	(6)
	Full RER Adjustment	Import Quotas	Naira Depreciation	Reduced Public Spending	Increased Taxes	Increased Public Spending
Real GDP	-1.82	-1.70	-1.97	-1.85	-1.81	-1.81
Consumption	-2.80	-1.56	-3.65	-3.08	-3.27	-2.30
Total investment	-23.19	-31.69	-18.10	-19.77	-20.42	-30.60
Private investment	-58.81	-80.37	-45.92	-50.15	-51.80	-64.56
Public investment	0.00	0.00	0.00	0.00	0.00	-8.50
Government consumption	0.00	0.00	0.00	-2.16	0.00	5.00
Government revenues	-8.48	-6.43	-7.81	-8.49	-4.38	-8.53
Real exchange rate	9.73	0.00	14.90	9.93	9.77	9.27
Exports (dollars)	-13.25	-16.07	-17.41	-13.14	-13.31	-13.56
Imports (dollars)	-9.91	-12.02	-13.02	-9.83	-9.96	-10.14
Foreign savings/GDP	-3.94	-3.94	-3.94	-3.94	-3.94	-3.94
Real output growth						
Cereals	1.10	2.50	1.50	0.99	0.90	1.23
Export crops	6.59	3.36	2.36	6.65	6.54	6.42
Other food crops	0.51	1.21	0.87	0.40	0.34	0.66
Livestock	-1.28	-3.33	-1.92	-0.70	-0.90	-1.67
Fish, forestry	-1.66	-0.70	-0.67	-1.62	-1.61	-2.84
Mining	1.61	0.10	2.27	1.81	1.62	1.23
Meat processing	0.99	3.89	0.78	0.60	0.51	1.44
Other food processing	0.10	0.15	0.28	0.20	-0.12	-0.17
Manufacturing	-0.36	-0.65	0.63	0.04	-0.43	-1.27
Construction	-8.85	-12.00	-6.86	-7.54	-7.82	-16.16
Commerce	0.16	0.54	0.17	0.36	0.15	-0.18
Transport	-0.56	-0.76	-0.70	-0.60	-0.63	-0.46
Private services	-0.93	0.18	-1.01	-0.92	-1.11	-1.12
Public administration	-0.03	0.07	-0.04	-2.15	-0.05	4.87
Factor incomes						
Unskilled labor	-3.00	-5.97	-4.19	-3.10	-2.91	-2.72
Formal capital	2.73	-12.32	9.10	4.19	3.05	-1.11
Informal capital	-3.98	-5.28	-4.25	-4.28	-4.06	-3.81
Land: North nonpoor	-3.01	-7.97	-5.46	-2.29	-2.59	-3.61
Land: North poor	6.31	4.53	2.01	6.27	5.70	5.33
Land: South nonpoor	1.07	-1.92	-1.67	1.32	0.90	0.68
Land: South poor	7.11	6.81	3.74	6.72	6.12	6.89
Real household income						
Urban nonpoor	-6.52	15.76	-6.77	-7.95	-8.65	-3.86
Urban poor	-4.76	-7.68	-5.83	-4.94	-5.92	-4.49
Semiurban	-2.51	-4.79	-3.44	-2.64	-2.47	-2.31
Rural North nonpoor	-2.25	-4.16	-3.17	-2.37	-2.25	-2.16
Rural North poor	-2.43	-5.16	-3.66	-2.51	-2.37	-2.27
Rural South nonpoor	-1.98	-4.14	-3.01	-2.08	-1.97	-1.84
Rural South poor	-1.83	-4.27	-3.00	-1.93	-1.81	-1.65
Total household income	-3.14	-1.36	-4.07	-3.47	-3.09	-2.56

Source: Model simulations.

Table 5 — Real Income Effects on Households, Simulation 1 - Full RER Adjustment

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-4.124	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.170	-1.498	-2.237	-1.126	-2.653	-1.918	-2.643
Informal capital	-0.694	-1.914	-0.869	-1.823	-0.227	-0.913	-0.125
Land: North nonpoor	0.000	-0.020	-0.037	-0.501	0.000	0.000	0.000
Land: North poor	0.000	0.019	0.035	0.000	0.371	0.000	0.000
Land: South nonpoor	0.000	0.008	0.014	0.000	0.000	0.140	0.000
Land: South poor	0.000	0.021	0.038	0.000	0.000	0.000	0.625
Total change	-4.988	-3.384	-3.056	-3.450	-2.508	-2.691	-2.142
Household consumer							
Price index	101.6	101.4	99.4	98.8	99.9	99.3	99.7
Real income							
(percentage change)	-6.517	-4.758	-2.508	-2.253	-2.432	-1.980	-1.828

Source: Model simulations.

households suffer less because the real exchange rate depreciation helps boost earnings from agricultural production.

REAL EXCHANGE RATE ADJUSTMENT WITH FOREIGN EXCHANGE RATIONING

Niger and the other countries of the CFA zone have thus far to a large extent avoided a real exchange rate depreciation like the one modeled in simulation 1. Instead, they have largely postponed adjustment through a combination of a resort to the operations account with the French Treasury (akin to a drawdown of reserves), accumulation of arrears to creditors, and additional borrowing.¹¹ To the extent that the decline in Niger's uranium export revenues are offset by additional net capital inflows, total foreign exchange earnings are unchanged and the short run impact on the domestic economy is minimal.¹² Of course, postponement of the consequences is not a substitute for solution of the problem.

The main alternative to allowing a real exchange rate depreciation used in non-CFA countries has been rationing of foreign exchange either explicitly or through import controls. Niger removed most of its quantitative restrictions on trade as part of its structural adjustment effort in the mid- to late 1980s. Simulation 2 models the re-imposition of trade restrictions so as to keep both the nominal exchange rate and the general price level unchanged. Equilibrium in the external accounts is achieved through implicit import tariffs on all imports, simulating rationing of foreign exchange for imports. The resulting rents are modeled as accruing solely to the urban nonpoor households.

By design, the depreciation of the real exchange rate, measured as the nominal exchange rate deflated by the consumer price index, is zero (Table 4). The implicit tariff on imports is 15.0 percent, however, implying a depreciation of the real exchange rate for imports of the same magnitude. With no change in the real exchange rate for exports, exports rise by only 1.8 percent, compared to 4.6 percent in simulation 1. Although the urban nonpoor enjoy a large gain in real incomes (15.8 percent) because of the rents received (Table 6), total savings and investment decline as returns to capital in the formal sector drop sharply. All other households suffer sharply lower real incomes in comparison

¹¹ Given a decline in uranium export revenues of 25.9 billion FCFA, Niger financed a trade deficit of 27.9 billion FCFA in 1990, 10.6 billion FCFA greater than its trade deficit of 1987 (Table 2). Without this additional foreign capital inflow, it is argued here that real exchange rate depreciation by 1990 would have been even greater than historically observed (15.6 percent between 1987 and 1990). Further adjustment did take place in 1991, however, as indicated by a real exchange rate depreciation of 14.6 percent that accompanied the decline in the trade deficit to 4.7 billion FCFA.

¹² Recall that production of the uranium export sector has not been affected. Possible long-term effects of increased debt on investment incentives and future debt repayments are ignored here.

Table 6 – Real Income Effects on Households, Simulation 2 - Import Quotas

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-8.202	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.339	-2.978	-4.448	-2.238	-5.275	-3.814	-5.25 5
Informal capital	-0.922	-2.541	-1.154	-2.420	-0.301	-1.212	-0.16 6
Land: North nonpoor	0.000	-0.054	-0.098	-1.329	0.000	0.000	0.000
Land: North poor	0.000	0.014	0.025	0.000	0.267	0.000	0.000
Land: South nonpoor	0.000	-0.014	-0.025	0.000	0.000	-0.252	0.000
Land: South poor	0.000	0.020	0.036	0.000	0.000	0.000	0.599
Rents	28.370						
Total change	18.908	-5.553	-5.663	-5.988	-5.310	-5.278	-4.82 2
Household consumer							
Price index	102.72	102.31	99.08	98.10	99.84	98.82	99.42
Real income							
(percentage change)	15.76	-7.68	-4.79	-4.16	-5.16	-4.14	-4.27

Source: Model simulations.

with a policy of real exchange rate adjustment. Rural households suffer an income decline of 3.0 to 3.3 percent, compared to the 1.9 to 2.5 percent declines when the real exchange rate adjusts freely (Simulation 1).

IMPACT OF NIGERIA'S MACROECONOMIC POLICY

Given the extent of cross-border trade, changes in Nigeria's macroeconomic policy can have a significant impact on the extent of real exchange rate depreciation required to restore external balance in Niger. Here, we model an exchange rate policy in Nigeria that prevents any real depreciation of the CFA franc versus the Nigerian Naira. The required real exchange rate adjustment vis à vis Niger's other trading partners is thus heightened.

In simulation 3, we adjust the world price (expressed in dollars) of goods traded with Nigeria so that there is no change in the border price expressed in CFA francs.¹³ Instead of a 9.7 percent depreciation of the real exchange rate as in simulation 1, the overall depreciation of the real exchange rate is now 14.9 percent. With no gain in price incentives for exports to Nigeria, total exports (measured in dollars) increase by only 0.5 percent, compared with 4.6 percent in simulation 1. Export crop production increases by only 2.4 percent (compared with 6.6 percent in simulation 1) and livestock production falls by 1.9 percent (compared with 1.3 percent in simulation 1). Real incomes of all groups decline further than in simulation 1, with rural households for whom cattle and cowpeas are important income sources suffering declines of 3.0 to 3.7 percent (Table 7).

FISCAL POLICY CONSIDERATIONS

Because the uranium sector is a major source of government revenues, the decline in uranium exports has implications for the budget deficit. Taxes on uranium exports and production equalled 9.8 billion FCFA in 1987, 13 percent of government revenues. With the decline in uranium exports, uranium revenues fell to only 6.2 billion FCFA by 1990, a 37 percent decline.

Since much of this decline was in the form of reduced royalties, corporate profits and export tax revenues, we model this as a transfer from the uranium sector to the government. Tax revenues also decline because of general equilibrium effects, in particular the loss of import tax revenues as imports decline. In simulation 4, government recurrent expenditures are reduced by an amount equal to the total decline in government revenues, so as to maintain the budget deficit at its pre-shock level.

¹³ The world prices of cowpeas and cattle are adjusted downward by the full amount of the CFA/dollar depreciation. The world price of imports of grains and manufactured goods are adjusted downward by 23 percent of the CFA/dollar depreciation, reflecting the estimated share of total imports of these products coming from Nigeria.

Table 7 – Real Income Effects on Households, Simulation 3 - Naira Depreciation

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-3.868	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.238	-2.092	-3.125	-1.572	-3.706	-2.680	-3.692
Informal capital	-0.742	-2.044	-0.928	-1.947	-0.242	-0.975	-0.133
Land: North nonpoor	0.000	-0.037	-0.067	-0.910	0.000	0.000	0.000
Land: North poor	0.000	0.006	0.011	0.000	0.118	0.000	0.000
Land: South nonpoor	0.000	-0.012	-0.022	0.000	0.000	-0.219	0.000
Land: South poor	0.000	0.011	0.020	0.000	0.000	0.000	0.328
Total change	-4.848	-4.168	-4.111	-4.430	-3.830	-3.874	-3.497
Household consumer							
Price index	102.06	101.76	99.30	98.70	99.82	99.11	99.48
Real income							
(percentage change)	-0.048	-0.042	-0.041	-0.044	-0.038	-0.039	-0.035

Source: Model simulations.

The total reduction in government recurrent expenditure is only 3.7 billion FCFA, equivalent to just 4.4 percent of total government recurrent expenditures on goods and services. The impact of this cut falls mainly on urban households who are employed by the public administration. Real incomes of the urban nonpoor fall by 8.0 percent (Table 8), compared with 6.5 percent in simulation 1. Rural households are only marginally worse off than in simulation 1.

The alternative to a cut in government expenditures, a tax increase, is modeled in simulation 5. Here, direct taxes on urban households are increased by an amount sufficient to restore the government budget deficit to its pre-shock level. We assume that the increase tax rates for the urban poor is only one-half of that for the nonpoor, given the greater share of incomes of the urban poor from the informal sector.

The resulting 2.4 percent increase in the marginal tax rate on the urban nonpoor (1.2 percent for the urban poor) reduces real incomes of the urban nonpoor by 8.6 percent (Table 9), 0.7 percent more than with the government expenditure cut modeled in simulation 4. Rural households are marginally worse off in this scenario, compared with simulation 4, because lower urban incomes lead to reduced total savings and investment spending and a 0.2 percent smaller real exchange rate depreciation.

The decline in uranium revenues has not been the major cause of the fiscal crisis, however. The widening gap between expenditures and revenues is due mainly to continuing increases in government expenditures (Figure 2). Unable to fund these commitments, the government's domestic arrears increased substantially in 1990.

Simulation 6 shows the effects of the increased government recurrent spending in spite of the decline in uranium revenues. Real government recurrent expenditures are increased by 5 percent, reflecting the 12 billion FCFA increase in expenditures on goods and services between 1987 and 1990, expressed in per capita terms. Government investment is reduced by 8.5 percent.¹⁴ The net result is a small (0.3 percent) drop in total government spending.

The major beneficiaries of this policy are the urban nonpoor, who receive the largest share of government salaries. Their income decline is only 3.9 percent (Table 10), compared to 6.5 percent with full real exchange rate adjustment but no change in government spending (simulation 1). By contrast, the urban poor are only 0.3 percent better off than in simulation 1 because lower government investment spending reduces incomes from the construction sector. Output of construction services falls 16.2 percent relative to the base 1987 level, and 8.0 percent relative to simulation 1. Rural households are affected only marginally by this shift in government spending.

¹⁴ Historically, real government investment increased by only 1 percent between 1986/87 and 1990. With population growth estimated at 3.1 percent per year, real government investment per capita fell by 8.5 percent (IMF 1992a).

Table 8 – Real Income Effects on Households, Simulation 4 - Reduced Public Spending

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-5.504	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.176	-1.548	-2.312	-1.163	-2.742	-1.982	-2.731
Informal capital	-0.747	-2.059	-0.935	-1.961	-0.244	-0.982	-0.134
Land: North nonpoor	0.000	-0.015	-0.028	-0.382	0.000	0.000	0.000
Land: North poor	0.000	0.019	0.035	0.000	0.370	0.000	0.000
Land: South nonpoor	0.000	0.009	0.017	0.000	0.000	0.173	0.000
Land: South poor	0.000	0.020	0.036	0.000	0.000	0.000	0.591
Total change	-6.427	-3.575	-3.188	-3.506	-2.616	-2.791	-2.275
Household consumer							
Price index	101.65	101.44	99.44	98.84	99.89	99.28	99.64
Real income							
(percentage change)	-7.95	-4.94	-2.64	-2.37	-2.51	-2.08	-1.93

Source: Model simulations.

Table 9 – Real Income Effects on Households, Simulation 5 - Increased Taxes

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-3.951	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.165	-1.455	-2.173	-1.093	-2.577	-1.863	-2.567
Informal capital	-0.709	-1.954	-0.887	-1.861	-0.231	-0.932	-0.127
Land: North nonpoor	0.000	-0.017	-0.032	-0.432	0.000	0.000	0.000
Land: North poor	0.000	0.017	0.032	0.000	0.336	0.000	0.000
Land: South nonpoor	0.000	0.006	0.012	0.000	0.000	0.118	0.000
Land: South poor	0.000	0.018	0.033	0.000	0.000	0.000	0.538
Total change	-4.825	-3.384	-3.016	-3.386	-2.472	-2.677	-2.156
Household consumer							
Price index	101.64	101.44	99.44	98.84	99.90	99.27	99.64
Real income							
(percentage change)	-6.36	-4.75	-2.47	-2.25	-2.37	-1.97	-1.80

Source: Model simulations.

Table 10 – Real Income Effects on Households, Simulation 6 - Increased Public Spending

	Urban Nonpoor	Urban Poor	Semi- urban	Rural North Nonpoor	Rural North Poor	Rural South Nonpoor	Rural South Poor
Percentage change in nominal income due to:							
Skilled labor	-1.554	0.000	0.000	0.000	0.000	0.000	0.000
Unskilled labor	-0.154	-1.358	-2.029	-1.021	-2.406	-1.740	-2.397
Informal capital	-0.665	-1.833	-0.832	-1.746	-0.217	-0.874	-0.119
Land: North nonpoor	0.000	-0.024	-0.044	-0.603	0.000	0.000	0.000
Land: North poor	0.000	0.016	0.030	0.000	0.314	0.000	0.000
Land: South nonpoor	0.000	0.005	0.009	0.000	0.000	0.089	0.000
Land: South poor	0.000	0.020	0.037	0.000	0.000	0.000	0.606
Total change	-2.373	-3.175	-2.831	-3.369	-2.309	-2.525	-1.911
Household consumer							
Price index	101.55	101.38	99.47	98.76	99.96	99.30	99.73
Real income							
(percentage change)	-3.86	-4.49	-2.31	-2.16	-2.27	-1.84	-1.65

Source: Model simulations.

5. CONCLUDING OBSERVATIONS

Niger faces severe economic difficulties: declining uranium revenues, fiscal shortfalls and mounting debt. Model simulations indicate that restoring external equilibrium in the aftermath of a sharp decline in uranium export revenues from 1987 to 1990 would have required a real exchange rate depreciation of 9 to 15 percent greater than actually observed in that period. Historically, Niger temporarily postponed the consequences of the terms of reduced export earnings through increased foreign capital inflows.

Reductions in uranium revenues lead unambiguously to lower household incomes. In the model simulations, with no change in foreign capital inflows, all household groups suffer as a result of the terms of trade shock, as economy-wide savings and investment decline, leading to reduced labor demand and real incomes. Without a depreciation of the real exchange rate (achieved through rationing of foreign exchange or import licensing restrictions in many non-CFA countries), however, simulation results indicate that real incomes of most household groups in Niger would decline by an additional 2 to 3 percent. The exceptions are the recipients of economic rents that result if foreign exchange and/or import licenses are rationed. Thus adjustment of the real exchange rate is superior to nonadjustment, particularly for the poor.

With the nominal exchange rate of the CFA franc fixed relative to the French franc, adjustment in the real exchange rate in Niger has been slow. Real depreciation takes place through either a decline in domestic prices or slower price increases in Niger than in its trading partners. A nominal exchange rate devaluation could speed the adjustment process and raise real incomes.

In recent years, several options for changes in exchange rate policies have been put forth for the CFA member countries, including moving to a flexible nominal exchange rate, a one-time devaluation of the nominal exchange rate, and a one-time devaluation of the nominal exchange rate of varying magnitudes for the different countries of the CFA zone (Devarajan 1992). This latter option would in effect mean the end of the monetary union.

Niger's membership in the monetary union entails both benefits and costs. The stable fixed nominal exchange rate and currency convertibility encourage foreign investment and growth, while restrictions on government borrowing in the CFA zone tend to produce low inflation and encourage fiscal discipline.¹⁵

Up until the adjustment period of the early eighties, the evidence seemed to suggest that overall impact of membership was positive. Cross-country

¹⁵ By the rules of the monetary union, the amount of a central government budget deficit that can be financed through domestic credit from the Central Bank is limited to 20 percent of the government's fiscal receipts in the previous year. This rule has not prevented financing of government spending from abroad through commercial bank loans to governments and parastatals (see Guillaumont and Guillaumont [1984] and Bhatia [1985]).

regression analysis by Devarajan and de Melo (1987a) showed that the CFA countries had significantly higher growth than other countries in sub-Saharan Africa over the 1960-1982 period. Guillaumont, Guillaumont, and Plane (1988) attributed the better economic performance of the franc zone countries "in part to their strong investment efforts and relatively greater degree of commercial openness", factors linked to convertibility, monetary discipline and stability of real exchange rates. For Niger, the sharp increase in uranium exports was the major factor explaining the country's rapid GDP growth during this period (see Jabara 1991).

Difficulties in adjusting the real exchange rate in response to adverse external shocks, however, led to a deterioration in the economic performance of franc zone countries in the 1980s (Devarajan and de Melo 1990). Sharp falls in world prices of major exports played a major role in economic decline in a number of CFA countries. Focusing only on "the costs of maintaining a fixed exchange rate regime in the context of a highly variable external terms of trade", Devarajan and Rodrik (1991) suggest that membership in the CFA zone has resulted in a tradeoff between output and inflation that has been "a bad bargain for CFA member countries."

Adjustment of the real exchange rate, however achieved, would not solve the fiscal problems that also burden Niger, as indicated by the model simulations.¹⁶ A devaluation may make it easier politically to slow real government spending, by enabling a reduction in real wages in the public sector through limiting nominal wage increases to a level less than the rise in domestic prices. Yet devaluation could discourage private investment, at least in the short- to medium-term, due to increased uncertainty regarding exchange rate policy. And a policy of worker retrenchment may be a more effective solution to the government wage bill problems in the long-run.

Thus, more rapid adjustment in the real exchange rate, achieved through a nominal exchange rate devaluation, is not a panacea for solving the country's economic woes, in particular the fiscal crisis. Moreover, membership in the CFA zone has worked to avoid the economic inefficiencies and lost incomes for the bulk of the population (including the rural poor) that would result from foreign exchange rationing and import licensing restrictions prevalent in non-CFA countries of sub-Saharan Africa.

¹⁶ In periods of high export receipts the inflow of foreign exchange in itself leads to increases in money supply. See Lane (1989) for a discussion of the monetary expansion in Côte d'Ivoire in the 1970s.

APPENDIX 1
VARIABLES OF THE NIGER MODEL

ENDOGENOUS VARIABLES

ACTSAL	Wage bill by activity j
CD	Total consumer demand of good i
CDHH	Consumer demand for good i by household h
DEPRECIA	Total value of depreciation
DIRTX	Direct tax
DK	Real investment by activity
DXTOT	Total real investment
DSALETX	Sales tax on domestic goods
DST	Change in stocks of good i
DUTY	Export duties
E	Exports
GD	Government consumption of good i
GID	Government investment demand for good i
GOVSAV	Government savings
GR	Government revenue
ID	Private investment demand for good i
INT	Intermediate use of good i
ISALETX	Sales tax on imported goods
L	Labor use (demand) in activity j
LCSAL	Total wage bill for labor of type lc
M	Imports
MARGDTOT	Total marketing margin on domestic goods
MARGMTOT	Total marketing margin on imports
MARGXTOT	Total marketing margin on exports
PC	User price of good i
PE	Domestic price of exported goods
PINDEX	national consumer price index
PK	Price of capital goods in activity j
PM	Domestic price of imported goods
PPD	Price of domestically produced goods
PPT	Price of output of good i
PPTACT	Price output of activity j
PRODTX	Revenue from producer taxes
PVA	Price of value added of activity j
PWE	World export price in dollars
RENT	Rent from import quotas on good i
RETK	Total returns to capital of type kc
SAVHH	Savings by household h
SAVINGS	Total value of savings
TARIFF	Tariff revenue
TOTDSTK	Total change in stocks

TOTHSAV	Total household savings
VGOVIVT	Nominal value of government investment
WA	Average wage rate
XPD	Domestic sales of production of commodity i
XPT	Domestic output of commodity i
XPTACT	Output of activity j
XT	Supply of commodity i
Y	Household income
YGDP	Definition of GDP

EXOGENOUS VARIABLES

ER	Exchange rate (FCFA/dollar)
FSAV	Foreign savings
GDTOT	Total government consumption
GOVIVT	Total government investment
K	Capital stock in activity j
LS	Labor supply
PWM	World import price in dollars
TM	Import tariff rate

ACTIVITIES (20): grains, export crops, other crops, livestock, forestry, mining, meat processing, food processing (F, I), manufacturing (F, I), construction (F, I), transport (F, I), private services (F, I), public services.

LABOR TYPES: skilled, unskilled

HOUSEHOLD TYPES:

Urban I (skilled head of household)
Urban II (unskilled head of household)
Semiurban
Rural north - high income
Rural north - low income
Rural south - high income
Rural south - low income

CAPITAL:

Formal sector
Informal sector
Agricultural - corresponding to each rural household group

APPENDIX 2 EQUATIONS OF THE NIGER MODEL

Prices:

$$(1) \quad PM_i = \overline{PWM}_i * (1 + \overline{TM}_i) * ER$$

$$(2) \quad PE_i * (1 - \overline{TE}_i) = PWE_i * ER$$

$$(3) \quad PPT_i * XPT_i = PPD_i * XPD_i + \frac{PE_i}{(1 + \text{margx}_i)} * E_i$$

$$(4) \quad PVA_j = PPT_j (1 - \text{tprod}_j) - \sum_i PC_{i,j}$$

$$(5) \quad PC_i * XT_i = PPD_i (1 + \text{margd}_i + \text{dtax}_i) * XPD_i + PM_i * (1 + \text{margm}_i + \text{itax}_i) * M_i$$

$$(6) \quad PK_j = \sum_i PC_i * \text{imat}_{i,j}$$

$$(7) \quad PPTACT_j = \sum_i PPT_i * \text{outmat}_{i,j}$$

$$(8) \quad \text{PINDEX} = \sum_i \theta_i * PC_i$$

Production:

$$(9) \quad XPTACT_j = \text{CES}(L_{1j}, L_{2j}, K_j)$$

$$(10) \quad XPT_i = \sum_j XPTACT_j * \text{outmat}_{j,i}$$

Trade:

$$(11) \quad E_i / \overline{E}_i = \left(\frac{PWE_i}{PWE_i} \right)^{\phi_i}$$

$$(12) \quad XPT_i = AT_i (\gamma_i E_i^{\phi_i} + (1 - \gamma_i) XPD_i^{\phi_i})^{1/\phi_i}, \text{ for } i = \text{exported goods}$$

$$(13) \quad \frac{E_i}{XPD_i} = \left[\frac{PE_i^{\phi_i}}{PPD_i} * \frac{(1 - \gamma_i)}{\gamma_i} \right]^{1/\phi_i}, \quad PE_i^{\phi_i} = \frac{PE_i}{1 + \text{margx}_i}, \quad \phi_i = \frac{1}{\varphi_i - 1}, \text{ for } i = \text{exported goods}$$

$$(14) \quad XT_i = AC_i (\delta_i M_i^* + (1 - \delta_i) XPD_i^*)^{-\frac{1}{\sigma_i}}, \text{ for } i = \text{imported goods}$$

$$(15) \quad \frac{M_i}{XPD_i} = \left(\frac{PPD_i^*}{PM_i^*} * \frac{\delta_i}{1 - \delta_i} \right)^{\sigma_i}, \quad \sigma_i = \frac{1}{1 + \rho_i}, \text{ for } i = \text{imported goods}$$

$$PPD_i^* = PPD_i (1 + \text{margd}_i + \text{dtax}_i), \text{ and } PM_i^* = PM_i (1 + \text{margm}_i) + \text{itax}_i$$

$$(16) \quad \overline{XT}_i = XPD_i, \text{ for } i = \text{non-imported goods}$$

$$(17) \quad XPT_i = XPD_i, \text{ for } i = \text{non-exported goods}$$

Factor markets:

$$(18) \quad W_{1c,j} / r_j = \frac{\alpha_{1c,j}}{1 - \sum_{1c} \alpha_{1c,j}} * K_j^{1-\rho_j} / L_{1c,j}^{1-\rho_j}$$

Household incomes, saving:

$$(19) \quad \sum_j L_{1c,j} = \overline{LS}_{1c}$$

$$(20) \quad r_j = (1 - \sum_{1c} \alpha_{1c,j}) * AD_j^{\rho_j} * K_j^{\rho_j-1} * PVA_j * Q_j^{1-\rho_j}$$

$$(21) \quad LCSAL_{1c} = \sum_j \text{wdist}_{1c,j} * W_j * L_{1c,j}$$

$$(22) \quad RETK_{kc} = \sum_j (PVA_j * XPTACT_j - ACTSAL_j) * \text{shr}_{kc,j}$$

$$(23) \quad ACTSAL_j = \sum_{1c} (WA_{1c}) * \text{wdist}_{j,1c} * L_{j,1c}$$

$$(24) \quad RENT_i = \overline{PWM}_i * (TM_i - \text{tmr}_i) * \overline{M}_i, \text{ for } i = \text{imq}$$

$$(25) \quad Y_h = \sum_{1c} (\text{shr}_{1c,h} * LCSAL_{1c}) + \sum_{kc} (\text{shr}_{kc,h} * RETK_{kc}) + \sum_{\text{imq}} (\text{rentshr}_{\text{imq},h} * RENT_{\text{imq}})$$

$$(26) \quad \text{SAVHH}_h = s0_h * \left(\frac{\text{PINDEX}}{\text{PINDEX}_0} \right) + \text{mps}_h * Y_h$$

$$(27) \quad YD_h = Y_h - \text{SAVHH}_h - \overline{\text{TDIR}}_h * Y_h$$

Intermediate Demand:

$$(28) \text{ INT}_i = \sum_j a_{ij} \text{ XPTACT}_j$$

$$(29) \text{ INT}_{i1} = \sum_j a_{ij} \text{ XPTACT}_j + (\text{MARGXTOT} + \text{MARGMTOT} + \text{MARGDTOT}) / \text{PC}_{i1}$$

$$(30) \text{ MARGXTOT} = \sum_i \text{PE}_i * \text{margx}_i / (1 + \text{margx}_i) * E_i$$

$$(31) \text{ MARGMTOT} = \sum_i \text{PM}_i * \text{margm}_i * M_i$$

$$(32) \text{ MARGDTOT} = \sum_i \text{PPD}_i * \text{margd}_i * \text{XPD}_i$$

Household Consumption:

$$(33) \text{ PC}_i * \text{CD}_{in} = \text{cles}_{in} * \text{YD}_n$$

$$(34) \text{ CD}_i = \sum_n \text{CDHH}_{i,n}$$

Government:

$$(35) \text{ GD}_i = \beta_i * \overline{\text{GDTOT}}$$

$$(36) \text{ GR} = \text{TARIFF} + \text{DUTY} + \text{PRODTX} + \text{DSALETX} + \text{ISALETX} + \text{DIRTX} + (\text{PVA}_{i1} * \text{XPTACT}_{i1} - \text{ACTSAL}_{i1})$$

$$(37) \text{ TARIFF} = \sum_i \overline{\text{TM}}_i * \overline{\text{PWM}}_i * M_i * \text{ER}$$

$$(38) \text{ DUTY} = \sum_i \overline{\text{TE}}_i * \text{PE}_i * E_i$$

$$(39) \text{ PRODTX} = \sum_j \text{tprod}_j * \text{PPTACT}_j * \text{XPTACT}_j$$

$$(40) \text{ DSALTEX} = \sum_i \text{dtax}_i * \text{PPD}_i * \text{XPD}_i$$

$$(41) \text{ ISALETX} = \sum_i \text{itax}_i * \text{PM}_i * M_i$$

$$(42) \text{DIRTX} = \sum_n \text{tdir}_n * Y_n$$

$$(43) \text{GOVSAV} = \text{GR} - \sum_i \text{PC}_i * \text{GD}_i$$

Investment:

$$(44) \text{ID}_i = \sum_j \text{imat}_{i,j} * \text{DK}_j$$

$$(45) \text{GID}_i = \text{gio}_i * \overline{\text{GOVIVT}}$$

$$(46) \text{VGOVIVT} = \sum_i \text{PC}_i * \text{GID}_i$$

$$(47) \text{PK}_j * \text{DK}_j = \text{KIO}_j * (\text{SAVINGS} - \text{TOTDSTK} - \text{VGOVIVT})$$

$$(48) \text{TOTDSTK} = \sum_i \text{PC}_i * \text{DST}_i$$

$$(49) \text{DST}_i = \text{dstr}_i * \text{XPT}_i$$

$$(50) \text{SAVINGS} = \text{TOTHSAV} + \text{GOVSAV} + \text{ENTFSAV} + \overline{\text{FSAV}} * \text{ER}$$

$$(51) \text{TOTHSAV} = \sum_n \text{SAVHH}_n$$

$$(52) \text{DEPRECIA} = \sum_j \text{DEPR}_j * \text{PK}_j * \text{K}_j$$

$$(53) \text{DKTOT} = \sum_j \text{DK}_j$$

National Income:

$$(54) \text{YGDP} = \sum_j \text{PVA}_j * \text{XPTACT}_j + \text{PRODTX} + \text{TARIFF} + \text{DUTY} + \text{DSALETX} + \text{ISALETX} - \text{DEPRECIA}$$

Model Closure:

$$(55) \sum_i \text{PWM}_i * \text{M}_i = \sum_i \text{PWE}_i * \text{E}_i + \overline{\text{FSAV}}$$

$$(56) \quad XT_t = INT_t + CD_t + GD_t + ID_t + GID_t + DST_t$$

Dynamic Equations:

$$(57) \quad \overline{LS}_{1c,t+1} = \overline{LS}_{1c,t} * (1 + \text{sgr}_{1c})$$

$$(58) \quad \overline{K}_{1,t+1} = \overline{K}_{1,t} * (1 - \text{depr}_1) + DK_1 + \text{gkio}_1 * \overline{GOVIVT}$$

Appendix Table 1 — Trade Levels and Parameters, Niger 1987

	Domestic Production	Exports	Imports	Elasticity of Substi- tution
	(million FCFA)			
1. Cereals	70.93	1.62	11.61	2.0
2. Export crops	23.82	14.12	0.21	2.0
3. Other food crops	56.84	2.71	6.44	0.9
4. Livestock	84.77	11.57	1.50	2.0
5. Forestry products	23.38	0.09	0.41	0.9
6. Mining	91.19	85.51	6.17	2.0
7. Meat	53.93	0.11	0.12	0.9
8. Processed food	17.19	1.35	20.02	0.9
9. Manufactures	84.55	13.91	141.14	0.7
10. Construction	55.83	0.00	0.00	0.4
11. Commerce	165.83	0.00	0.00	0.4
12. Transport./communic.	56.60	0.00	4.85	0.4
13. Private services	76.92	0.00	5.75	0.4
14. Public services	82.12	0.00	0.00	0.4
Total	943.92	131.00	198.21	n.a.

Source: Dorosh and Nssah (1992).

Appendix Table 2 — Household Budget Shares, Niger 1987

	Urban		Semi-urban	Rural North		Rural North		Rural South	
	Nonpoor	Poor		Nonpoor	Poor	Nonpoor	Poor		
	(Percent)								
1. Cereals	11.07	16.22	17.74	10.41	24.57	15.03	19.58		
2. Export crops	0.66	0.98	1.43	0.84	1.98	1.21	1.58		
3. Other food crops	7.59	11.17	15.77	4.01	9.48	22.02	28.69		
4. Livestock	0.56	0.83	11.45	29.59	3.68	12.55	1.62		
5. Forestry products	2.53	3.72	2.48	2.55	2.79	2.28	2.25		
6. Mining	2.70	1.66	0.00	0.00	0.00	0.00	0.00		
7. Meat	10.69	6.14	11.06	11.38	12.44	10.15	10.01		
8. Processed food	5.13	7.03	7.31	7.53	8.23	6.71	6.62		
9. Manufactures	40.62	34.52	12.21	12.56	13.73	11.20	11.05		
10. Construction	0.61	0.65	0.25	0.26	0.28	0.23	0.23		
11. Commerce	3.04	4.48	5.19	5.34	5.84	4.76	4.70		
12. Transport, commun.	2.04	2.99	5.57	5.73	6.27	5.11	5.04		
13. Private services	12.34	8.83	9.45	9.73	10.63	8.67	8.56		
14. Public services	0.43	0.79	0.08	0.08	0.08	0.08	0.08		
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00		
Total expenditures (million FCFA)	178.54	169.07	34.27	198.67	210.60	161.83	479.86		

Appendix Table 3 – Effects of a Terms of Trade Shock: Niger Simulation Results (Year 5)

	(1)	(2)	(3)	(4)	(5)	(6)
	Full RER Adjustment	Import Quotas	Naira Depreciation	Reduced Public Spending	Increased Taxes	Increased Public Spending
Real GDP	-3.99	-4.53	-3.88	-3.75	-3.75	-4.36
Consumption	-4.29	-3.60	-4.96	-4.34	-4.57	-4.05
Total investment	-26.68	-35.58	-21.47	-23.18	-23.85	-34.44
Private investment	-58.88	-78.52	-47.39	-51.16	-52.63	-65.75
Public investment	0.00	0.00	0.00	0.00	0.00	-8.50
Government consumption	0.00	0.00	0.00	-2.16	0.00	5.00
Government revenues	-5.30	-4.33	-4.09	-4.88	-1.04	-5.97
Real exchange rate	10.05	0.37	15.84	10.25	10.08	9.40
Exports (dollars)	1.58	-2.35	-2.34	2.14	1.90	0.64
Imports (dollars)	-12.69	-15.59	-15.58	-12.27	-12.45	-13.38
Foreign savings/GDP	-13.33	-13.33	-13.33	-13.33	-13.33	-13.33
Real output growth						
Cereals	1.20	3.04	1.86	1.05	0.92	0.77
Export crops	8.01	4.62	3.59	7.99	7.91	5.90
Other food crops	0.14	0.64	0.47	0.07	0.02	0.08
Livestock	-6.72	-10.94	-6.10	-5.34	-5.68	-7.80
Fish, forestry	-0.18	2.37	1.12	-0.39	-0.35	-0.33
Mining	-4.33	-7.44	-2.77	-3.41	-3.71	-5.34
Meat processing	-1.75	-0.24	-1.34	-1.69	-1.84	-1.63
Other food processing	-1.58	-2.06	-1.08	-1.20	-1.59	-2.08
Manufacturing	-3.28	-4.43	-1.81	-2.51	-3.05	-4.70
Construction	-11.44	-15.14	-9.20	-9.95	-10.26	-19.00
Commerce	-1.57	-1.89	-1.22	-1.14	-1.39	-2.08
Transport	-3.73	-5.03	-3.36	-3.36	-3.46	-4.07
Private services	-2.24	-1.72	-2.08	-2.06	-2.25	-2.50
Public administration	-0.05	0.03	-0.06	-2.17	-0.07	4.85
Factor incomes						
Unskilled labor	-1.74	-5.24	-2.80	-1.61	-1.49	-2.10
Formal capital	4.14	-10.86	11.07	5.71	4.62	0.88
Informal capital	-2.09	-3.47	-2.48	-2.30	-2.12	-1.78
Land: North nonpoor	-2.34	-8.89	-4.88	-1.29	-1.63	-2.77
Land: North poor	11.50	5.38	4.42	11.67	11.05	16.48
Land: South nonpoor	2.10	-3.14	-1.12	2.66	2.21	3.86
Land: South poor	9.62	6.01	4.87	9.44	8.84	14.86
Real household income						
Urban nonpoor	-10.37	10.54	-10.24	-11.26	-9.83	-8.27
Urban poor	-5.43	-8.52	-6.63	-5.49	-5.36	-5.33
Semiurban	-3.63	-6.35	-4.42	-3.55	-3.44	-3.82
Rural North nonpoor	-4.16	-6.83	-4.80	-3.96	-3.92	-4.23
Rural North poor	-3.31	-6.55	-4.50	-3.21	-3.12	-3.45
Rural South nonpoor	-3.15	-5.91	-4.08	-3.04	-2.97	-3.13
Rural South poor	-2.55	-5.51	-3.73	-2.49	-2.41	-2.52
Total household income	-4.70	-3.64	-5.51	-4.77	-4.47	-4.38

Source: Model simulations.

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